

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(A), SRIKAKULAM**

**SEMESTER-I**

**COURSE 1: GENERAL CHEMISTRY**

**Theory**

**Credits: 3**

**3hrs/week**

**I. LEARNING OBJECTIVES:**

1. To understand the structure of the atom and its relation to periodic properties.
2. To explain different types of chemical bonding-ionic, covalent, metallic, hydrogen bonding.
3. To apply bonding theories to predict molecular structure and bonding nature.
4. To correlate periodic trends with physical and chemical properties of elements.
5. To evaluate practical applications of nuclear chemistry in science and industry.

**II. COURSE OUTCOMES:**

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

1. Describe the electronic configuration of elements and periodic trends.
2. Analyze the formation and properties of ionic and covalent compounds.
3. Apply VSEPR, hybridization, and MOT to predict molecular geometry and bonding.
4. Explain metallic bonding, hydrogen bonding, and intermolecular forces and relate them to physical properties.
5. Explain types of radioactivity, nuclear reactions, and real-life applications.

**III. SYLLABUS:**

**UNIT-1: ATOMIC STRUCTURE AND PERIODIC TABLE**

**(9 h)**

Electronic configuration-Aufbau principle, Hund's rule and Pauli's exclusion principle. Periodic law and arrangement of elements in the periodic table, horizontal, vertical, and diagonal relationships in the periodic table. Definition and periodic trends of atomic radii, ionic radii, covalent radii, ionization potential, electron affinity, and electronegativity, Pauling scale, variable valency, inert-pair effect.

**UNIT-2: IONIC BOND**

**(9 h)**

Properties of ionic compounds, factors favouring the formation of ionic compounds, Lattice energy: definition, factors affecting lattice energy, Born-Haber cycle - enthalpy of formation of ionic compound and stability, Covalent character in ionic compounds - polarization and Fajan's rules, effects of polarization.

**UNIT- 3: COVALENT BOND**

**(9 h)**

**Valence Bond theory:** Hybridization of atomic orbitals and geometry of molecules -  $\text{BeCl}_2$ ,  $\text{BF}_3$ ,  $\text{CH}_4$ ,  $\text{PCl}_5$ , and  $\text{SF}_6$

**VSEPR model:** Effect of bonding and nonbonding electrons on the structure of molecules -  $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{SF}_4$ ,  $\text{ICl}_2^-$ ,  $\text{NH}_4^+$  and  $\text{XeF}_4$

**Molecular orbital theory:** LCAO method, construction of M.O. diagrams for homo nuclear and hetero nuclear diatomic molecules ( $\text{N}_2$ ,  $\text{O}_2$ ,  $\text{CO}$  and  $\text{NO}$ )

#### **UNIT - 4: METALLIC AND HYDROGEN BONDS**

**(9 h)**

**Metallic bond:** Metallic properties, free electron theory, band theory of metals. Explanation of conductors, semiconductors and insulators.

**Hydrogen bonding:** Intra and Inter-molecular hydrogen bonding, influence on the physical properties of molecules, Van der waals forces, dipole-dipole interactions.

#### **UNIT-5: NUCLEAR CHEMISTRY**

**(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 in agriculture and medicine.

#### **IV. REFERENCES:**

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,
4. James E. Huheey, **Inorganic Chemistry: Principles of Structure and Reactivity**, 4th ed., 2017.
5. W.U. Malik, G.D Tuli, R.D Madan, Selected Topics in Inorganic Chemistry, S. Chand Publishing, 1998.
6. H.J. Arnikaar, Essentials of Nuclear Chemistry, New Age International Publishers, 2015.

#### **V. PROPOSED ACTIVITIES:**

1. Chart on periodic trends like radii, ionization energy, electronegativity across groups/periods.
2. Worksheet solving- MOT diagrams and hybridization problems.
3. Model Building-Build 3D structures using kits/software for CH<sub>4</sub>, PCl<sub>5</sub>, XeF<sub>4</sub> etc.

#### **VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS**

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning.
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

## SEMESTER-I

### COURSE 1: QUALITATIVE ANALYSIS OF SIMPLE SALT

Practical

Credits: 1

2 hrs/week

---

#### I. LEARNING OBJECTIVES:

1. To understand the theoretical principles behind classical qualitative analysis of cations and anions.
2. To develop the ability to identify common cations and anions in inorganic salts.
3. To practice laboratory safety and correct handling of reagents.
4. To record and interpret observations accurately in systematic salt analysis.

#### II. COURSE OUTCOMES:

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

1. Proper use of glassware, equipment and chemicals in the laboratory
2. Apply systematic procedures to identify one cation and one anion in a given inorganic salt.
3. Analyze reactions based on solubility, color changes, and precipitate formation.
4. Interpret results to draw conclusions and confirm the identity of ions.

#### III. SYLLABUS:

Analysis of simple salt containing **one anion and one cation** from the following:

**Anions:** Carbonate, sulphate, chloride, bromide, acetate, nitrate, borate, phosphate.

**Cations:** Lead, copper, iron, aluminium, zinc, nickel, manganese, calcium, strontium, barium, ammonium.

#### IV. REFERENCES

1. G. Svehla, Vogel's Textbook of Qualitative Inorganic Analysis, Pearson Education, 2008.
2. K. Nagaraj, S. Kamalesu, S. Lokhandwala, N.M. Parekh, Textbook of Semi-micro Inorganic Qualitative Analysis, Notion Press, 2023.
3. G. Pass, H. Sutcliffe, Practical Inorganic Chemistry. 2<sup>nd</sup> edition, John-Wiley & Sons, 2020.

#### V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(A), SRIKAKULAM**

**SEMESTER-I**

**COURSE 2: INORGANIC CHEMISTRY**

**Theory**

**Credits: 3**

**3hrs/week**

**I. LEARNING OBJECTIVES:**

:

1. To explain preparation and uses of selected p-block compounds.
2. To understand the structural and chemical properties of selected p-block compounds.
3. To classify and analyze the characteristics of d- and f-block elements.
4. To compare the properties of lanthanides and actinides.
5. To understand the processes involved in the extraction of metals from their ores.

**II. COURSE OUTCOMES:**

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

1. Explain the structures and preparation of key p-block compounds.
2. Classify d- and f-block elements and discuss their properties and oxidation states.
3. Analyze magnetic, catalytic, and color properties of transition metals.
4. Compare and contrast lanthanides and actinides based on electronic configuration.
5. Explain and differentiate various metallurgical processes used in the extraction of metals.

**III. SYLLABUS:**

**UNIT-1: CHEMISTRY OF p-BLOCK ELEMENTS – I**

**(9 h)**

**Group 13:** Preparation and structure of Diborane, Borazine and (BN)<sub>x</sub>.

**Group 14:** Preparation, classification and uses of silicones.

**Group 15:** Preparation and structure of Phosphonitrilic Chloride P<sub>3</sub>N<sub>3</sub>Cl<sub>6</sub>.

**UNIT-2: CHEMISTRY OF p-BLOCK ELEMENTS – II (9 h)**

**Group 16:** Classification of oxides, structures of oxides and oxoacids of sulphur.

**Group 17:** Preparation and structures of Interhalogen compounds, Pseudohalogens.

**UNIT-3: CHEMISTRY OF d-BLOCK ELEMENTS (9 h)**

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

**UNIT-4: CHEMISTRY OF f-BLOCK ELEMENTS (9 h)**

**Chemistry of Lanthanides:** Electronic configuration, oxidation states, colour, magnetic properties, lanthanide contraction, consequences of lanthanide contraction.

**Chemistry of Actinides:** Electronic configuration, oxidation states, actinide contraction, comparison of lanthanides and actinides.

#### **UNIT-5: GENERAL PRINCIPLES OF METALLURGY (9 h)**

Occurrence of metals, minerals and ores, Concentration of ores- levigation, magnetic separation, froth floatation, leaching, Conversion of concentrated ores to oxide- calcination and roasting, reduction of oxide to the metal, Refining of crude metal-distillation, liquation, poling, electrolysis, zone refining and vapour phase refining, Corrosion and its prevention, Alloys.

#### **IV. REFERENCES:**

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, P.W. Atkins, Inorganic Chemistry, W. H. Freeman and Co, London,1999.
4. J.E. Huheey, **Inorganic Chemistry: Principles of Structure and Reactivity**, 4thed., 2017.
5. A.K. Das, Fundamentals of Metallurgy. Tata McGraw Hill Education, 2011.

#### **V. PROPOSED ACTIVITIES:**

1. Group discussion: Trends in d-block and f-block properties across periods and groups.
2. Comparative worksheet: Lanthanide vs Actinide behaviour.
3. Seminar: Uses of metals in daily life.

#### **VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:**

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning.
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

## SEMESTER-I

### COURSE 2: INORGANIC PREPARATIONS

Practical

Credits: 1

2 hrs/week

---

#### I. LEARNING OBJECTIVES:

1. To understand and apply stoichiometry and principles of inorganic salt preparation.
2. To learn techniques such as crystallization, filtration, and drying.
3. To calculate percentage yields.
4. To handle reagents and lab apparatus safely and precisely

#### II. COURSE OUTCOMES:

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

1. Demonstrate safe use of laboratory equipment and chemical handling.
2. Describe the theoretical background for the preparation of inorganic salts.
3. Perform synthesis of potash alum, ferrous salts, and cuprous chloride following proper procedures.
4. Analyze colour changes, crystal formation, and yields to evaluate reaction completion.

#### III. SYLLABUS:

1. Preparation of Potash alum.
2. Preparation of Ferrous oxalate
3. Preparation of Ferrous ammonium sulphate.
4. Preparation of Cuprous chloride.
5. Preparation of Chrome alum.

#### IV. REFERENCES:

1. G. Svehla, Vogel's Textbook of Qualitative Inorganic Analysis, Pearson Education, 2008.
2. G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denney, Vogel's Textbook of Quantitative Chemical Analysis, John Wiley and Sons, 1989.

#### V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**FIRST YEAR B.Sc HONOURS CHEMISTRY: MAJOR**

**SEMESTER-I**

**COURSE -1GENERAL CHEMISTRY**

---

**TIME:3 Hrs**

**MAX MARKS: 60**

**PART-A**

Answer **All** of the following questions . Each carries **EIGHT** Marks.

5X8=40Marks

1. (a) Explain the periodic law and Arrangement of elements in the periodic table.  
(Or)  
(b) Define the periodic trends of atomic radii, ionic radii, covalent radii, I.P
2. (a) What is ionic bond and the factors favouring the formation ionic compounds?  
(Or)  
(b) Explain about Born- Haber cycle?
3. (a) Explain hybridisation and geometry of CH<sub>4</sub>, BeCl<sub>2</sub>, PCl<sub>5</sub>, SF<sub>6</sub>.  
(Or)  
(b) Draw the M.O Diagram for homo and hetero nuclear diatomic molecules N<sub>2</sub> and CO?
4. (a) Explain Band theory of metals.  
(Or)  
(b) Explain Intra and Inter molecular Hydrogen bonding ,influence on the physical properties of molecules?
5. (a) Write the types of Radioactivity?  
(Or)  
(b) Explain the Soddy-Fajan's Displacement law.

### **PART-B**

Answer any **FIVE** of the following questions. Each carries **FOUR** marks.  
**5X4=20Marks**

6. Write the diagonal relationship in the periodic Table?
7. Explain Hund's Rule, Pauli's exclusion principle
8. What are Electron Affinity and electronegativity?
9. What is Lattice Energy?
10. Explain VSEPR Model for  $\text{NH}_3$  and  $\text{XeF}_4$ ?
11. Explain Geometry of molecule  $\text{BF}_3$ ?
12. Define semiconductors and insulators?
13. What is Vanderwaals Forces?
14. What is Nuclear Fission?
15. Write the applications of Radioactivity?

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**FIRST YEAR B.Sc HONOURS CHEMISTRY : MAJOR**

**SEMESTER-I**

**COURSE -1 GENERAL CHEMISTRY**

---

**TIME:3 Hrs**

**MAX MARKS: 60**

**PART-A**

Answer **All** of the following questions . Each carries **EIGHT** Marks.

5X8=40Marks

1. (a) Explain any five general properties of atoms in periodic table ?  
(Or)  
(b) Explain the following?
  - i) Hund's Rule?
  - ii) Pauli's Exclusion Principle?
2. (a) Define lattice energy and explain the factors affecting lattice energy?  
(Or)  
(b) Explain the properties of ionic compounds? Factors favouring the formation of ionic compounds
3. (a) What is the LCAO method and construct MO diagrams for CO and NO molecules  
(Or)  
(b) Discuss ,geometry and structure of  $\text{PCl}_5$ ,  $\text{XeF}_4$  and  $\text{H}_2\text{O}$  molecules by VESPR theory ?
4. (a) Explain Band theory of metals and explain all properties of metals?  
(Or)  
(b) Describe all types of hydrogen bonding with examples?
5. (a) Explain the Radioactive decay series?  
(Or)  
(b) Write the difference between Nuclear Fission and Nuclear Fusion?

### **PART-B**

Answer any **FIVE** of the following questions. Each carries **FOUR** marks.  
**5X4=20Marks**

6. What is Inert-pair effect?
7. What is periodicity?
8. Describe Born-Haber cycle?
9. Write Fajan's Rule?
10. Discuss structure of SF<sub>4</sub> and ICl<sub>2</sub>?
11. Write a short note on Free Electron Theory?
12. What are conductors and semiconductors
13. Construct M.O diagram for O<sub>2</sub> molecule?
14. Write a short note on Isotopes ?
15. What is Binding Energy

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**FIRST YEAR B.Sc HONOURS CHEMISTRY : MAJOR**

**SEMESTER-I**

**COURSE -2 INORGANIC CHEMISTRY**

---

**TIME:3 Hrs**

**MAX MARKS: 60M**

**PART-A**

Answer **All** of the following questions . Each carries **EIGHT** Marks.

5X8=40Marks

1. (a) Explain the preparation and structure of Diborane?  
(Or)  
(b) Explain the preparation, classification, and uses of silicones?
2. (a) Explain the structure of oxides and oxoacids of sulphur?  
(Or)  
(b) Explain the preparation and structure of Interhalogen compounds?
3. (a) Explain the characteristics of d-block elements with special reference to electronic configuration?  
(Or)  
(b) What are magnetic & catalytic properties and ability to form complexes of d-block elements?
4. (a) What is Lanthanide contraction? Explain consequences of Lanthanide Contraction?  
(Or)  
(b) Explain the Separation of Lanthanides by ion -exchange Method?
5. (a) Explain Froth Flotation ?  
(Or)  
(b) Explain calcinations and Roasting reduction of oxides to the Metal ?

### **PART-B**

Answer any **FIVE** of the following questions. Each carries **FOUR** marks.  
**5X4=20Marks**

6. Explain the structure of Borazine?
7. Explain the preparation & structure of phosphonitrilic compounds?
8. Write a note on Pseudohalogens?
9. Explain Classification of oxides?
10. Explain stability of various oxidation states of 3d series ?
11. Explain about variable valence of d- Block elements ?
12. Explain actinide contraction?
13. Write about magnetic properties of lanthanides ?
14. Define leaching,magnetic separation in concentration of ores
15. Explain Corrosion and its prevention

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**FIRST YEAR B.Sc HONOURS CHEMISTRY : MAJOR**

**SEMESTER-I**

**COURSE-2 INORGANIC CHEMISTRY**

---

**TIME:3 Hrs**

**MAX MARKS: 60M**

**PART-A**

Answer **All** of the following questions . Each carries **EIGHT** Marks.

5X8=40Marks

1. (a) Explain Preparation and structure of Borazine and  $(BN)_x$   
(Or)  
(b) Explain preparation ,Classification and uses of silicones?
2. (a) Explain the classification and structures of oxides of sulphur  
(Or)  
(b) Explain the preparation and structure of interhalogen compounds?
3. (a) Explain the characteristics of d-block elements with special reference to electronic configuration?  
(Or)  
(b) Explain the stability of various oxidation states and colour properties of 3d -series?
4. (a) What is Lanthanide contraction? Explain consequences of Lanthanide Contraction?  
(Or)  
(b) Explain oxidation states, colour, magnetic properties of lanthanides
5. (a) Explain refining of crude metal by distillation, poling?  
(Or)  
(b) Explain about Zone refining and vapour phase refining ?

### **PART-B**

Answer any **FIVE** of the following questions. Each carries **FOUR** marks.  
**5X4=20Marks**

6. Explain the structure of Diborane?
7. Explain the preparation & structure of phosphonitrilic compounds?
8. Write a note on pseudohalogens?
9. Explain the structures of oxoacids of sulphur?
10. Explain the Magnetic properties of d-block elements?
11. Write a short note on variable valency of d-block elements?
12. Explain actinide contraction?
13. Write a comparison of lanthanides and actinides?
14. Explain the electrolysis process?
15. Write about occurrence of Metals?

GOVERNMENT DEGREE COLLEGE FOR WOMEN(A), SRIKAKULAM

SEMESTER-II

COURSE 3: ORGANIC CHEMISTRY -1

Theory

Credits: 3

3hrs/week

---

**I. LEARNING OBJECTIVES:**

1. To understand the structural theory behind reactivity in organic chemistry.
2. To identify and classify hydrocarbons, their reactions, and stability.
3. To explain organic reaction mechanisms and orientation in aromatic substitution.
4. To apply concepts like resonance, inductive effects, hyperconjugation, and aromaticity.
5. To analyze stereochemistry through molecular representations and optical activity.

**II. COURSE OUTCOMES:**

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

1. Study Inductive effect, Mesomeric effect, Hyperconjugation and its applications.
2. Explain the preparation and chemical properties of alkanes, alkenes, alkynes and benzene.
3. Analyze and apply Huckel's rule to benzenoid and non-benzenoid aromatic compounds.
4. Differentiate between Markownikoff and Anti-markownikoff addition, Ring activating and deactivating groups.
5. Interpret stereochemical representations and identify chiral molecules.

**III. SYLLABUS:**

**UNIT-1: STRUCTURAL THEORY IN ORGANIC CHEMISTRY**

**(9 h)**

Functional groups in organic chemistry, Types of bond fission, Electrophiles, Nucleophiles, Reactive intermediates-carbocations, carbanions & free radicals. Inductive effect and its application: (a) Basicity of amines and (b) Acidity of carboxylic acids, Resonance or Mesomeric effect and its application: (a) Acidity of phenol, and (b) Acidity of carboxylic acids. Hyper conjugation and its application to the stability of carbonium ions.

**UNIT-2: SATURATED HYDROCARBONS (ALKANES & CYCLOALKANES) (9 h)**

**Types of organic reactions:** Addition, Elimination, Substitution and Rearrangement reactions.

**Alkanes:** Preparation of alkanes by Corey House synthesis, Substitution reactions of alkanes.

**Cycloalkanes:** Cycloalkanes and their relative stability, Baeyer strain theory, Cyclohexane conformations with energy diagram.

**UNIT-3: UNSATURATED HYDROCARBONS (ALKENES & ALKYNES) (9 h)**

**Alkenes:** Preparation of alkenes by dehydration of alcohols, Saytzeff and Hofmann eliminations, Electrophilic Additions of  $X_2$ ,  $H_2O$ ,  $HX$  to alkene, Markownikoff and Anti-markownikoff addition, Ozonolysis, Diels-Alder reaction, 1,2- and 1,4-addition reactions in conjugated dienes.

**Alkynes:** Additions of  $X_2$ ,  $H_2O$ ,  $HX$  to alkynes, acidity and alkylation of terminal alkynes

#### **UNIT-4: AROMATICITY, BENZENE AND ITS REACTIVITY (9 h)**

**Aromaticity:** Concept of aromaticity, Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non-Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation). Electrophilic aromatic substitution benzene- Halogenation, Nitration, Friedel-Craft's alkylation and Friedel- Craft's acylation.

**Orientation of aromatic substitution:** Ortho, para and meta directing groups with examples, Ring activating and deactivating groups with examples.

#### **UNIT- 5: STEREOCHEMISTRY OF CARBON COMPOUNDS (9 h)**

Molecular representations - Wedge, Fischer, Newman and Saw-Horse formulae.

**Optical isomerism:** Optical activity, optical rotation and specific rotation. Chiral molecules- Symmetry elements-enantiomers and diastereomers, Explanation of optical isomerism with examples- Glyceraldehyde, Lactic acid, and Tartaric acid. Relative configuration (D, L- notation), CIP rules, Absolute configuration (R, S-Configuration)

#### **IV. REFERENCES:**

1. R.N. Morrison, R.N. Boyd, Organic Chemistry, Pearson Education, 7th edition, 2010.
2. Peter Sykes, Guidebook to Mechanism in Organic Chemistry, 6th edition, 1985.
3. S.P. Singh, O. Prakash, Reaction mechanism in organic chemistry, Laxmi Publications, 2017.
4. P.Y. Bruice, Organic Chemistry, 8th Edition, Pearson, 2017.
5. V.K. Ahluwalia, P. Bhagat, R. Aggarwal, R. Chandra, Intermediate for Organic Synthesis, I.K. International. 2005.
6. T.W.G. Solomons, C.B. Fryhle, S.A. Snyder, Organic Chemistry, 12th Edition, Wiley, 2016.
7. P.S. Kalsi, Stereochemistry, New Age International, 2015.
8. D. Nasipuri, Stereochemistry of organic compounds, New Age International, 2020.

#### **V. PROPOSED ACTIVITIES:**

1. Mechanism writing exercises- Electrophilic aromatic substitution, electrophilic additions.
2. Group quiz on directive effects and reactive intermediates.
3. Concept mapping-Properties of alkane, alkene, alkyne, benzene.

#### **VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:**

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

## SEMESTER-II

### COURSE 3: ORGANIC PREPARATIONS

Practical

Credits: 1

2 hrs/week

---

#### I. LEARNING OBJECTIVES:

1. Understand mechanisms and conditions for common organic synthesis reactions (nitration, bromination, esterification, acetylation).
2. Perform organic synthesis using appropriate techniques such as heating, reflux, crystallization, and filtration.
3. Develop safe laboratory practices and chemical handling procedures.

#### II. COURSE OUTCOMES:

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

1. Describe the theoretical background and reaction mechanisms of organic preparations.
2. Synthesize organic compounds using standard laboratory procedures.
3. Analyze reaction steps and evaluate the melting point, and yield of synthesized products.
4. Relate synthesis methods to pharmaceutical and industrial applications.

#### III. SYLLABUS:

1. Preparation of tribromo aniline
2. Preparation of p-nitroacetanilide
3. Preparation of nerolin
4. Preparation of aspirin (Acetylsalicylic acid)
5. Preparation of paracetamol (Acetaminophen)

#### IV. REFERENCES:

1. B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, Pearson, 2012.
2. V.K. Ahluwalia, R. Agarwal, Comprehensive Practical Organic Chemistry, University Press, 2010.

#### V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(A), SRIKAKULAM**

**SEMESTER-II**

**COURSE 4: PHYSICAL CHEMISTRY-1**

**Theory**

**Credits: 3**

**3hrs/week**

**I. LEARNING OBJECTIVES:**

1. To understand the theoretical principles governing gases, liquids, solids, and colloidal systems.
2. To apply gas laws and interpret the behavior of real and ideal gases.
3. To describe physical properties of matter in various states and relate them to structural features.
4. To interpret phase diagrams and apply Gibbs' phase rule to one- and two-component systems.

**II. COURSE OUTCOMES:**

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

1. Explain gas laws, ideal and real gases behaviour, and critical phenomena.
2. Describe properties of liquids and classify types and applications of liquid crystals.
3. Derive Bragg's equation and identify types of crystal defects.
4. Apply the phase rule to interpret phase diagrams and systems with eutectic/congruent/incongruent points.
5. Differentiate between types of adsorption and colloidal systems, and evaluate their applications.

**III. SYLLABUS:**

**UNIT-1: GASEOUS STATE**

**(9 h)**

Gas laws, Ideal Gas equation, Vander Waal's equation of state, Andrew's isotherms of carbon dioxide, Critical phenomena, Relationship between critical constants and van der Waal's constants, Law of corresponding states, Joule-Thomson effect, Inversion temperature.

**UNIT-2: LIQUID STATE**

**(9 h)**

**Physical properties of liquids:** Definition of vapour pressure, boiling point, surface tension and coefficient of viscosity, Effect of temperature and addition of solutes on surface tension and viscosity.

**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-3: SOLID STATE**

**(9 h)**

Law of constancy of interfacial angles, The law of rationality of indices-Miller indices, Symmetry in crystals, 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, Defects in crystals: Stoichiometric and Non-stoichiometric defects.

**UNIT-4: PHASE RULE****(9 h)**

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

**UNIT-5: SURFACE CHEMISTRY****(9 h)**

**Colloids:** Definition and classification of Colloids, Coagulation of colloids, Hardy-Schulze rule. Stability of colloids, Protection of Colloids-Gold number.

**Adsorption:** Physical and chemical adsorption, Freundlich and Langmuir adsorption isotherm, applications of adsorption.

**IV. REFERENCES:**

1. P.W. Atkins, J.de., Paula, Atkin's Physical Chemistry, 10th Edition, Oxford University Press, 2014.
2. D.W. Ball, Physical Chemistry, 2nd Edition, Cengage Learning, 2017.
3. G.W. Castellan, Physical Chemistry, 4th Edition, Narosa, 2014.
4. K.L. Kapoor, A Textbook of Physical Chemistry, 6th Edition, McGraw-Hill Education, 2015.

**V. PROPOSED ACTIVITIES:**

1. Model building: Bravais lattices and symmetry in crystals
2. Chart preparation of phase diagrams (Water, Pb-Ag, NaCl-H<sub>2</sub>O)
3. PPT: Adsorption isotherms or colloidal behavior.
4. List out applications of Liquid crystals in different display devices.
5. Peer Teaching: Phase rule and eutectic systems

**VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:**

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

## SEMESTER-II

### COURSE 4: PHYSICAL CHEMISTRY -1 PRACTICAL

Practical

Credits: 1

2 hrs/week

---

#### I. LEARNING OBJECTIVES:

1. To understand the concepts of surface tension and viscosity of liquids.
2. To familiarize students with using different lab equipment and glassware for the determination of the coefficient of viscosity and surface tension.
3. To gain hands-on experience in preparing colloidal solutions.

#### II. COURSE OUTCOMES:

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

1. Use glassware, equipment and follow experimental procedures in the laboratory.
2. Determine surface tension and viscosity using standard experimental techniques.
3. Prepare colloidal solutions and study their stability.
4. Conduct adsorption experiments and verify Freundlich isotherm

#### III. SYLLABUS:

1. Determination of surface tension of liquid by drop count method.
2. Determination of surface tension of liquid by drop weight method.
3. Determination of coefficient of viscosity of an organic liquid.
4. Preparation of sols:  $\text{Al}(\text{OH})_3$ ,  $\text{Fe}(\text{OH})_3$  and starch.
5. Adsorption of acetic acid on animal charcoal, verification of Freundlich isotherm.

#### IV. REFERENCES

:

1. B.D. Khosla, V.C. Garg, A. Gulati, Senior Practical Physical Chemistry, R. Chand & Co, New Delhi, 2015.
2. K.L. Kapoor, A Textbook of Physical Chemistry, McGraw-Hill Education, 2019.
3. C.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th Edition, McGraw-Hill, New York, 2003.

#### V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce

GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM

MODEL PAPER

FIRST YEAR B.Sc HONOURS CHEMISTRY: MAJOR

SEMESTER-II

COURSE -3: ORGANIC CHEMISTRY -1

---

TIME:3 Hrs

MAX MARKS: 60

PART-A

Answer ALL the following questions. Each question carries EIGHT marks.

5 × 8 = 40 Marks

1.(a) Explain the different types of bond fission in organic compounds. Discuss the formation and stability of carbocations, carbanions and free radicals.

OR

(b) Explain the Inductive effect and discuss its applications in:

i) Basicity of amines

ii) Acidity of carboxylic acids.

2.(a) Explain the Corey–House synthesis for the preparation of alkanes. Discuss the substitution reactions of alkanes.

OR

(b) Explain Baeyer strain theory and discuss the relative stability of cycloalkanes.

3.(a) Explain the preparation of alkenes by dehydration of alcohols. Discuss Saytzeff and Hofmann elimination with suitable examples.

OR

(b) Explain the electrophilic addition reactions of alkenes with  $X_2$ ,  $H_2O$  and  $HX$ . Discuss Markovnikov and Anti-Markovnikov addition with examples.

4.(a) Explain the concept of aromaticity and Hückel's rule. Apply Hückel's rule to benzene, naphthalene, cyclopropenyl cation, cyclopentadienyl anion and tropylium cation.

OR

(b) Explain the mechanism of electrophilic aromatic substitution reactions of benzene:

i) Halogenation

ii) Nitration

5.(a) Explain optical isomerism. with glyceraldehyde, lactic acid, and tartaric acid examples.

OR

(b) Explain the CIP rules and discuss the determination of R and S configurations with suitable examples.

### **PART – B**

Answer ANY FIVE of the following questions. Each question carries FOUR marks.

**5 × 4 = 20 Marks**

6. What are electrophiles and nucleophiles? Give suitable examples.
7. Explain Resonance or Mesomeric effect and its application to the acidity of phenol.
8. What are addition, elimination, reactions? Give one example for each.
9. Explain the Ozonolysis of alkenes with a suitable example.
10. What is the Diels–Alder reaction? Explain with an example.
11. Explain the acidity and alkylation of terminal alkynes.
12. What are ortho, para and meta directing groups? Give suitable examples.
13. Explain ring activating and ring deactivating groups in aromatic substitution.
14. Explain the Wedge, Fischer, Newman and Saw-Horse representations of organic molecules.
15. Define optical activity, optical rotation with examples

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**FIRST YEAR B.Sc HONOURS CHEMISTRY: MAJOR**

**SEMESTER-II**

**COURSE -4: PHYSICAL CHEMISTRY -1**

---

**TIME:3 Hrs**

**MAX MARKS: 60**

**PART-A**

**Answer ALL the following questions. Each question carries EIGHT marks**      5x8=40 Marks

1.(a) Derive the Van der Waals equation of state for real gases. Explain the significance of the constants 'a' and 'b'.

OR

(b) Explain critical phenomena and derive the relationship between critical constants and Van der Waals constants.

2.(a) Define surface tension and coefficient of viscosity. Explain the effect of temperature and addition of solutes on surface tension and viscosity.

OR

(b) Explain the mesomorphic state Describe the classification of liquid crystals into Smectic and Nematic types .

3.(a) State and derive Bragg's law of X-ray diffraction. Explain its importance in the determination of crystal structure.

OR

(b) Explain unit cell, and Bravais lattices. Discuss the different crystal systems with suitable examples.

4.(a) Explain the phase diagram to the one-component water system.

OR

(b) Explain the simple eutectic system with reference to the Pb–Ag system. Discuss the desilverisation of lead using the phase diagram.

5.

(a) Define colloids and explain their classification. Discuss the coagulation of colloids and Hardy–Schulze rule.                      (Or)

(b) Discuss the Langmuir adsorption isotherm with suitable equations.

## **PART – B**

Answer ANY FIVE of the following questions. Each question carries FOUR marks.

5 × 4 = 20 Marks

6. Explain the Joule–Thomson effect.
7. What is vapour pressure? Explain its relationship with boiling point.
8. Write applications of liquid crystals as LCD devices.
9. Explain the law of rationality of indices.
10. What are stoichiometric defects? Explain with examples.
11. State Gibbs phase rule and explain the terms involved in it.
12. Explain congruent and incongruent melting points with suitable examples.
13. Explain freezing mixtures.
14. What are protective colloids? Explain the significance of the Gold number.
15. Differentiate between physical adsorption and chemical adsorption.

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(A), SRIKAKULAM**

**SEMESTER-III**

**COURSE 5: ORGANIC CHEMISTRY-II**

**Theory**

**Credits: 3**

**3hrs/week**

---

**I. LEARNING OBJECTIVES:**

1. To understand the structure, reactivity, and mechanisms of halogenated organic compounds, alcohols and phenols.
2. To analyze the mechanisms of key reactions involving aldehydes and ketones.
3. To discuss the properties and synthetic applications of carboxylic acids.
4. To explore the importance and utility of active methylene compounds in organic synthesis.

**II. COURSE OUTCOMES:**

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

1. Describe and compare SN1 and SN2 mechanisms in halogen compounds
2. Illustrate the methods of preparation and reactions of alcohols and phenols including rearrangements.
3. Predict products and explain mechanisms of carbonyl compound reactions.
4. Demonstrate the preparation and properties of carboxylic acid with mechanisms.
5. Apply synthetic strategies using acetoacetic and malonic esters for target molecule synthesis

**III. SYLLABUS:**

**UNIT-1: HALOGENATED HYDROCARBONS**

**(9 h)**

**Alkyl halides:** Nucleophilic substitution reactions – SN1 and SN2 mechanisms with energy profile diagrams, Comparison of SN1 and SN2 reactions.

**Aryl halides:** Nucleophilic aromatic substitution, relative reactivity of alkyl, allyl, vinyl, benzyl and aryl halides towards nucleophilic substitution reactions.

**UNIT-2: ALCOHOLS AND PHENOLS**

**(9 h)**

**Alcohols:** Preparation of 1<sup>o</sup>, 2<sup>o</sup>, 3<sup>o</sup>-alcohols from Grignard's reagent, Chemical properties: substitution of –OH by using PCl<sub>5</sub>, PCl<sub>3</sub>, SOCl<sub>2</sub> and HX / ZnCl<sub>2</sub>, Oxidation of alcohols with PCC and PDC, Pinacol-Pinacolone rearrangement with mechanism.

**Phenols:** Preparation from diazonium salt, Reimer-Tiemann and Kolbe–Schmidt reaction with mechanism.

### **UNIT-3: CARBONYL COMPOUNDS**

**(9 h)**

Preparation from acid chlorides, Nucleophilic addition reactions with HCN, and alcohols, addition-elimination reactions with hydroxylamine, hydrazine, phenyl hydrazine, 2,4-DNP, semi-carbazide, Oxidation with KMnO<sub>4</sub>, Clemmensen reduction, Wolf–Kishner reduction.

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

### **UNIT-4: CARBOXYLIC ACIDS (9 h)**

Preparation of carboxylic acids from Grignard reagent, Reactions of carboxylic acids involving -H, -OH and -COOH groups: formation of salts, esters, acid chlorides, amides and anhydrides. Hunsdiecker reaction, Schmidt reaction, Arndt-Eistert synthesis, Hell-Volhard-Zelinsky reaction, Mechanism of acidic hydrolysis of esters.

### **UNIT- 5: ACTIVE METHYLENE COMPOUNDS (9 h)**

Acetoacetic ester (AAE): Keto-enol tautomerism, preparation of Acetoacetic ester by Claisen condensation with mechanism, synthetic applications of AAE in the preparation of mono carboxylic acids, dicarboxylic acids,  $\alpha$ ,  $\beta$ -unsaturated acids and heterocyclic compounds.

Malonic ester: Preparation and synthetic applications of Malonic ester.

### **IV. REFERENCES:**

1. R.N. Morrison, R.N. Boyd, Organic Chemistry, Pearson Education, 7th edition, 2010.
2. Peter Sykes, Guidebook to Mechanism in Organic Chemistry, 6th edition, 1985.
3. S.P. Singh, O. Prakash, Reaction mechanism in organic chemistry, Laxmi Publications, 2017.
4. P.Y. Bruice, Organic Chemistry, 8th Edition, Pearson, 2017.
5. V.K. Ahluwalia, P. Bhagat, R. Aggarwal, R. Chandra, Intermediate for Organic Synthesis, I.K. International. 2005.
6. T.W.G. Solomons, C.B. Fryhle, S.A. Snyder, Organic Chemistry, 12th Edition, Wiley, 2016.

### **V. PROPOSED ACTIVITIES:**

1. Concept Mapping- Compare SN<sub>1</sub> & SN<sub>2</sub> mechanisms with energy diagrams.
2. Lab-based Demonstration-Tests for alcohols and phenols.
3. Problem Solving / Reaction Mapping- Interconversion exercises between carboxylic acid derivatives.
4. Group Discussion: How esters are used in perfumes, solvents, and food industries.

- VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:**
1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning.
  2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
  3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

## SEMESTER-III

### COURSE 5: ORGANIC QUALITATIVE ANALYSIS

Practical

Credits: 1

2 hrs/week

---

#### I. LEARNING OBJECTIVES:

2. To determine the physical constants of organic compounds accurately.
3. 1. To identify functional groups in unknown organic compounds using systematic analysis.  
To prepare suitable solid derivatives to confirm the presence of functional groups.
4. To apply laboratory safety protocols and precise techniques during analysis.

#### II. COURSE OUTCOMES:

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

1. Proper use of glassware, equipment and chemicals in the laboratory.
2. Systematically analyze unknown organic compounds to identify functional groups.
3. Determine melting point or boiling point of organic compounds to assess purity.
4. Prepare derivatives for confirmation of functional groups.

#### III. SYLLABUS:

Systematic Qualitative Analysis of an organic compounds for functional group identification including the determination of melting point and boiling point with suitable derivatives: **Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic primary amines, amides and simple sugars.**

#### IV. REFERENCES:

1. F.G. Mann, B.C. Saunders, Practical Organic Chemistry, Pearson Education, 2009.
2. B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, Pearson, 2012.
3. V.K. Ahluwalia, R. Aggarwal, (2004), Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press, 2004
4. V.K. Ahluwalia, S. Dhingra, (2004), Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press, 2004.

#### V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**SECOND YEAR B.Sc HONOURS CHEMISTRY: MAJOR**

**SEMESTER-III**

**COURSE -5: ORGANIC CHEMISTRY**

---

**TIME:3 Hrs**

**MAX MARKS: 60**

**PART-A**

Answer **All** of the following questions . Each carries **EIGHT** Marks.

5X8=40Marks

1.(a) Explain the SN1 and SN2 nucleophilic substitution reactions of alkyl halides with suitable mechanisms and energy profile diagrams. Compare SN1 and SN2 reactions.

**OR**

(b) Explain nucleophilic aromatic substitution reactions. Discuss the relative reactivity of alkyl, allyl, vinyl, benzyl and aryl halides towards nucleophilic substitution.

2.(a) Explain the preparation of primary, secondary and tertiary alcohols from Grignard reagents with suitable chemical equations. Discuss the reactions of alcohols with PCl<sub>5</sub>, PCl<sub>3</sub>, SOCl<sub>2</sub> and HX/ZnCl<sub>2</sub>.

**OR**

(b) Explain the Pinacol–Pinacolone rearrangement with a suitable example and give its mechanism. Also discuss the oxidation of alcohols using PCC and PDC.

3.(a) Explain the nucleophilic addition reactions of carbonyl compounds with HCN and alcohols. And Write Clemmensen reduction ,wolf-kishner reduction.

**OR**

(b) Explain the Aldol condensation and Cannizzaro reaction with suitable examples and mechanisms.

4.(a) Explain the preparation of carboxylic acids from Grignard reagents. Discuss the reactions of carboxylic acids involving the –H, –OH and –COOH groups, including formation of salts, esters, acid chlorides..

**OR**

**(b)** Explain the following reactions with suitable mechanisms:

- i) Hunsdiecker reaction
- ii) Schmidt reaction

5.(a) What are active methylene compounds? Explain the preparation of acetoacetic ester by Claisen condensation with mechanism.

OR

(b) Explain the synthetic applications of acetoacetic ester in the preparation of:

- i) Monocarboxylic acids
- ii) Dicarboxylic acids
- iii)  $\alpha,\beta$ -Unsaturated acids
- iv) Heterocyclic compound

**PART-B**

Answer any **FIVE** of the following questions. Each carries **FOUR** marks. 5X4=20Marks

- 6. Compare the SN1 and SN2 reactions
- 7. Explain preparation of phenol from diazonium salts.
- 8. Write the mechanism of Reimer-Tiemann reaction and mention its major product.
- 9. Explain the reaction of carbonyl compounds with hydroxylamine, hydrazine and 2,4-DNP.
- 10. Write short notes on Clemmensen reduction and Wolff-Kishner reduction.
- 11. Explain the acidic hydrolysis of esters with mechanism.
- 12. What is Hell-Volhard-Zelinsky reaction? Give its mechanism and one example.
- 13. What is keto-enol tautomerism? Explain with reference to malonic ester
- 14. Discuss the oxidation of alcohols using PCC and PDC
- 15. Write a short note on the synthetic applications of malonic ester.

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS)**

**SRIKAKULAM**

**SEMESTER-III**

**COURSE 6: PHYSICAL CHEMISTRY-II**

**Theory**

**Credits: 3**

**3hrs/week**

---

**I. LEARNING OBJECTIVES:**

1. Understand the principles governing the behaviour of solutions.
2. Apply colligative properties to determine molecular weights and solution behaviours.
3. Describe and differentiate between thermal and photochemical reactions, Fluorescence, Phosphorescence, with mechanistic insights.
4. Explain and apply concepts of ionic conductance and perform conductometric titrations.
5. Analyze electrochemical cells, EMF, electrode potentials, and perform potentiometric titrations.

**II. COURSE OUTCOMES:**

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

1. Understand Azeotropes, Raoult's law and Nernst distribution law.
2. Calculate colligative properties and molecular masses of solutes using various experimental methods.
3. Explain laws of photochemistry and mechanisms of photochemical reactions with qualitative concepts of fluorescence and phosphorescence.
4. Evaluate conductance behavior of electrolytes and perform conductometric titrations.
5. Illustrate working principles of electrochemical cells and perform potentiometric titrations.

**III. SYLLABUS:**

**UNIT-1: SOLUTIONS**

**(9 h)**

Classification - miscible, partially miscible and Immiscible, Raoult's Law, Azeotropes, HCl-H<sub>2</sub>O system and ethanol-water system, Partially miscible liquids: phenol- water system, Critical solution temperature (CST), Effect of impurity on consolute temperature, Nernst distribution law, Calculation of the partition coefficient, Applications of Nernst distribution law.

**UNIT- 2: 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 Berkeley-Hartley method.

**UNIT - 3: PHOTOCHEMISTRY**

**(9 h)**

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, and Photosensitization.

**UNIT - 4: ELECTROCHEMISTRY-I****(9 h)**

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

**UNIT- 5: ELECTROCHEMISTRY-II****(9 h)**

Electrochemical Cells, Types of electrodes with examples: Metal- metal ion, Gas electrode, Inert electrode, Redox electrode, Metal-metal insoluble salt - salt anion. Single electrode potential, Standard electrode potential, Determination of EMF of a cell, Nernst equation, Potentiometric titrations.

**IV. REFERENCES:**

1. P.W. Atkins, J.de. Paula, Atkin's Physical Chemistry Ed., 10th Edition, Oxford University Press, 2014.
2. G.W. Castellan, Physical Chemistry, 4th Edition, Narosa., 2004.
3. K.L. Kapoor, A Textbook of Physical Chemistry, 3rd Edition, McGraw-Hill Education, 2015.
4. B.R. Puri, L.R. Sharma, M.S. Pathania, *Principles of Physical Chemistry*, Vishal Publishing, 2020.
5. P. Bahadur, **Concepts of Physical Chemistry**, G.R. Bathla Publications, 2018.

**V. PROPOSED ACTIVITIES:**

1. Experiment: Plot miscibility curves and CST.
2. Comparative worksheet: Thermal and photochemical reactions, Fluorescence and Phosphorescence.
3. Group Work: Determination of EMF and Conductivity.

**VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:**

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning.
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

## SEMESTER-III

### COURSE 6: PHYSICAL CHEMISTRY-II PRACTICAL

Practical

Credits: 1

2 hrs/week

---

#### I. LEARNING OBJECTIVES:

1. Determine critical solution temperature (CST) and study the effect of electrolytes.
2. Use conductometry to determine the concentrations of strong and weak acids.
3. Apply potentiometric methods for accurate titration of acid-base systems.
4. Develop precision, accuracy, and skill in handling electrochemical instruments.

#### II. COURSE OUTCOMES:

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

1. Determine the CST of a partially miscible liquid system and interpret the effect of impurities.
2. Conduct and interpret conductometric and potentiometric titrations of strong and weak acids with a strong base.
3. Use and calibrate electrochemical instruments accurately in titrations.

#### III. SYLLABUS:

1. Determination of Critical Solution Temperature (CST) for Phenol-water system.
2. Study the effect of electrolyte on Critical Solution Temperature.
3. Conductometric titration- Determination of the concentration of HCl solution using standard NaOH solution.
4. Conductometric titration - Determination of the concentration of CH<sub>3</sub>COOH solution using standard NaOH solution.
5. Potentiometric titration - Determination of the concentration of HCl using standard NaOH solution.

#### IV. REFERENCES:

1. B.D. Khosla, V.C. Garg, A. Gulati, Senior Practical Physical Chemistry, R. Chand & Co, New Delhi, 2015.
2. K.L. Kapoor, A Textbook of Physical Chemistry, McGraw-Hill Education, 2019.
3. C.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th Edition, McGraw-Hill, New York, 2003.

#### V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**SECOND YEAR B.Sc HONOURS CHEMISTRY: MAJOR**

**SEMESTER-III**

**COURSE -6: PHYSICAL CHEMISTRY-II**

---

**TIME:3 Hrs**

**MAX MARKS: 60**

**PART-A**

Answer **All** of the following questions . Each carries **EIGHT** Marks. 5X8=40Marks

**1.(a)** Discuss Raoult's law and explain the formation of azeotropes with suitable examples.

**OR**

**(b)** Explain the Nernst distribution law with its applications.

**2.(a)** Derive the expressions for relative lowering of vapour pressure, Describe the determination of molecular mass of a non-volatile solute by Ostwald–Walker method

**OR**

**(b)** Explain osmotic pressure and its relation to molecular mass determination. Describe the determination of molecular mass of a non-volatile solute by Berkeley–Hartley method.

**3.(a)** Discuss fluorescence, phosphorescence and chemiluminescence with suitable examples. Explain the Jablonski diagram.

**OR**

**(b)** Explain the photochemical reaction mechanism of hydrogen–chlorine and hydrogen–bromine reactions.

**4.(a)** What are transport numbers , Explain and determine by Hittorf's method.

**OR**

**(b)** . Explain conductometric titrations with suitable examples.

**5.(a)** Explain different types of electrodes with suitable examples

1. Metal–metal ion electrode
2. Gas electrode
3. Inert electrode
4. Redox electrode
5. Metal–metal insoluble salt–salt anion electrode

OR

(b) Describe the determination of EMF of a cell and derive the Nernst equation.

**PART – B**

Answer ANY FIVE of the following questions. Each carries FOUR marks.

- 6) Explain the classification of liquid mixtures.
- 7) Explain Critical Solution Temperature (CST) with reference to the phenol–water system.
- 8) Explain the colligative properties of solutions
- 9) State Grotthuss–Draper law and Stark–Einstein law of photochemistry.
- 10) Write a short note on quantum yield.
- 11) Define specific conductance and molar conductance. Explain their variation with dilution.
- 12) State Kohlrausch’s law and write any one of its applications.
- 13) Explain the Debye-Hückel-Onsager equation for strong electrolytes.
- 14) Explain single electrode potential and standard electrode potential.
- 15) Explain potentiometric titration with a suitable example.

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(A), SRIKAKULAM**

**SEMESTER-III**

**COURSE 7: COORDINATION CHEMISTRY**

**Theory**

**Credits: 3**

**3hrs/week**

---

**I. LEARNING OBJECTIVES:**

1. Understand the nomenclature, structure and isomerism of coordination compounds.
2. Apply VBT and CFT to explain bonding, geometry, magnetism, and reactivity in coordination complexes.
3. Analyze the stability of metal complexes using kinetic and thermodynamic principles.
4. Interpret the properties of organometallic compounds, especially metal carbonyls, using MO theory and the 18-electron rule.
5. Explore the roles of metal ions in biological systems and understand their physiological and toxicological effects.

**II. COURSE OUTCOMES:**

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

1. Classify ligands and write IUPAC names of coordination compounds.
2. Explain VBT and CFT concepts to predict structures of complexes.
3. Analyze substitution mechanisms and assess kinetic/thermodynamic stability of complexes.
4. Describe bonding, electron count and synergic bonding in metal carbonyls.
5. Examine the biological roles and toxicity of metal ions and apply chelation in medicine.

**III. SYLLABUS:**

**UNIT-1: COORDINATION CHEMISTRY-I**

**(9 h)**

Types of Ligands-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.

**UNIT-2: COORDINATION CHEMISTRY-II**

**(9 h)**

Crystal Field Theory: Postulates of CFT, 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 crystal field splitting energy, Spectrochemical series.

**UNIT-3: INORGANIC REACTION MECHANISM AND STABILITY OF COMPLEXES**

**(9 h)**

**Inorganic Reaction Mechanism:** Labile and inert complexes, Substitution reactions in square planar complexes, Trans-effect and its applications, Cisplatin as an anti-cancer drug.

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

#### **UNIT- 4: ORGANOMETALLIC COMPOUNDS-METAL CARBONYLS (9h)**

Definition and classification of organometallic compounds based on bond type.

**Metal carbonyls:** General methods of preparation of metal carbonyls of 3d series, 18-electron rule, electron count of mononuclear and polynuclear carbonyls. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT,  $\pi$ -acceptor behaviour of CO, synergic effect.

#### **UNIT- 5: BIOINORGANIC CHEMISTRY (9 h)**

Metal ions present in biological systems, classification of elements according to their action in biological systems. Na / K- pump, carbonic anhydrase and carboxypeptidase. Toxicity of metal ions (Hg, Pb, Cd and As) and reasons for toxicity, Use of chelating agents in medicine. Haemoglobin - transfer of oxygen, Myoglobin-Storage and transfer of iron.

#### **IV. REFERENCES:**

1. P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller, F.A. Armstrong, Shriver and Atkins Inorganic Chemistry, 5th Edition, Oxford University Press, 2010.
2. G.L. Miessler, P.J. Fischer, D.A. Tarr, Inorganic Chemistry, 5th Edition, Pearson, 2014.
3. J.E. Huheey, E.A. Keiter, R.L. Keiter, O.K. Medhi, Inorganic Chemistry- Principles of Structure and Reactivity, Pearson Education, 2009.
4. B.W. Pfennig, Principles of Inorganic Chemistry. John Wiley & Sons, 2015.
5. F.A. Cotton & G. Wilkinson, Advanced Inorganic Chemistry Wiley-VCH, 1999.
6. J.D. Lee, **Concise Inorganic Chemistry**, Oxford University Press, 2008.

#### **V. PROPOSED ACTIVITIES:**

1. Worksheet on writing IUPAC names and isomer structures of complex compounds.
2. Electron-count assignments of metal carbonyls.
3. Chart: Role of metal ions in enzymes and metal toxicity.
4. Group project: Use of chelating agents in medicine

#### **VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:**

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

## SEMESTER-III

### COURSE 7: PREPARATION OF COORDINATION COMPOUNDS

Practical

Credits: 1

2 hrs/week

---

#### I. LEARNING OBJECTIVES:

1. To develop safe laboratory practices and chemical handling procedures.
2. To synthesize and isolate coordination compounds.
3. To determine the composition of a metal-ligand complex in solution.

#### II. COURSE OUTCOMES:

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

1. Synthesize and purify coordination compounds.
2. Understand coordination numbers, geometries, and ligand types.
3. Demonstrate methods of complex preparation and analysis.
4. Apply Job's method to determine stoichiometric ratios of complexes.

#### III. SYLLABUS:

1. Preparation of Tetraamminecopper (II) sulphate.
2. Preparation of Potassium tri(oxalato)ferrate(III).
3. Preparation of hexaamminecobalt(III) chloride.
4. Acetylacetonate complexes of  $\text{Cu}^{2+}/\text{Fe}^{3+}$ .
5. Determination of the stoichiometry of a metal-ligand complex by the Jobs method.

#### IV. REFERENCES:

1. James E. Huheey, Inorganic Chemistry: Principles of Structure and Reactivity, Harper Collins College Publishers, 1993.
2. Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, Pearson Education, 2000.
3. R. Gopalan, P.S. Subramanian, Elements of Analytical Chemistry, Sultan Chand & Sons, 3rd Edition, 2003.
4. G. Svehla, Vogel's Qualitative Inorganic Analysis, 7th Edition, Prentice Hall, 1996.

#### V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**SECOND YEAR B.Sc HONOURS CHEMISTRY: MAJOR**

**SEMESTER-III**

**COURSE -7: COORDINATION CHEMISTRY**

---

**TIME:3 Hrs**

**MAX MARKS: 60**

**PART-A**

Answer **All** of the following questions . Each carries **EIGHT** Marks.

5X8=40Marks

- 1) a) Explain about Valence bond theory and its limitations.  
Or  
b) Discuss about stereo isomerism in coordination compounds .
- 2) a) Explain crystal field splitting in octahedral and tetrahedral complexes.  
Or  
b) Define CFSE and explain the factors affecting CFSE.
- 3) a) Explain the substitution reactions in square planar complexes.  
Or  
b) Explain the determination method of the composition of a complex by Job's method.
- 4) a) Explain the classification of organometallic compounds.  
Or  
b) Write a note on the 18-electron rule. Apply the rule in following carbonyls  
1)  $\text{Mn}_2(\text{CO})_{10}$                       2)  $\text{Fe}_2(\text{CO})_9$                       3) Ferrocene
- 5) a) Write about the classification of elements based on biological significance.  
Or  
b) Explain the structure and functions of the Haemoglobin.

**PART-B**

Answer any FIVE questions .Each question carries 4 marks.

5 x 4 =20 Marks

- 6) Write the structural isomerism in coordination compounds.
- 7) Write about IUPAC nomenclature of coordination compounds.
- 8) Write a note on spectrochemical series .
- 9) Write the postulates of CFT.
- 10) Explain thermodynamic stability of metal complexes.
- 11) Write trans effect and it's applications.
- 12) Write a note on synergic effect.
- 13) Write the structure of  $\text{Fe}(\text{CO})_5$ ,  $\text{Ni}(\text{CO})_4$ .
- 14) Explain the toxic effects of Hg, Pb, Cd.

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(A), SRIKAKULAM**

**SEMESTER-III ( CHEMISTRY MINOR)**

**COURSE 1: GENERAL CHEMISTRY**

**Theory**

**Credits: 3**

**3hrs/week**

---

**I. LEARNING OBJECTIVES:**

1. To understand the structure of the atom and its relation to periodic properties.
2. To explain different types of chemical bonding: ionic, covalent, metallic, hydrogen bonding.
3. To apply bonding theories to predict molecular structure and bonding nature.
4. To correlate periodic trends with physical and chemical properties of elements.
5. To evaluate acid-base behaviour using various theories and apply the HSAB principle.

**II. COURSE OUTCOMES:**

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

1. Describe the electronic configuration of elements and periodic trends.
2. Analyze the formation and properties of ionic and covalent compounds.
3. Apply VSEPR, hybridization, and MOT to predict molecular geometry and bonding.
4. Explain metallic bonding, hydrogen bonding, and intermolecular forces and relate them to physical properties.
5. Compare and evaluate acid-base theories and explain HSAB applications in predicting chemical reactivity.

**III. SYLLABUS:**

**UNIT-1: ATOMIC STRUCTURE AND PERIODIC TABLE**

**(9h)**

Electronic configuration-Aufbau principle, Hund's rule and Pauli's exclusion principle. Periodic law and arrangement of elements in the periodic table, horizontal, vertical, and diagonal relationships in the periodic table. Definition and periodic trends of atomic radii, ionic radii, covalent radii, ionization potential, electron affinity, and electronegativity, Pauling scale, variable valency, inert-pair effect.

**UNIT-2: IONIC BOND**

**(9h)**

Properties of ionic compounds, factors favouring the formation of ionic compounds, Lattice energy: definition, factors affecting lattice energy, Born-Haber cycle - enthalpy of formation of ionic compound and stability, Covalent character in ionic compounds - polarization and Fajan's rules, effects of polarization.

**UNIT-3: COVALENT BOND**

**(9h)**

**Valence Bond theory:** Hybridization of atomic orbitals and geometry of molecules-BeCl<sub>2</sub>, BF<sub>3</sub>, CH<sub>4</sub>, PCl<sub>5</sub>, and SF<sub>6</sub>

**VSEPR model:** Effect of bonding and nonbonding electrons on the structure of molecules- $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{SF}_4$ ,  $\text{ICl}_2^-$ ,  $\text{NH}_4^+$ ,  $\text{XeF}_4$

**Molecular orbital theory:** LCAO method, construction of M.O. diagrams for homo nuclear and heteronuclear diatomic molecules ( $\text{N}_2$ ,  $\text{O}_2$ ,  $\text{CO}$  and  $\text{NO}$ )

#### **UNIT -4: METALLIC AND HYDROGEN BONDS ( 9h)**

**Metallic bond:** Metallic properties, free electron theory, band theory of metals. Explanation of conductors, semiconductors and insulators.

**Hydrogen bonding:** Intra- and Inter molecular hydrogen bonding, influence on the physical properties of molecules, Vanderwaals forces, dipole-dipole interactions.

#### **UNIT -5: ACIDS, BASES AND HSAB PRINCIPLE (9h)**

Definition of Acid and base- Arrhenius, Bronsted-Lowry, Lewis theories, the solvent system, Classification of solvents, pH, Types of salts, Salt hydrolysis. Pearson's concept, HSAB principle and its application.

#### **IV. REFERENCES:**

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,
4. James E. Huheey, **Inorganic Chemistry: Principles of Structure and Reactivity**, 4th ed., 2017.
5. W.U. Malik, G.D Tuli, R.D Madan, Selected Topics in Inorganic Chemistry, S.Chand Publishing, 1998.

#### **V. PROPOSED ACTIVITIES:**

1. Chart on periodic trends like radii, ionization energy, electronegativity across groups/periods.
2. Worksheet solving-MOT diagrams, hybridization problems, salt hydrolysis calculations.
3. Case study-Analyze real-life use of acids and bases,
4. Model Building-Build 3D structures using kits/software for  $\text{CH}_4$ ,  $\text{PCl}_5$ ,  $\text{XeF}_4$  etc.

#### **VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS**

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning.
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination(SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

\*\*\*

## SEMESTER-III (MINOR)

### COURSE 1: QUALITATIVE ANALYSIS OF SIMPLE SALT

Practical

Credits: 1

2 hrs/week

---

#### I. LEARNING OBJECTIVES:

1. To understand the theoretical principles behind classical qualitative analysis of cations and anions.
2. To develop the ability to identify common cations and anions in inorganic salts.
3. To practice laboratory safety and correct handling of reagents.
4. To record and interpret observations accurately in systematic salt analysis.

#### II. COURSE OUTCOMES:

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

1. Proper use of glassware, equipment and chemicals in the laboratory
2. Apply systematic procedures to identify one cation and one anion in a given inorganic salt.
3. Analyze reactions based on solubility, color changes, and precipitate formation.
4. Interpret results to draw conclusions and confirm the identity of ions.

#### III. SYLLABUS:

Analysis of simple salt containing **one anion and one cation** from the following:

**Anions:** Carbonate, sulphate, chloride, bromide, acetate, nitrate, borate, phosphate.

**Cations:** Lead, copper, iron, aluminium, zinc, nickel, manganese, calcium, strontium, barium, ammonium.

#### IV. REFERENCES

1. G. Svehla, Vogel's Textbook of Qualitative Inorganic Analysis, Pearson Education, 2008.
2. K. Nagaraj, S. Kamalesu, S. Lokhandwala, N.M. Parekh, Textbook of Semi-micro Inorganic Qualitative Analysis, Notion Press, 2023.
3. G. Pass, H. Sutcliffe, Practical Inorganic Chemistry. 2<sup>nd</sup> edition, John-Wiley & Sons, 2020.

#### V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**SECOND YEAR B.Sc HONOURS CHEMISTRY: MINOR**

**SEMESTER-III**

**COURSE -1 : GENERAL CHEMISTRY**

---

**TIME:3 Hrs**

**MAX MARKS: 60**

**PART-A**

Answer **All** of the following questions . Each carries **EIGHT** Marks. 5X8=40Marks

1. Write about Pauli's exclusion principle, Hund's rule and Aufbau principle.  
( Or )  
Explain periodic law and horizontal, vertical, diagonal relationship in the periodic table.
2. Explain the Born-Haber cycle?  
( Or )  
Explain covalent character in ionic compounds and Fajan's rules.
3. Explain hybridization and geometry of molecules of  $\text{BeCl}_2$ ,  $\text{BF}_3$ ,  $\text{PCl}_5$ ,  $\text{SF}_6$ .  
( Or )  
Explain the molecular orbital diagram for CO and NO molecules.
4. Explain intra and inter molecular hydrogen bonding and , influence on physical properties of molecules. ( Or )  
Explain the Band theory of metals.
5. Write about Bronsted -lowry theory and Lewis theory.  
(Or )  
Explain HSAB principle, give it's applications .

**PART-B**

Answer **ANY FIVE** of the following questions. Each carries **FOUR** marks

**5 × 4 = 20Marks**

6. What is inert-pair effect?
7. Define atomic and ionic radii.
8. What is lattice energy? Explain the factors affecting it.
9. Explain Fajan rules?
10. Explain the structures of  $\text{ICl}_2^-$ ,  $\text{NH}_4^+$ .
11. Explain the structure of  $\text{H}_2\text{O}$ ,  $\text{XeF}_4$ .
12. Write Metallic properties.
13. Explain types of Vanderwall forces
14. What is Salt hydrolysis?
15. Write the classifications of solvents.

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(A), SRIKAKULAM**

**SEMESTER-IV**

**COURSE 8: ORGANIC CHEMISTRY-III**

**Theory**

**Credits: 3**

**3hrs/week**

---

**I. LEARNING OBJECTIVES:**

1. To understand classification, synthesis, and reactions of amines and nitro hydrocarbons.
2. To interpret the chemistry and reactivity of heterocyclic compounds and their aromaticity.
3. To understand structural details and interconversions of carbohydrates.
4. To classify amino acids and explain their synthesis, structure, and properties.

**II. COURSE OUTCOMES:**

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

1. Describe the synthesis and chemical behaviour of amines and nitro hydrocarbons.
2. Understand the synthetic applications of diazonium salts.
3. Illustrate aromaticity and reactivity patterns in five- and six-membered heterocycles.
4. Explain the structural features, stereochemistry, and reactivity of carbohydrates.
5. Classify and synthesize amino acids and explain their biochemical behaviour.

**III. SYLLABUS:**

**UNIT-1: AMINES (9 h)**

Classification and Basicity of amines, Preparation- Gabriel synthesis and reduction of amides. Distinction between Primary, secondary and tertiary amines using Hinsberg's method. Hoffmann's exhaustive methylation with mechanism, Hoffmann and Cope elimination with mechanism.

Diazonium Salts: Preparation and synthetic applications of diazonium salts. Preparation of azo dyes.

**UNIT-2: NITRO HYDROCARBONS**

**(9 h)**

Classification, Tautomerism of nitroalkanes leading to acid and keto form, Preparation of Nitroalkanes-from alkyl halides, oxidation of amines and oximes, Reactivity - halogenation, nitration, reaction with HONO, Nef reaction and Mannich reaction.

**UNIT-3: HETEROCYCLIC COMPOUNDS**

**(9 h)**

Classification and nomenclature of heterocyclic compounds with one hetero atom,

**Pyrrole, Furan, and Thiophene:** Aromatic character, Preparation from 1,4-dicarbonyl compounds (Paul-Knorr synthesis). Electrophilic substitution reactions-Halogenation, Nitration, Sulphonation, Acylation and Formylation, Diels-Alder reaction in furan.

**Pyridine:** Basicity, Aromaticity, Synthesis from acetylene, Chichibabin Reaction.

#### **UNIT-4: CARBOHYDRATES**

**(9 h)**

Structural elucidation of glucose and fructose, epimers and anomers, mutarotation, Haworth projections and conformational structures of glucose and fructose, Interconversions of aldoses and ketoses: Killiani-Fischer synthesis, Ruff degradation.

#### **UNIT- 5: 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. Synthesis of amino acids-Strecker's synthesis and Gabriel-Phthalimide synthesis. Zwitter ion structure, Iso-electric point, Peptide bond.

#### **IV. REFERENCES:**

1. R.N. Morrison, R.N. Boyd, Organic Chemistry, Pearson Education, 7th edition, 2010.
2. P.Y. Bruice, Organic Chemistry, 8th Edition, Pearson, 2017.
3. V.K. Ahluwalia, P. Bhagat, R. Aggarwal, R. Chandra, Intermediate for Organic Synthesis, I.K. International. 2005.
4. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry, Springer, 2008.
5. T.L. Gilchrist, Heterocyclic Chemistry, Pearson Education, 1997.
6. I.L. Finar, Organic Chemistry, Vols. 1 & 2, Pearson Education, 2002.
7. O.P. Agarwal, Chemistry of Organic Natural Products, Vols. 1&2, Goel Pubs, 2015.

#### **V. PROPOSED ACTIVITIES:**

1. Group debate on tautomerism and worksheets on named reactions.
2. Create Haworth projection models using paper/polystyrene.
3. Worksheet on epimer/anomer identification.

#### **VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:**

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning.
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

## SEMESTER-IV

### COURSE 8: ORGANIC CHEMISTRY -III PRACTICAL

Practical

Credits: 1

2 hrs/week

---

#### I. LEARNING OBJECTIVES:

1. To understand the principles and mechanisms involved in substitution reactions.
2. To apply laboratory safety protocols and precise techniques during organic synthesis.
3. To identify functional groups in amino acids using qualitative colour reactions such as the Ninhydrin and Xanthoproteic tests.
4. To detect simple carbohydrates by qualitative tests like Molisch's, Benedict's, Barfoed's, and Seliwanoff's tests.

#### II. COURSE OUTCOMES:

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

1. Perform acylation, benzylation and halogenation reactions.
2. Demonstrate skill in safe and accurate laboratory practices for organic compound synthesis.
3. Evaluate the differences between monosaccharides like glucose and fructose.
4. Identify functional groups in amino acids through characteristic colour reactions.

#### III. SYLLABUS:

1. Benzylation of aniline.
2. Acetylation of aniline.
3. Bromination of aniline (Synthesis of p-Bromoaniline from Aniline).
4. Identification of Functional Groups in Amino Acids by Ninhydrin test & Xanthoproteic test.
5. Qualitative tests for Glucose/Fructose-Molisch's, Benedict's, Barfoed's, and Seliwanoff's tests.
6. Estimation of Glucose by using Fehling's solution.

#### IV. REFERENCES:

1. B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, Pearson, 2012.
2. V.K. Ahluwalia, R. Aggarwal, Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press, 2004.
3. D.L. Pavia, G.M. Lampman, G.S. Kriz, R.G. Engel, Introduction to Organic Laboratory Techniques, Cengage Learning, 2014. \

#### V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**SECOND YEAR B.Sc HONOURS CHEMISTRY: MAJOR**

**SEMESTER-IV**

**COURSE -8: ORGANIC CHEMISTRY-III**

---

**TIME:3 Hrs**

**MAX MARKS: 60**

**PART-A**

Answer **All** of the following questions . Each carries **EIGHT** Marks.

5X8=40Marks

1.(a) Explain the Hinsberg's method for distinguishing primary, secondary and tertiary amines with suitable chemical equations.

(Or)

.(b) Explain the preparation of diazonium salts from primary aromatic amines and discuss their important synthetic applications.

2.(a) Explain the tautomerism of nitroalkanes leading to aci-nitro and nitro forms. Discuss the preparation of nitroalkanes with suitable examples.

(Or)

(b) Explain the Nef reaction and Mannich reaction involving nitro compounds with suitable mechanisms.

3.(a) Explain the aromatic character, and preparation of pyrrole, furan and thiophene.

(Or)

(b) Explain the basicity and aromaticity of pyridine. Discuss its preparation from acetylene and the Chichibabin reaction.

4.(a) Explain the structural elucidation of glucose. Discuss its Haworth projection.

(Or)

( b) Explain Interconversions of aldoses and ketoses.

5.(a) Define amino acids and explain their classification.

(Or)

(b)Discuss synthesis of amino acids by Strecker synthesis and Gabriel -Phthalimide synthesis

## PART-B

Answer ANY FIVE of the following questions. Each question carries FOUR marks.

5 × 4 = 20 Marks

6. Explain Gabriel phthalimide synthesis for the preparation of primary amines.
7. Write a note on the preparation and synthetic applications of azo dyes.
8. Explain the preparation of nitroalkanes from alkyl halides with a suitable example.
9. Discuss electrophilic substitution reactions of pyrrole.
10. Explain Diels–Alder reaction of furan with a suitable example.
11. Explain mutarotation.
12. What are epimers and anomers? Give suitable examples.
13. Classification of amino acids into acidic, basic, and neutral amino acids.
14. Explain the zwitterion structure and isoelectric point of amino acids.
15. What is a peptide bond? Explain its formation with a suitable example.

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(A), SRIKAKULAM**

**SEMESTER-IV**

**COURSE 9: PHYSICAL CHEMISTRY-III**

**Theory**

**Credits: 3**

**3hrs/week**

---

**I. LEARNING OBJECTIVES:**

1. To analyze ionic equilibria in aqueous solutions, including pH, buffer systems, and solubility.
2. To evaluate acid-base behaviour using various theories and apply the HSAB principle
3. To grasp fundamental thermodynamic concepts such as energy, enthalpy, and heat capacity.
4. To apply the first law of thermodynamics to chemical systems and calculate work and heat changes.
5. To explore entropy, spontaneity, and laws of thermodynamics in physical and chemical processes.

**II. COURSE OUTCOMES:**

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

1. Compare and evaluate acid-base theories and explain HSAB applications in predicting chemical reactivity.
2. Interpret concepts of pH, buffer solutions, solubility product, and ionic equilibria.
3. Apply the first law of thermodynamics to closed and open systems.
4. Calculate thermodynamic parameters (q, w, U, H) for ideal gases under various conditions.
5. Analyze entropy changes and distinguish between reversible, irreversible, spontaneous, and non-spontaneous processes.

**III. SYLLABUS:**

**UNIT - 1: ACIDS, BASES AND HSAB PRINCIPLE**

**(9 h)**

Definition of Acid and base- Arrhenius, Bronsted-Lowry, Lewis theories, the solvent system, Classification of solvents, pH, Types of salts, Salt hydrolysis. Pearson's concept, HSAB principle and its application.

**UNIT - 2: IONIC EQUILIBRIUM**

**(9 h)**

Degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. pH-scale, Buffer solutions, Henderson's equation. Common ion effect and its applications, Solubility and solubility product of sparingly soluble salts, applications of solubility product.

### **UNIT- 3: THERMODYNAMICS- I**

**(9 h)**

Intensive and extensive variables, State function and Path function, Isolated, closed and open systems, Concept of heat (q), work (w), internal energy (U), First law of thermodynamics, Enthalpy (H), Heat capacities at constant volume and pressure and their relation.

### **UNIT - 4: THERMODYNAMICS- II**

**(9 h)**

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 the enthalpy of formation-Kirchoff's equation.

### **UNIT - 5: THERMODYNAMICS- III**

**(9 h)**

Second law of thermodynamics: Different Statements of the law, Carnot cycle and its efficiency, Concept of entropy, entropy as a state function, entropy changes in reversible and irreversible processes. Entropy changes in spontaneous and equilibrium processes. Spontaneous and non-spontaneous processes, Third law of thermodynamics.

#### **IV. REFERENCES:**

1. P.W. Atkins, J.de. Paula, Atkin's Physical Chemistry Ed., 10th Edition, Oxford University Press, 2014.
2. K.L. Kapoor, A Textbook of Physical Chemistry, 3rd Edition, McGraw-Hill Education, 2015.
3. B.R. Puri, L.R. Sharma, M.S. Pathania, *Principles of Physical Chemistry*, Vishal Publishing, 2020.
4. S. Glasstone, Thermodynamics for Chemists, Ewp, 2008.
5. W.U. Malik, G.D Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, S. Chand Publishing, 1998.

#### **V. PROPOSED ACTIVITIES:**

1. pH measurement of common household items using pH paper or indicators.
2. Case study- Analyze real-life use of acids and bases, HSAB principle in metallurgy/pharmaceuticals.
3. Buffer preparation and Henderson equation calculations.
4. Debate on spontaneous vs. non-spontaneous reactions.
5. Concept map activity linking the laws of thermodynamics and entropy.

#### **VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:**

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning.
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

## SEMESTER-IV

### COURSE 9: QUALITATIVE ANALYSIS OF INORGANIC MIXTURE

Practical

Credits: 1

2 hrs/week

---

#### I. LEARNING OBJECTIVES:

1. Handle laboratory reagents and equipment safely and responsibly
2. Understand group-wise separation and detection of cationic and anionic radicals.
3. Systematically analyze inorganic salt mixtures using confirmatory chemical tests.
4. Distinguish between interfering ions and eliminate them during analysis.

#### II. COURSE OUTCOMES:

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

1. Demonstrate safe use of laboratory equipment and chemical handling.
2. Identify the presence of common anions and cations in a given salt mixture.
3. Apply group analysis techniques for systematic detection and separation.
4. Perform confirmatory tests and recognize characteristic colors, precipitates, and reactions.

#### III. SYLLABUS:

**Analysis of a mixture salt containing two anions and two cations (From two different groups):**

**Anions:** Carbonate, Sulphate, Chloride, Bromide, Acetate, Nitrate, Borate, Phosphate.

**Cations:** Lead, Copper, Iron, Aluminium, Zinc, Nickel, Manganese, Calcium, Strontium, Barium, magnesium and Ammonium.

***Minimum of five mixtures should be analyzed.***

#### IV. REFERENCES:

1. G. Svehla, Vogel's Textbook of Qualitative Inorganic Analysis, Pearson Education, 2008.
2. K. Nagaraj, S. Kamalesu, S. Lokhandwala, N.M. Parekh, Textbook of Semi-micro Inorganic Qualitative Analysis, Notion Press, 2023.
3. G. Pass, H. Sutcliffe, Practical Inorganic Chemistry. 2nd edition, John-Wiley & Sons, 2020.

#### V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**SECOND YEAR B.Sc HONOURS CHEMISTRY: MAJOR**

**SEMESTER-IV**

**COURSE -9 : PHYSICAL CHEMISTRY-III**

---

**TIME:3 Hrs**

**MAX MARKS: 60**

**PART-A**

Answer **All** of the following questions . Each carries **EIGHT** Marks. 5X8=40Marks

1. (a) Define acids and bases according to Brønsted–Lowry and Lewis theories. Explain with suitable examples.

OR

(b) Explain Pearson's Hard and Soft Acids and Bases (HSAB) principle. Discuss its applications with suitable examples.

2.(a) What is a buffer solution? Derive Henderson– equation for an acidic buffer and explain its applications.

OR

(b) Explain the solubility product . Derive the relationship between solubility and solubility product for a sparingly soluble salt and discuss its applications.

3.(a) Explain the concepts of intensive and extensive variables, state functions and path functions. Distinguish between open, closed and isolated systems.

OR

(b) State and explain the First Law of Thermodynamics. Derive the relationship between  $C_p$  and  $C_v$  for an ideal gas.

4.(a) Explain the Joule–Thomson effect and the Joule–Thomson coefficient

OR

(b). Discuss Kirchhoff's equation and its significance.

5.(a) Explain the Carnot cycle and its efficiency.

OR

(b) Define entropy and explain entropy as a state function. Discuss entropy changes in reversible and irreversible processes.

## PART-B

Answer ANY FIVE of the following questions. Each carries FOUR marks.

5 × 4 = 20 Marks

6. Explain the Arrhenius theory of acids and bases with suitable examples.
7. What are different types of salts? Explain salt hydrolysis with an example.
8. Define degree of ionization. Explain the factors affecting the degree of ionization.
9. What is the common ion effect? Give two important applications.
10. Define internal energy (U) and enthalpy (H). Write the relationship between them.
11. ) State and explain the Second Law of Thermodynamics with different statements.
12. Explain the work done during reversible isothermal expansion of an ideal gas.
13. Explain the calculation of q, w,  $\Delta U$  and  $\Delta H$  for reversible and irreversible processes
14. What is entropy? Explain entropy change in a spontaneous process.
15. Differentiate between spontaneous and non-spontaneous processes. Give suitable examples.

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(A), SRIKAKULAM**

**SEMESTER-IV**

**COURSE 10: APPLIED AND PHYSICAL CHEMISTRY**

**Theory**

**Credits: 3**

**3hrs/week**

---

**I. LEARNING OBJECTIVES:**

1. Understand polymer classification, methods of polymerization, and applications of commercial polymers.
2. Describe the fundamentals, properties, synthesis, and applications of nanomaterials.
3. Classify drugs, understand their development process, and identify their forms.
4. Apply rate laws to chemical reactions and determine kinetic parameters.
5. Analyze enzyme kinetics using rate theories and the Michaelis-Menten equation.

**II. COURSE OUTCOMES:**

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

1. Explain polymer classification and applications of commercial polymers.
2. Describe types, synthesis methods, and applications of nanomaterials.
3. Explain basic pharmaceutical concepts, including drug development and dosage forms.
4. Apply kinetic laws to analyze reaction rates and derive rate equations.
5. Evaluate the role of activation energy and enzyme catalysis in chemical reactions.

**III. SYLLABUS:**

**UNIT-1: POLYMERS**

**(9 h)**

Classification of polymers, Methods of polymerization- addition, condensation, co-polymerization. Structure and applications of some important polymers: Polythene, PVC, Nylon, Polyesters, Bakelite, Natural rubber. Biodegradable and non-biodegradable polymers-examples.

**UNIT-2: NANOMATERIALS**

**(9 h)**

Definition and classification of nanomaterials, Magnetic and mechanical properties of nanomaterials, Types of nanomaterials (metal-based, carbon-based, and polymer-based), Synthesis of nanomaterials by Top-down approach and Bottom-up approach, Applications of nanomaterials in medicine and environment.

**UNIT-3: DRUGS**

**(9 h)**

Definition of Drug and Medicine, Drug discovery-preclinical and clinical trials, Classification of drugs based on therapeutic use. Classification of dosage forms-solid, liquid, gaseous and

semisolid dosage forms, Generic and brand names of any four drugs, Introduction to Computer Aided Drug Design (CADD).

#### **UNIT - 4: CHEMICAL KINETICS-I**

**(9 h)**

The concept of reaction rates. Factors affecting reaction rates. Order and molecularity of a reaction, Derivation of integrated rate equations for zero, first and second order reactions (similar reactants). Half-life of a reaction. General methods for the determination of the order of a reaction.

#### **UNIT-5: 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. Enzyme catalysis- Specificity, factors affecting enzyme catalysis, Inhibitors and Lock & key model. Michaelis-Menten equation- derivation.

#### **IV. REFERENCES:**

1. F.W. Billmeyer, Text Book of Polymer Science, Wiley Inter Science, 2007.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing, 2020.
3. Charles P. Poole Jr, Frank J. Owens, Introduction to nanotechnology, Wiley India, 2003.
4. K.K. Choudhary, Nanoscience and Nanotechnology, Narosa Publishing, 2016.
5. G. Patrick, Introduction to Medicinal Chemistry, Oxford University Press, 2017.
6. H. Singh, V.K. Kapoor, Medicinal & Pharmaceutical Chemistry, Vallabh Prakashan, 1996.
7. P.W. Atkins, J.de. Paula, Atkin's Physical Chemistry, Oxford University Press, 2014.
8. Gurudeep Raj, Advanced physical chemistry, Krishna Prakashan Media, 2016.

#### **V. PROPOSED ACTIVITIES:**

1. Industrial Visit: Visit to a plastic or rubber manufacturing plant
2. Seminar or case study on nanomedicine or nanofiltration
3. Solve numerical problems on half-life, Arrhenius equation, rate laws.

#### **VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:**

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

## SEMESTER-IV

### COURSE 10: APPLIED AND PHYSICAL CHEMISTRY PRACTICAL

Practical

Credits: 1

2 hrs/week

---

#### I. LEARNING OBJECTIVES:

1. To develop practical skills in measuring the rate of chemical reactions and understanding factors affecting reaction rates.
2. To introduce students to basic nanomaterial synthesis with a focus on zinc oxide nanoparticles.
3. To develop an understanding of pharmaceutical terminology and differentiate between generic and brand names of common drugs.

#### II. COURSE OUTCOMES:

1. Evaluate the influence of concentration on the rate of a chemical reaction experimentally.
2. Analyze temperature dependence on reaction rate and interpret kinetic data.
3. Compare the strengths of different acids based on kinetic measurements in ester hydrolysis.
4. Synthesize zinc oxide nanoparticles and understand their significance in modern chemistry and nanotechnology.
5. Identify and categorize commonly used drugs by comparing their generic and brand names.

#### III. SYLLABUS:

1. Determination of the rate constant of acidic hydrolysis of an ester.
2. Study the effect of concentration on the rate of reaction between sodium thiosulphate and hydrochloric acid.
3. Study the effect of temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid.
4. Comparison of the strengths of HCl and H<sub>2</sub>SO<sub>4</sub> by studying the kinetics of hydrolysis of methyl acetate.
5. Preparation of Zinc oxide nano particles.
6. Prepare a chart of 10 commonly used drugs with their generic and brand names and therapeutic classification.

#### IV. REFERENCES:

1. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing, 2020.
2. P.W. Atkins, J.de. Paula, Atkin's Physical Chemistry, Oxford University Press, 2014.
3. K.K. Choudhary, Nanoscience and Nanotechnology, Narosa Publishing, 2016..
4. Tripathi, K. D. Essentials of Medical Pharmacology (9th ed.). Jaypee Brothers Medical Publishers, 2021.

#### V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**SECOND YEAR B.Sc HONOURS CHEMISTRY: MAJOR**

**SEMESTER-IV**

**COURSE -10: APPLIED AND PHYSICAL CHEMISTRY**

---

**TIME:3 Hrs**

**MAX MARKS: 60**

**PART-A**

Answer **All** of the following questions . Each carries **EIGHT** Marks.

5X8=40Marks

- 1) a) Explain about the Classification of Polymers.  
Or  
b) Discuss about the structure and applications of the following.  
1)PVC 2)Bakelite 3)Polyester
- 2) a) Explain the synthesis of nanomaterials.  
Or  
b) Define Nanomaterials and write the classification of it.
- 3) a) Explain the classification of drugs based on therapeutic use.  
Or  
b) Explain the Computer Aided Drug Design .
- 4) a) Explain the determination methods of order of a reaction.  
Or  
b) Derive the rate of reaction for first order reaction.
- 5) a) Derive the Michaels – Menten Equation write it's significance.  
Or  
b) Derive the Arrhenius equation to calculate Activation energy.

**PART-B**

Answer any FIVE questions .Each question carries 4 marks.

5 x 4 =20 Marks

- 6) Write about condensation polymerization.
- 7) Write about Biodegradable and non-biodegradable polymers.
- 8) Write a note on types of nanomaterials.
- 9) Write the applications of nanomaterials.
- 10) Explain about the Drug discovery.
- 11) Write Generic and brand names of any four drugs .
- 12) Write a note on effecting factors of rate of reaction..
- 13) Derive the zero order rate equation.
- 14) Explain Lock and Key model.
- 15) Discuss the importance of iron,cobalt,zinc in biological system.

**GOVERNMENT DEGREE COLLEGE FOR WOMEN(A), SRIKAKULAM**

**SEMESTER-IV ( CHEMISTRY MINOR)**

**COURSE 2: ORGANIC CHEMISTRY**

**Theory**

**Credits: 3**

**3hrs/week**

**I. LEARNING OBJECTIVES:**

1. To understand the structural theory behind reactivity in organic chemistry.
2. To classify hydrocarbons and understand the preparation and reactions of alkenes and alkynes.
3. To explain aromaticity and interpret mechanisms of key organic reactions.
4. To explore the structure, preparation, and substitution reactions of benzene.
5. To understand the structure, reactivity, and mechanisms of halogenated organic compounds, alcohols and phenols

**II. COURSE OUTCOMES:**

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

1. Study Inductive effect, Mesomeric effect, hyperconjugation and its applications.
2. Explain the preparation and chemical properties of alkenes, alkynes and benzene.
3. Analyze and apply Huckel's rule to benzenoid and non-benzenoid aromatic compounds.
4. Analyze the reactivity and reaction mechanisms of alkyl halides, alcohols and phenols.
5. Differentiate between Markownikoff and Antimarkownikoff addition, SN1 and SN2 mechanisms.

**III. SYLLABUS:**

**UNIT-1: STRUCTURAL THEORY IN ORGANIC CHEMISTRY**

**(9 h)**

Functional groups in organic chemistry, Types of bond fission, Electrophiles, Nucleophiles, Reactive intermediates-carbocations, carbanions & free radicals. Inductive effect and its application: (a) Basicity of amines and (b) Acidity of carboxylic acids, Resonance or Mesomeric effect and its application: (a) Acidity of phenol, and (b) Acidity of carboxylic acids. Hyper conjugation and its application to the stability of carbonium ions.

**UNIT-2: UNSATURATED HYDROCARBONS (ALKENES &ALKYNES)**

**(9 h)**

**Alkenes:** Preparation of alkenes by dehydration of alcohols, Saytzeff and Hofmann eliminations, Electrophilic Additions of X<sub>2</sub>, H<sub>2</sub>O, HX to alkene, Markownikoff and Anti-markownikoff addition, Ozonolysis, Diels-Alder reaction, 1,2- and 1,4-addition reactions in conjugated dienes.

**Alkynes:** Additions of X<sub>2</sub>, H<sub>2</sub>O, HX to alkynes, acidity and alkylation of terminal alkynes

**UNIT-3: BENZENE AND ITS REACTIVITY (9 h)**

Structure of Benzene, Preparation: polymerisation of acetylene and decarboxylation, Properties: Electrophilic aromatic substitution- Halogenation, Nitration, Friedel-Craft's alkylation and Friedel- Craft's acylation.

#### UNIT-4: AROMATICITY AND ALKYL HALIDES

(9h)

**Aromaticity:** Concept of aromaticity, Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non-Benzenoid compounds (cyclo propenyl cation, cyclopentadienyl anion and tropylium cation).

**Alkyl halides:** Nucleophilic substitution reactions – SN1 and SN2 mechanisms with energy profile diagrams, Comparison of SN1 and SN2 reactions

#### UNIT-5: ALCOHOLS AND PHENOLS

(9 h)

**Alcohols:** Preparation of 1o,2o,3o-alcohols from Grignard's reagent, Chemical properties: substitution of –OH by using PCl5, PCl3, SOCl2 and HX / ZnCl2, Oxidation of alcohols with PCC and PDC, Pinacol-Pinacolone rearrangement with mechanism.

**Phenols:** Preparation from diazonium salt, Reimer-Tiemann and Kolbe–Schmidt reaction with mechanism.

#### IV. REFERENCES:

1. R.N. Morrison, R.N. Boyd, Organic Chemistry, Pearson Education, 7th edition, 2010.
2. Peter Sykes, Guidebook to Mechanism in Organic Chemistry, 6th edition, 1985.
3. S.P. Singh, O. Prakash, Reaction mechanism in organic chemistry, Laxmi Publications, 2017.
4. P.Y. Bruice, Organic Chemistry, 8th Edition, Pearson, 2017.
5. V.K. Ahluwalia, P. Bhagat, R. Aggarwal, R. Chandra, Intermediate for Organic Synthesis I.K. International. 2005.
6. T.W.G. Solomons, C.B. Fryhle, S.A. Snyder, Organic Chemistry, 12th Edition, Wiley, 2016.

#### V. PROPOSED ACTIVITIES:

1. Mechanism writing exercises-Electrophilic aromatic substitution, electrophilic additions.
2. Group quiz on aromaticity and reactive intermediates.
3. Concept mapping-Properties of alkane, alkene, alkyne, benzene.

#### VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

## SEMESTER-IV (MINOR)

### COURSE 2: ORGANIC QUALITATIVE ANALYSIS

Practical

Credits: 1

2 hrs/week

---

#### I. LEARNING OBJECTIVES:

1. To identify functional groups in unknown organic compounds using systematic analysis.
2. To determine the physical constants of organic compounds accurately.
3. To prepare suitable solid derivatives to confirm the presence of functional groups.
4. To apply laboratory safety protocols and precise techniques during analysis.

#### II. COURSE OUTCOMES:

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

1. Proper use of glassware, equipment and chemicals in the laboratory.
2. Systematically analyze unknown organic compounds to identify functional groups.
3. Determine melting point or boiling point of organic compounds to assess purity.
4. Prepare derivatives for confirmation of functional groups.

#### III. SYLLABUS:

Systematic Qualitative Analysis of an organic compounds for functional group identification including the determination of melting point and boiling point with suitable derivatives: ***Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic primary amines, amides and simple sugars.***

#### IV. REFERENCES:

1. F.G. Mann, B.C. Saunders, Practical Organic Chemistry, Pearson Education, 2009.
2. B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, Pearson, 2012.
3. V.K. Ahluwalia, R. Aggarwal, (2004) ,Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press, 2004
4. V.K. Ahluwalia, S. Dhingra, (2004), Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press, 2004.

#### V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce.

GOVERNMENT DEGREE COLLEGE FOR WOMEN(AUTONOMOUS), SRIKAKULAM

MODEL PAPER

SECOND YEAR B.Sc HONOURS CHEMISTRY: MINOR

SEMESTER-IV

COURSE -2 : ORGANIC CHEMISTRY

---

TIME:3 Hrs

MAX MARKS: 60

**PART-A**

Answer **All** of the following questions . Each carries **EIGHT** Marks.

5X8=40Marks

1. What is inductive effect? Give its applications  
(Or )  
What is Hyperconjugation? Give its applications.
2. What is Markovnikov's rule? Explain with suitable examples.  
( Or )  
Explain Saytzeff's rule with an example.
3. Give the mechanism for Nitration and Halogenation of Benzene.  
(Or )  
Write the orientations of Nitro and halo functional groups.
4. Explain Aromaticity and What are Benzenoid and non-Benzenoid compounds? Give examples.  
(Or )  
Explain SN1 and SN2 Reactions with suitable mechanisms.
5. Write the reaction mechanism of the pinacol-pinacolone rearrangement with suitable examples.  
( Or )  
Write about preparation of 1<sup>o</sup>, 2<sup>o</sup>, 3<sup>o</sup> alcohols from Grignard reagent .

**PART-B**

Answer **ANY FIVE** of the following questions. Each carries **FOUR** marks

5 × 4 = 20Marks

6. what are Bond fission? Give it's types?
7. Explain the Acidity of phenol.
8. Write the preparation methods of Alkenes.
9. Diels-Alder reaction with examples.
10. Give two preparation methods of benzene.
11. Write a note on ortho, para, meta orientation groups.
12. What is Hückel's rule? With suitable examples .
13. Describe the classification of Alcohols
14. Explain Reimer-Tiemer reaction with mechanism.
- 15 Write the preparation of phenol from Diazonium salts.

**DEPARTMENT OF CHEMISTRY**  
**GOVERNMENT DEGREE COLLEGE FOR (W) (A), SRIKAKULAM**

**V- SEMESTER**

**Course 12 B : Environmental Chemistry**  
**Credits: 03**

**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
- 3) ecosystems services.
- 4) Engage in simple and advanced analytical tools used to measure the different types of pollution.
- 5) Explain the energy crisis and different aspects of sustainability.
- 6) Analyze key ethical challenges concerning biodiversity and understand the moral principles, goals
- 7) and virtues important for guiding decisions that affect Earth's plant and animal life.

**II Syllabus**

**UNIT-I**

**Environmental chemistry**

**9h**

Definition – Concept of Environmental chemistry-Scope and importance of environment in now a days – 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 Hydrological cycle.

**UNIT-II**

**Air Pollution**

**9h**

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 – Green house effect – Formation and depletion of ozone – Bhopal gas disaster-Instrumental techniques to monitor pollution – Controlling methods of air pollution.

**UNIT-III**

**Water pollution**

**9h**

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**

**9h**

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 Ecosystem :**

#### **Concepts–structure–Functions and types of ecosystem**

**9h**

Abiotic and biotic components – Energy flow and Energy dynamics of ecosystem– Food chains – Food web– Tropic levels– Biogeochemical cycles (carbon, nitrogen and phosphorus) Bio diversity: Definition – level and types of biodiversity – concept- significance – magnitude and distribution of biodiversity– trends-biogeographical classification of india – biodiversity at national, global and regional level.

#### **Suggested Co-Curricular Activities:**

- 1) Training of students by related industrial experts.
- 2) Assignments, Seminars, Group discussions, Debates and Quiz(on related topics).
- 3) Visits to laboratories, firms, research organizations etc.
- 4) Invited lectures and presentations on related topics by field/industrial experts.
- 5) Preparation of videos on tools, techniques on selected topics.

#### **I. List of Reference books:**

1. Fundamentals of ecology by M.C.Dash
2. A Text book of Environmental chemistry byW. 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, SM Khopkar ( IIT Bombay )
7. Environmental Chemistry by BK Sharma & H Kaur, Goel publishing house.
8. Fundamentals of Environmental Chemistry, Manahan, Stanley. E
9. Applications of Environmental Chemistry, Eugene R. Wiener
10. Web related references suggested by teacher.

**DEPARTMENT OF CHEMISTRY**  
**GOVERNMENT DEGREE COLLEGE FOR (W) (A), SRIKAKULAM**

**V- SEMESTER**

**Course 12 B : Environmental Chemistry**

**Credits: 01**

**Learning Outcomes:**

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

1. List out, Identify and handle various equipment in Chemistry lab.
2. Learn the procedures of preparation of standard solutions.
3. Demonstrate skills in operating instruments.
4. Acquire skills in handling spectrophotometer.
5. Analyze water and soil samples.

**Laboratory course**

**Syllabus:**

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 pHmetry.

**Suggested Co-Curricular Activities:**

Mandatory:(Lab /field training of students by teacher:(lab:10+field:05):

- 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 Field work / project work Report:05.
- 4) Suggested Format for Fieldwork/project work: Title page, student details, index page, details of place visited, observations, findings and acknowledgements.
- 5) Unit tests (IE).

**II. 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, SM Khopkar ( IIT Bombay )
4. Web related references suggested by teacher.

**DEPARTMENT OF CHEMISTRY**  
**GOVERNMENT DEGREE COLLEGE FOR (W) (A), SRIKAKULAM**

**V - SEMESTER**

**Course 13 B Green Chemistry and Nanotechnology.**

**Credits: 03**

**I. 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**

**UNIT-I**

**Green Chemistry: I**

**9hrs**

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 sono chemical reactions (Heck, Hunsdiecker and Wittig reactions).

**UNIT- II**

**Green Chemistry :**

**9hrs**

Part- II A) Selection of solvent: i) Aqueous phase reactions ii) Reactions in ionic liquids, Heck reaction, Suzuki reactions, epoxidation. iii) Solid supported synthesis.

B) Supercritical CO<sub>2</sub>: Preparation, properties and applications, (decaffeination, drycleaning)  
C) Green energy and sustainability.

### **UNIT-III**

#### **Microwave and Ultrasound assisted green synthesis:**

**9hrs**

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

### **UNIT-IV**

#### **Green catalysis and Green synthesis**

**9hrs**

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 imino diacetate (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)

### **UNIT – V**

#### **Nanotechnology in Green chemistry**

**9hrs**

Basic concepts of Nanoscience and Nanotechnology – Bottom-up approach and Top down approaches with examples – Synthesis of Nano materials – Classification of Nanomaterials – Properties and Application of Nanomaterials. 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. Suggested Co-Curricular Activities:**

- 1) Training of students by related industrial experts.
- 2) Assignments, Seminars, Group discussions, Debates and Quiz(on related topics).
- 3) Visits to laboratories, firms, research organizations etc.
- 4) Invited lectures and presentations on related topics by field/industrial experts.
- 5) Preparation of videos on tools, techniques and applications of Green chemistry and Nanosynthesis.

#### **IV. List of 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)
5. Principles and practice of heterogeneous catalysis, Thomas J.M., Thomas M.J., John Wiley
6. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.M Srivastava, Narosa Publications
7. Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, CRC Press (2008).
8. Green Processes for Nanotechnology: From Inorganic to Bioinspired Nanomaterials, Vladimir A. Basiuk, Elena V. Basiuk Springer (2015)
9. Web related references suggested by teacher.

**DEPARTMENT OF CHEMISTRY**  
**GOVERNMENT DEGREE COLLEGE FOR (W) (A), SRIKAKULAM**

**V- SEMESTER**

**Course 13 B Green Chemistry and Nanotechnology**

**Credits: 01**

**V. Learning 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.

**VI. Laboratory course**

**Syllabus:**

1. Identification of various equipment in the laboratory.
2. Acetylation of 10 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. Photoreduction of Benzophenone to Benzopinacol in the presence of sunlight.

## **VII. Suggested Co-Curricular Activities:**

Mandatory:(Lab /field training of students by teacher:(lab:10+field:05):

- 1) For Teacher: Training of students by the teacher in the classroom or in the laboratory for not less than 15 hours on field related quantitative techniques for Enzymatic catalysis, Microwave assisted organic synthesis, Biodiesel preparation etc
- 2) For Student: Student shall visit a related industry / chemistry laboratory in universities / research organizations/private sector facility and observe various methods used for the analysis of water. Write their observations and submit a hand written fieldwork /project work report not exceeding10pages in the given format to the teacher.
- 3) Max marks for Field work / project work Report:05.
- 4) Suggested Format for Fieldwork/project work: Title page, student details, index page, details of place visited, observations, findings and acknowledgements.
- 5) Unit tests (IE).

## **VIII. List of 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)
- 5) Web related references suggested by teacher.

**DEPARTMENT OF CHEMISTRY**  
**GOVERNMENT DEGREE COLLEGE FOR (W) (A), SRIKAKULAM**

**V – SEMESTER**

**Course 14 B: Industrial Chemistry- Fertilizers and Surface coatings**

**Credits: 03**

**I. Learning Outcomes:**

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

- 1) Identify the importance of different surface coatings.
- 2) Acquire a critical knowledge on manufacture of ceramics and cement.
- 3) Understand various steps in the manufacture of cane sugar.
- 4) Explain the manufacture of pulp and paper.

**II. Syllabus:**

**Unit-1: Fertilizers**

**9 hours**

A brief introduction to industrial chemistry. Different types of fertilizers. Manufacture of the following fertilizers :Urea, Ammonium nitrate, Calcium ammonium nitrate, Ammoniumphosphates; Polyphosphate, Superphosphate, Compound and mixed fertilizers.

**Unit-2: Silicates**

**9 hours**

Ceramics: Important clays and Feldspar. Ceramics - types, uses and manufacture. High technology ceramics and their applications. Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

**Unit-3 : Surface Coatings**

**9 hours**

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments - formulation, composition and related properties. Oil paint ,modified oils, Pigments, toners and lake pigments, fillers, thinners, enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Water and Oil paints.

**Unit-4: Sugar Chemistry****9hours**

Introduction – Manufacture and recovery of cane sugar from molasses, manufacture of sucrose from beet root, testing and estimation of sucrose.

**Unit-5: Paper Industry****9 hours**

Pulp and Paper-Introduction, Manufacture of pulp, sulphate or Kraft pulp, soda pulp, sulphite pulp, rag pulp, beating, refining, filling, sizing and colouring of pulp, manufacture of paper.

**III. Suggested Co – Curricular Activities:**

Training of students by related industrial experts. Assignments, Seminars, debates , discussions and Quiz(on related topics). Visits to industries, firms, research organizations etc. Invited lectures and presentations on related topics by field/industrial experts. Preparation of PPTS and videos.

**List of Reference books:**

- 1) J.A.Kent : Riegel's Hand book of Industrial Chemistry, CBS Publishers, New Delhi.
- 2) P.C.Jain, M.Jain : Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
- 3) R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
- 4) B.K.Sharma: Engineering Chemistry,Goel Publishing House,Meerut
- 5) O. P. Vermani, A. K. Narula: Industrial Chemistry, Galgotia Publications Pvt. Ltd., New Delhi.

**DEPARTMENT OF CHEMISTRY**  
**GOVERNMENT DEGREE COLLEGE FOR (W) (A), SRIKAKULAM**

**V - SEMESTER**

**Course - 14-B Industrial Chemistry- Fertilizers and Surface coatings**

**Credits: 01**

**V. Learning Outcomes:**

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

- 1) Determine free acidity in ammonium sulphate fertilizer.
- 2) Learn the procedure for the Estimation of Calcium in Calcium ammonium nitrate fertilizer.
- 3) Demonstrate skills on Estimation of phosphoric acid in superphosphate fertilizer.
- 4) Acquire skills in using colorimeter for the estimation of sucrose.

**VI. Laboratory course Syllabus:**

- 1) determination of free acidity in ammonium sulphate fertilizer.
- 2) Estimation of Calcium in Calcium ammonium nitrate fertilizer.
- 3) Estimation of phosphoric acid in superphosphate fertilizer.
- 4) Estimation of sucrose by colorimetry.

**VII. Suggested Co-Curricular Activities:**

Mandatory:(Lab / field training of students by teacher :(lab:10+field:05):

1) For Teacher: Training of students by the teacher in laboratory and field for not less than 15hours on field related skills in determination of free acidity, estimation of calcium and phosphoric acid in a fertilizer, use of colorimeter to estimate sucrose.

2) For Student :Student shall visit a related industry /chemistry laboratory in universities/research organizations/private sector facility and observe the surface coatings of surfaces used to prevent the corrosion. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

3) Max marks for Field work/ project work Report:05.

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

5) Unit tests(IE).

#### **VIII. List of Reference books:**

1) Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.

2) Text book on Experiments and Calculations in Engineering Chemistry, S.S.Dara, S.Chand.

3) R.Gopalan, D.Venkappayya, S.Nagarajan: Engineering Chemistry,Vikas Publications.

4) B.K.Sharma: Engineering Chemistry, Goel Publishing House, Meerut

**DEPARTMENT OF CHEMISTRY**

**GOVERNMENT DEGREE COLLEGE FOR (W) (A), SRIKAKULAM**

**Course 15 B : Industrial Chemistry- Polymers and water analysis**

**Credits: 03**

**I. Learning Outcomes:**

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

- 1) Understand the basic concepts of polymers
- 2) Acquire a critical knowledge on the preparation and applications of organic polymers.
- 3) Explain the sources of air pollution.
- 4) Demonstrate the analysis of water quality parameters.
- 5) Identify the importance of industrial waste management.

**II. Syllabus:**

**Unit-1: Organic Polymers-1 9 hours**

Basic definitions, degree of polymerization, classification of polymers-Natural and Synthetic polymers, Organic and Inorganic polymers, Thermo plastic and Thermosetting polymers, Plastics, Elastomers, Fibers and Resins, Linear, Branched and Cross-Linked polymers.

**Unit-2: Organic Polymers-2 9 hours**

Addition polymers and Condensation polymers, mechanism of polymerization- Free radical, ionic and Zeigler-Natta polymerization. Industrial manufacturing and applications of following polymers, Polystyrene, Poly acrylo nitrile, Poly methacrylate, Polymethyl- methacrylate.

**Unit-3: Air Pollution 9 hours**

Sources of air pollution, acid rain, photochemical smog, Greenhouse effect, Formation and depletion of ozone, sources and effects of various gaseous pollutants: NO<sub>x</sub>, SO<sub>x</sub>, SPM, CO, hydrocarbons, controlling methods of air pollution.

**Unit-4 Analysis of water 9hours**

Determination of total hardness of water, Dissolved oxygen, BOD, COD, total dissolved solids, turbidity, alkalinity, determination of chloride using Mohr's method.

## **Unit-5 : Industrial Waste Management 9 hours**

Waste water treatment - primary, secondary & tertiary treatment. (All treatment methods in detail). Characteristics of solid wastes, methods of solid waste treatment and disposal, microbiology involved in solid waste disposal, methods of solid waste disposal-composting, sanitary and filling - economic, aesthetic and environmental problems.

### **III. Suggested Co- Curricular Activities**

- 1) Training of students by related industrial experts.
- 2) Assignments, Seminars, discussions and Quiz(on related topics).
- 3) Visits to laboratories, firms, research organizations etc.
- 4) Invited lectures and presentations on related topics by field / industrial experts.

### **IV. List of Reference books :**

- 1) E.Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK
- 2) J.A.Kent : Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- 3) P.C.Jain, M.Jain : Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
- 4) R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
- 5) B.K.Sharma : Engineering Chemistry, Goel Publishing House, Meerut
- 6) O.P.Verma, A.K.Narula: Industrial Chemistry, Galgotia Publications Pvt. Ltd., New Delhi.
- 7) A.K.De, Environmental Chemistry : NewAgeInternational Pvt, Ltd, NewDelhi.
- 8) C.k.Varshney:Water Pollution and Management,Wiley Eastern Limited, Chennai.
- 9) S.S. Dara and D.D. Mishra: Text book of Environmental Chemistry and Pollution Control, Revised edition, S.C.Hand & CoLtd.

**DEPARTMENT OF CHEMISTRY**  
**GOVERNMENT DEGREE COLLEGE FOR (W) (A), SRIKAKULAM**

**V -SEMESTER**

**Course – 15- B Industrial Chemistry- Polymers and water analysis**

**Credits: 01**

**V. Learning Outcomes:**

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

- 1) Learn the procedures for the determination of BOD and COD.
- 2) Demonstrate skills in the determination of chloride in the given water sample.
- 3) Acquire skills in determining the hardness of water.
- 4) Analyse the soil samples
- 5) Handle pHmeter.

**VI. Laboratory course Syllabus:**

- 1) Determination of Hardness of water by EDTA titration.
- 2) Determination of Chemical Oxygen Demand(COD)
- 3) Determination of Biological Oxygen Demand(BOD)
- 4) Determination of chloride using Mohr's method.
- 5) Determination of pH, turbidity and total solids in water sample.
- 6) Determination of  $\text{Ca}^{+2}$  and  $\text{Mg}^{+2}$  in soil sample by flame photometry.
- 7) Determination of pH in soil samples using pHmetry.

**VII. Suggested Co-curricular activities**

Mandatory:(Student training by teacher in field related skills:inlab:15,in field:05hours):

- 1) For Teacher: Training of students by the teacher in laboratory and field for not less than 15 hours on the field related skills in the determination of hardness of water, estimation of COD and BOD in water sample, determination of chloride ion in water sample.

2) For Student: Student shall visit a related industry /chemistry laboratory in universities/research organizations /private sector facility and observe the measurement of water quality parameters. Write their observations and submit a hand written field work / project work report not exceeding 10 pages in the given format to the teacher.

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

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

5) Unit tests (IE).

### **VIII. List of Reference books :**

1) Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.

2) Text book on Experiments and Calculations in Engineering Chemistry, S.S.Dara, S.Chand.

Note-1: For SEMESTER –VII & VIII, for the domain subject Chemistry, Three Core courses and Two Skill Enhanced Courses shall be chosen course A or B from the list of Courses in each SEMESTER. Three pairs of Core Courses are 16A&16B, 17A&17B, 18A&18B for Sem- VII and 21A & 21 B, 22 A & 22 B and 23 A & 23 B in Sem-VIII.

Two Pairs of Skill Enhanced Courses are 19A&19B, 20A&20 B for Sem-VII and 24A & 24 B, 25A&25 B from Sem- VIII

One Online Course chosen from Swayam/NPTEL/Any other courses recognized by universities per SEMESTER -VII and VIII.

Note-2: One of the main objectives of Skill Enhancement Courses (SEC) is to inculcate skills related to the domain subject in students. The syllabus of SEC will be partially skill oriented. Hence, teachers shall also impart practical training to students on the skills embedded in syllabus citing related real field situations.

**GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**THIRD YEAR B. Sc HONOURS CHEMISTRY: MAJOR**

**SEMESTER-V**

**COURSE -12B ENVIRONMENTAL CHEMISTRY**

**Time: 3 hrs**

**Maximum Marks: 60M**

**PART-A**

Answer ALL the questions. Each carries **EIGHT** Marks

**5X8=40 Marks**

1. (a) Explain the scope and importance of Environment now-a days.

(OR)

- (b) Explain about thermal power and atomic energy.

2. (a) Explain about Acid rain and photochemical smog . Write its impact.

(OR)

- (b) Explain the formation and depletion of ozone layer.

3. (a) What is eutrophication and explain its effects.

(OR)

- (b) Write about industrial waste water treatment.

4. (a) Describe the toxic effects of lead and mercury.

(OR)

- (b) Write about solid waste management and its impacts.

5. (a) Outline the functions and types of Eco system.

(OR)

- (b) What is biochemical cycle and explain about carbon cycle.

**PART-B**

Answer any **FIVE** of the following. Each Question carries **FOUR** Marks.

**5X4=20M**

- 6 Explain the terms with examples. (a) Pollutant (b) contaminant
- 7 Explain about Nuclear fission and Nuclear fusion.
- 8 Write a short note on Acid rains.
- 9 Write briefly about Green house effect.
- 10 What are COD and BOD. .
- 11 Explain the conversion of temporary hard water to soft water.
- 12 Explain the toxic effects of Cyanide.
- 13 Explain the toxicity of Arsenic.
- 14 Give in detail about food chains.
- 15 What are biotic and abiotic compounds.

**GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**THIRD YEAR B. Sc HONOURS CHEMISTRY: MAJOR**

**SEMESTER-V**

**COURSE -13B GREEN CHEMISTRY AND NANOTECHNOLOGY**

**Time: 3 hrs**

**Maximum Marks: 60M**

**PART -A**

Answer **ALL** Questions. Each Question carries **EIGHT** Marks .

**5X8=40M**

1. (a) Write briefly about the basic principles of Green chemistry.

(OR)

(b) Explain (i) Atom economy and give examples.

(ii) Two Examples of Green synthesis.

2. (a) Discuss the Aqueous phase reaction .

(OR)

(b) Discuss in detail about Green energy and Sustainability.

3. (a) Discuss the Advantages and disadvantages of MAOS.

(OR)

(b) Discuss any two reactions of Ultrasound assisted Green synthesis.

4. (a) .Illustrate any two reactions of microwave Assisted synthesis in Water.

(OR)

(b) Give the Green synthesis of Adipic acid , catechol Disodium imino diacetate.

5. (a) Discuss the classifications and applications of Nano materials.

(OR)

(b) Give the chemical synthesis of Nano materials.

(a). Solgel Method      (b). Precipitation Method.

### **PART-B**

Answer any **FIVE** of the following. Each Question carries **FOUR** Marks.      **5X4=20M**

- 6 .Write a short note on goals of Green chemistry.
7. What is the Need of Green chemistry.
- 8 .Describe the Applications of super critical CO<sub>2</sub> in Green chemistry.
- 9 .How do you select a solvent in Green synthesis.
- 10 Explain Microwave Technology of conventional heating and Microwave heating .
- 11 .Explain Ultrasound Assisted Strecker's Synthesis.
12. What is Zeolites give its Applications.
- 13 Define Bio catalysis and Mention its Applications.
- 14 Write about physical and chemical properties of Nanomaterials.
- 15 Explain co- precipitation method

**GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**THIRD YEAR B. Sc HONOURS CHEMISTRY: MAJOR**

**SEMESTER-V**

**COURSE -14B INDUSTRIAL CHEMISTRY – FERTILIZERS AND SURFACE COATINGS**

**Time: 3 hrs**

**Maximum Marks: 60M**

**PART-A**

Answer ALL the questions. Each carries **EIGHT** Marks

**5X8=40 Mark**

1. (a). Explain Manufacture of Ammonium phosphate and Polyphosphate.

(Or)

- (b). Explain (i) Manufacture of Superphosphate

(ii) Manufacture of Ammonium Nitrate.

2. (a). Explain the Manufacture of Ceramics and Cement .

(Or)

- (b). Explain the Manufacture of cement and its Setting process.

3. (a). Explain the Following (i) Oil paint (ii) Modified oils (iii) Pigments (iv) Filters.

(Or)

- (b). Explain about special paints and Surface coatings.

4. (a). Write about the testing and Estimation process of Sucrose .

(Or)

- ( b). Explain the Manufacture of Sucrose from Beetroot.

5. (a). Explain the Manufacture of Sulphate (or) Kraft pulp.

(Or)

- (b). Explain the Following

(i) Filling and its Importance      (ii) Colouring of pulp      (iii) Sizing in paper Making

### **PART -B**

Answer any **FIVE** questions . Each carries **FOUR** Marks

**5X4=20Marks**

6. Write about the Types of Fertilizers
7. . Explain the Compound and Mixed Fertilizers .
8. .Explain High – Technology Ceramics and Their applications .
9. What are Clays and their types of Clays.
10. Write about Coating Surfaces.
11. Explain about the Pigments .
12. Explain the Biological Importance of sugars.
13. Write about Manufacture of Sugarcane.
14. Write the Importance of Paper Industry.
15. Write the Manufacture of Soda pulp.

**GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS), SRIKAKULAM**

**MODEL PAPER**

**THIRD YEAR B. Sc HONOURS CHEMISTRY: MAJOR**

**SEMESTER-V**

**COURSE -14B INDUSTRIAL CHEMISTRY – POLYMERS AND WATER ANALYSIS**

**Time: 3 hrs**

**Maximum Marks: 60M**

---

**PART-A**

Answer ALL the questions. Each carries **EIGHT** Marks

**5X8=40 Mark**

1. (a). Explain the classification of Polymers .

(Or)

- (b). Explain (i) Fiber and Resins

(ii) Addition Polymerization.

2. (a). Explain the Mechanism of Cationic and Anionic Polymerization.

(Or)

- (b). Explain the Mechanism of Zeigler- Natta Polymerization , Addition polymerization.

3. (a). Explain about the Formation and Depletion of Ozone Layer.

(Or)

- (b). Explain about Green House effect and its causes .

4. (a). Write about the DO, COD, BOD .

(Or)

- (b). Explain the Determination of Chloride by Mohr's Method.

5. (a). Explain the Primary, Secondary, Tertiary treatment of Waste Water Management .

(Or)

- (b). Explain the Following

(i) Methods of Solid Waste Disposal    (ii) Methods of solid Waste Treatment

**PART -B**

Answer any **FIVE** questions . Each carries **FOUR** Marks

**5X4=20Marks**

6. Write about the Thermoplastics and Thermosetting polymers.
7. . Explain the Polymer based on Source .
8. .Explain the PAN, PMMA .
9. What are Free Radical polymer.
10. Write the effects of Photochemical Smog .
11. Explain about Acid Rains .
12. Explain the TDS.
13. Write a short note on Hardness of water.
14. Write the Importance of Sanitary land Filling Method.
15. Write the Microbiology involved in Water waste Disposal.

