

## **Sri Venkateswara University, Tirupati**

**Syllabus for Chemistry (Major) in consonance with Curriculum frame work  
(W.E.F. AY-2026-27)**

### **COURSE STRUCTURE (for Semesters IV)**

| Year | Semester | Course | Title of the Course                                                             | No. of Hrs /Week | No. of Credits |
|------|----------|--------|---------------------------------------------------------------------------------|------------------|----------------|
|      | IV       | 8      | Organic Chemistry-III<br>(Nitrogen Containing Organic Compounds & Biomolecules) | 3                | 3              |
|      |          |        | Organic Chemistry-III Practical                                                 | 2                | 1              |
|      |          | 9      | Physical Chemistry – III<br>(Ionic equilibrium and Thermodynamics)              | 3                | 3              |
|      |          |        | Qualitative Analysis of Inorganic Mixture                                       | 2                | 1              |
|      |          | 10     | Applied and Physical Chemistry                                                  | 3                | 3              |
|      |          |        | Applied and Physical Chemistry Practical                                        | 2                | 1              |

  
(BOS Chairman)  
**Dr. V. PRABHAKAR RAO**  
M.Sc., M.Phil, Ph.D.  
LECTURER IN CHEMISTRY  
Dr. YSR GOVT. DEGREE COLLEGE -  
VEDURUKUPPAM - 517 569  
CHITTOOR (DIST), A.P.

## SEMESTER-IV

### COURSE 9: PHYSICAL CHEMISTRY-III

Theory

Credits: 3

3 hrs/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****(9h)**

Definition of thermodynamics, 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- (with derivation).

**UNIT - 4: THERMODYNAMICS- II****(9 h)**

Reversible and irreversible processes, Joule-Thomson effect- coefficient, derivation of work done for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes. Temperature dependence of the enthalpy of formation- Kirchoff's equation-(with derivation).

**UNIT - 5: THERMODYNAMICS- III****(9 h)**

Second law of thermodynamics: Different Statements of the law, Carnot cycle and its efficiency- (with derivation), 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., 10<sup>th</sup> Edition, Oxford University Press, 2014.
2. K.L. Kapoor, A Textbook of Physical Chemistry, 3<sup>rd</sup> 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

**Cations:** Lead, Copper, Iron, Aluminium, Zinc, Nickel, Manganese, Calcium, Barium, 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. 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

**4- Year UG Honours, Major**  
**Syllabus**  
**(2026-27)**  
**Semester-IV**

**Model Question Paper**

**Time : 3hrs**

**Marks:75**

**Part-A**

**Answer any Five Questions. Each Question carries 3 Marks.**

**5x3=15**

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

**Answer the following questions. Each question carries 12 Marks**

**5x12=60**

11. a) Unit-I  
(Or)  
b) Unit-I

12. a) Unit-II  
(Or)  
b) Unit-II

13. a) Unit-III  
(Or)  
b) Unit-III

14. a) Unit-IV  
(Or)  
b) Unit-IV

15. a) Unit-V  
(Or)  
b) Unit-V