

**GOVERNMENT COLLEGE FOR WOMEN,  
PARADE GROUND, JAMMU  
(An Autonomous College)**



**CHEMISTRY SYLLABUS**

**B.Sc. SEMESTER III-VI**

**UNDER**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

---

**GOVERNMENT COLLEGE FOR WOMEN, PARADE GROUND, JAMMU**  
**(An Autonomous College)**

---

**Syllabi and Courses of study in Chemistry for B.Sc. Semester III-VI (CBCS) Core Courses (C):**

**Skill Enhancement Courses (SEC):**

Semester	Course Number	Course Title	Credits
III	UCHTS 301	Fuel Chemistry (Skill Theory Course SEC-1)	2
	UCHPS 301	Laboratory Course	2
IV	UCHTS 401	Pesticide Chemistry (Skill Theory Course SEC-2)	2
	UCHPS 401	Laboratory Course	2
V	UCHTS 501	Cosmetics, Perfumes & Medicinal Agents from Natural Sources (Skill Theory Course SEC-3)	2
	UCHPS 501	Laboratory Course	2
VI	UCHTS 601	Green Methods In Chemistry (Skill Theory Course SEC-4)	2
	UCHPS 601	Laboratory Course	2

**Discipline Specific Elective Courses (DSE):**

Semester	Course Number	Course Title	Credits
V	UCHTDSE 501	Spectroscopy, Photochemistry, Organometallics & Bioinorganic Chemistry (DSE 1)	4
	UCHPDSE 501	laboratory Course: Chemistry - V	2
V	UCHTDSE 511	Quantum Mechanics, Polymeric Materials, Industrial Metallurgy & Environment (DSE 2)	4
	UCHPDSE 511	laboratory Course: Chemistry - V	2
VI	UCHTDSE 601	Inorganic Materials of Industrial Importance & Organic Spectroscopy (DSE 3)	4
	UCHPDSE 601	laboratory Course: Chemistry - VI	2
VI	UCHTDSE 611	Analytical Methods, Electronic and Magnetic Properties of Transition Metals & Synthetic Organic Chemistry (DSE 4)	4
	UCHPDSE 611	laboratory Course: Chemistry - VI	2

**Note:- Select two Papers, one each in Semester V (DSE 1 or DSE 2)& Semester VI (DSE 3 or DSE 4)**

---

**GOVERNMENT COLLEGE FOR WOMEN, PARADE GROUND, JAMMU**  
**(An Autonomous College)**

---

**Syllabi and courses of study in chemistry for B.Sc. Semester III for the examinations to be held in Dec. 2021, 2022 & 2023**

**Course No.: UCHTC 301**

**Theory: 60 Lectures**

**Title: SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE,  
ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY**

**Credits: 04**

**Maximum Marks: 100**

**Time: 03 Hrs**

**External Examination: 80 marks**

**Internal Assessment: 20 marks**

***Objectives:** The aim of this course is to make students understand phase equilibria, conductance and application of conductance measurement, concepts of electrochemical cells and applications of thermodynamics to solutions. Further the course gives a better understanding of the organic functional groups, which include carboxylic acids and nitrogen containing functional groups course and aims to introduce the learner to the fascinating chemistry of some biomolecules, i.e., amino acids, peptides, proteins, carbohydrates.*

***Learning outcomes:***

*After the completion of course, the students will be able to:*

- *Understand the applications of thermodynamic principles to solutions, critical solution temperature and Nernst distribution law and its applications.*
- *Explain the thermodynamic aspects of equilibria between phases and draw phase diagrams of simple one component and two component systems.*
- *Explain the chemistry of conductance and its variation with dilution, migration of ions in solutions and applications of conductance measurement.*
- *Understand different types of galvanic cells, their Nernst equations, measurement of emf, calculations of thermodynamic properties and other parameters from the emf measurements.*
- *Understand preparation, properties and reactions of carboxylic acids and nitrogen containing functional groups.*
- *Use the synthetic chemistry learnt in this course to do functional group transformations and propose plausible mechanism for any relevant reaction.*
- *Understand and demonstrate how structure of biomolecules determines their reactivity and biological functions.*

(For examinations to be held in Dec. 2021, 2022 & 2023)

**Section A: Physical Chemistry-II (30 Lectures)**

**Solutions**

**(8 Lectures)**

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law–non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Azeotropes.

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

**Phase Equilibrium**

**(8 Lectures)**

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius–Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems (Pb-Ag and  $\text{FeCl}_3\text{-H}_2\text{O}$ ).

**Conductance**

**(6 Lectures)**

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions. Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

**Electrochemistry**

**(8 Lectures)**

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties:  $G$ ,  $H$ ,  $S$  and equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.

pH determination using hydrogen electrode and quinhydrone electrode.

Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

**Section B: Organic Chemistry-III (30 Lectures)**

**Carboxylic acids and their derivatives.**

**(7 Lectures)**

Strength of organic acids and bases; comparative study with emphasis on factors affecting pK values.

Carboxylic acids (aliphatic and aromatic)

*Preparation:* Acidic and Alkaline hydrolysis of esters.

*Reactions:* Hell-Vohland-Zelinsky reaction, Decarboxylation and Curtius reaction.

(For examinations to be held in Dec. 2021, 2022 & 2023)

Carboxylic acid derivatives (aliphatic)

*Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion.

*Reactions:* Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

### **Amines and Diazonium Salts**

**(6 Lectures)**

Amines (Aliphatic and Aromatic):

*Preparation:* from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.

*Reactions:* Hofmann elimination, Carbylamine test, Hinsberg test, reaction with nitrous acid, Schotten–Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

**Diazonium salts:** *Preparation:* from aromatic amines. *Reactions:* conversion to benzene, phenol, dyes.

### **Amino Acids, Peptides and Proteins:**

**(9 Lectures)**

*Preparation of Amino Acids:* Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.

*Reactions of Amino acids:* ester of  $-\text{COOH}$  group, acetylation of  $-\text{NH}_2$  group, complexation with  $\text{Cu}^{2+}$  ions, ninhydrin test.

Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C-terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (*t*-butyloxycarbonyl and phthaloyl) & C-activating groups, removal of protecting groups. Merrifield solid-phase peptide synthesis.

Overview of the structural aspects of Primary, Secondary, Tertiary and Quaternary proteins.

### **Carbohydrates**

**(8 Lectures)**

**Carbohydrates:** Classification, and General Properties, Glucose and Fructose (open chain and cyclic structures). Mutarotation, ascending and descending in monosaccharides. Interconversion of Glucose and Fructose. Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose. Structure of disaccharides (sucrose, cellobiose, maltose, lactose) and polysaccharides

(starch and cellulose) excluding their structure elucidation.

(For examinations to be held in Dec. 2021, 2022 & 2023)

**Reference Books:**

- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
- Mahan, B.H. *University Chemistry*, 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry*, 5th Ed., Macmillan Publishing Co.: New York (1985).
- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry (Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7<sup>th</sup>Ed.*, W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.

**NOTE FOR PAPER SETTERS**

**Internal Assessment (Total Marks: 20; Time Duration: 1 hour)**

- The internal assessment test shall be held on completion of about 40% of the prescribed syllabus. The question paper will consist of eight short answer type questions of three marks each. The candidate will have to attempt any five questions (Total: 15 marks).
- Weightage for attendance – 5 marks

**External End Semester Examination (Total Marks: 80; Time Duration: 3 hours)** The question paper will have three sections.

Section A will consist of five short answer type questions (with explanation having 70 to 80 words) of three marks each, covering the entire syllabus. The candidate shall have to attempt all the questions (Total: 15 marks).

Section B will consist of five medium answer type questions (with explanation having 250 to 300 words) of seven marks each, covering the entire syllabus. The candidate shall have to attempt all the questions (Total: 35 marks).

Section C will consist of five long answer type questions (with detailed explanation having 500 to 600 words) of fifteen marks each, covering the entire syllabus. The candidate shall have to attempt any two questions (Total marks: 30).

-----

## SEMESTER-III

Course No.: UCHPC 301 (Practicals)

(For examinations to be held in Dec. 2021, 2022 & 2023)

**Title:- Laboratory Course: Chemistry-III**

**Maximum Marks: 50**

**Credits: 02**

**External Examination: 25 marks**

**Time: 4 Hrs**

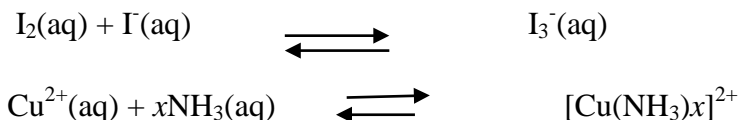
**Internal Examination: 25 marks**

*Learning outcomes: The students will be trained in constructing phase diagram and determining the CST, determining the concentration by conductometric and potentiometric titrations. Moreover, students will be trained in qualitative organic analysis of organic compounds.*

### **Section A: Physical Chemistry**

#### **Distribution**

Study of the equilibrium of one of the following reactions by the distribution method:



#### **Phase equilibria**

1. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
2. Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
3. Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

#### **Conductance**

1. Determination of cell constant.
2. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
3. Perform the following conductometric titrations:
  - i. Strong acid vs. strong base
  - ii. Weak acid vs. strong base

#### **Potentiometry**

Perform the following potentiometric titrations:

- i. Strong acid vs. strong base
- ii. Weak acid vs. strong base
- iii. Potassium dichromate vs. Mohr's salt

(For examinations to be held in Dec. 2021, 2022 & 2023)

### **Section B: Organic Chemistry**

I. Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

II.

1. Determination of the concentration of glycine solution by formylation method.
2. Titration curve of glycine
3. Action of salivary amylase on starch
4. Effect of temperature on the action of salivary amylase on starch.
5. Differentiation between a reducing and a nonreducing sugar.

#### **Reference Books:**

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press.

#### **DISTRIBUTION OF MARKS**

A.	Daily evaluation of practical records/viva-voce/attendance, etc.	Attendance: 05 marks
		Practical Test: 08 marks
		Day to day performance: 12 marks
B.	External Examination (100% syllabus)	Examination: 20 marks
		(Two practicals of 10 marks each)
		Viva-voce: 05 marks



## SEMESTER-III

**Course No.: UCHTS 301 (Skill Theory Course SEC-1)      Theory: 30 Lectures**  
**(For examinations to be held in Dec. 2021, 2022 & 2023)**

**Title: FUEL CHEMISTRY**

**Maximum Marks: 50**

**Credits: 02**

**External Examination: 40 marks**

**Time: 02 Hrs**

**Internal Assessment: 10 marks**

***Objectives:** The course aims to provide students with a basic scientific and technical understanding of the production, behavior and handling of hydrocarbon fuels and lubricants, including emerging alternative & renewable fuels. This will enable them to be industry ready to contribute effectively in the field of petroleum chemistry and technology.*

***Learning outcomes:***

*After the completion of course, the students will be able to:*

- *Understand both conventional petroleum-based fuels, and alternative & renewable fuels, including gaseous fuels.*
- *Understand the chemistry that underpins petroleum fuel technology, will understand the refining processes used to produce fuels and lubricants and will know how differences in chemical composition affect properties of fuels and their usage in different applications.*
- *Understand the origin of petroleum, crude oil, composition, different refining processes employed industrially to obtain different fractions of petroleum. Further, course will cover various alternative and renewable fuels like Biofuels (Different generations), Gaseous Fuels (e.g. CNG, LNG, CBG, Hydrogen etc.).*
- *Understand the fuel product specifications, various test methods used to qualify different types of fuels as well characterization methods.*

***Section A: Coal (15 Lectures)***

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

*Coal:* Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal.

Coal gas, producer gas and water gas—composition and uses.

Fractionation of coal tar, uses of coal tar based chemicals, requisites of a good metallurgical coke,

Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

(For examinations to be held in Dec. 2021, 2022 & 2023)

**Section B: Petroleum and Lubricants (15 Lectures)**

Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming of Petroleum.

Non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives, Xylene.

*Lubricants*: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pour point) and their determination.

**Reference Books:**

- Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
- Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

**NOTE FOR PAPER SETTERS**

**Internal Assessment (Total Marks: 10; Time Duration: 45 minutes)**

The internal assessment test shall be held on completion of about 40% of the prescribed syllabus. The question paper will consist of eight short answer type questions of two marks each. The candidate will have to attempt any five questions (Total: 10 marks).

**External End Semester Examination (Total Marks: 40; Time Duration: 2 hours)** The question paper will have three sections.

Section A will consist of four short answer type questions (with explanation having 70 to 80 words) of two marks each, covering the entire syllabus selecting two questions from each section. The candidate shall have to attempt all the questions (Total: 08 marks).

Section B will consist of four medium answer type questions (with explanation having 250 to 300 words) of five marks each, covering the entire syllabus selecting two questions from each section. The candidate shall have to attempt all the questions (Total: 20 marks).

Section C will consist of three long answer type questions (with detailed explanation having 500 to 600 words) of twelve marks each, covering the entire syllabus (1.5 questions to be set from each section). The candidate shall have to attempt any one question (Total marks: 12).

-----

## SEMESTER-III

**Course No.: UCHPS 301 (Skill Practical Course SEC-1)**

**(For examinations to be held in Dec. 2021, 2022 & 2023)**

**Title: Laboratory Course**

**Credits: 02**

**Time: 04 Hrs**

**Maximum Marks: 50**

**External Examination: 25 marks**

**Internal Assessment: 25 marks**

***Learning outcomes:** The students will be trained in functional group analysis, purification of organic compounds and determining the melting and boiling points of organic compound. Further they will be skilled in determining the different parameters of lubricants and evaluating the energy density and relative cleanliness of commonly used fuels.*

### **Section A**

1. Determination of melting point of naphthalene and benzoic acid.
2. Determination of boiling point of ethanol and toluene.
3. Crystallization of benzoic acid from hot water and naphthalene from ethanol.
4. Sublimation of camphor and naphthalene.
5. Detection of functional groups (phenolic, carboxylic, carbonyl, esters, amines and nitro groups)

### **Section B**

1. Evaluate energy density and relative cleanliness of several commonly used fuels.
2. Prepare lamp black in laboratory from camphor.
3. Fractional distillation of water ethanol mixture using water condenser
4. Determine viscosity index of given lubricant.
5. Determine cloud point of given lubricant.
6. Determine pore point of given lubricant.

### **Reference Books:**

- Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
- Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).
- Debasis Mohanty, *Fuel Chemistry*, Skill enhancement Course, Kalyani Publishers

(For examinations to be held in Dec. 2021, 2022 & 2023)

### DISTRIBUTION OF MARKS

A.	Daily evaluation of practical records/vivavoce/attendance, etc.	Attendance: 05 marks
		Practical Test: 08 marks
		Day to day performance: 12 marks
B.	External Examination (100% syllabus)	Examination: 20 marks (Two practicals of 10 marks each)
		Viva-voce: 05 marks

-----

---

**GOVERNMENT COLLEGE FOR WOMEN, PARADE GROUND, JAMMU**  
**(An Autonomous College)**

---

**Syllabi and courses of study in chemistry for B.Sc. Semester IV for the examinations to be held in May 2022, 2023 & 2024**

**Course No.: UCHTC 401**

**Theory: 60 Lectures**

**Title: COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS**

**Credits: 04**

**Maximum Marks: 100**

**Time: 03 Hrs**

**External Examination: 80 marks**

**Internal Assessment: 20 marks**

***Objectives:** To introduce students to coordination compounds, the d and f block elements, kinetics of chemical reaction and states of matter.*

***Learning outcomes:***

*After the completion of course, the students will be able to:*

- Understand the important properties of transition metals.*
- Understand the structure, bonding and isomerism in various types of complexes.*
- Understand the kinetic theory of gases and explain why real gases deviate from ideal behaviour..*
- Understand the different types of molecular speeds and their temperature dependence.*
- Understand collision number, collision frequency, collision diameter and mean free path of molecules and viscosity of gases.*
- Understand the properties of liquids and liquid crystals.*
- Understand various symmetry elements and crystal structure of NaCl, KCl and CsCl.*
- Understand rate of reactions and the factors that affect the rates of reaction, rate laws, different theories of reaction rates and how these account for experimental observations.*

***Section A: Inorganic Chemistry-II (30 Lectures)***

**Transition Elements (3d series)**

**(12 Lectures)**

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

(For examinations to be held in May 2022, 2023 & 2024)

### **Coordination Chemistry**

**(8 Lectures)**

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6.

Drawbacks of VBT. IUPAC system of nomenclature.

### **Crystal Field Theory**

**(10 Lectures)**

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for  $O_h$  and  $T_d$  complexes, Tetragonal distortion of octahedral geometry. Crystal field splitting in square planar geometry.

Jahn-Teller distortion, Square planar coordination.

### **Section B: Physical Chemistry-III (30 Lectures)**

#### **Kinetic Theory of Gases**

**(8 Lectures)**

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of  $CO_2$ .

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

#### **Liquids**

**(6 Lectures)**

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

Liquid Crystals: Introduction and types (nematic, smectic & cholesteric)

#### **Solids**

**(8 Lectures)**

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals.

(For examinations to be held in May 2022, 2023 & 2024)

## Chemical Kinetics

(8 Lectures)

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

### Reference Books:

- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
- Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry*, Wiley.
- Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
- Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
- Rodgers, G.E. *Inorganic & Solid State Chemistry*, Cengage Learning India Ltd., 2008.

### NOTE FOR PAPER SETTERS

#### Internal Assessment (Total Marks: 20; Time Duration: 1 hour)

- The internal assessment test shall be held on completion of about 40% of the prescribed syllabus. The question paper will consist of eight short answer type questions of three marks each. The candidate will have to attempt any five questions (Total: 15 marks).
- Weightage for attendance – 5 marks

**External End Semester Examination (Total Marks: 80; Time Duration: 3 hours)** The question paper will have three sections.

Section A will consist of five short answer type questions (with explanation having 70 to 80 words) of three marks each, covering the entire syllabus. The candidate shall have to attempt all the questions (Total: 15 marks).

Section B will consist of five medium answer type questions (with explanation having 250 to 300 words) of seven marks each, covering the entire syllabus. The candidate shall have to attempt all the questions (Total: 35 marks).

Section C will consist of five long answer type questions (with detailed explanation having 500 to 600 words) of fifteen marks each, covering the entire syllabus. The candidate shall have to attempt any two questions (Total marks: 30).

## SEMESTER-IV

**Course No.: UCHPC 401 (Practicals)**

**(For examinations to be held in May 2022, 2023 & 2024)**

**Title:- Laboratory Course: Chemistry-I**

**Credits: 02**

**Time: 4 Hrs**

**Maximum Marks: 50**

**External Examination: 25 marks**

**Internal Examination: 25 marks**

*Learning outcomes: The students will be trained in qualitative salt analysis and quantitative estimation of some metal ions in a given solution, determining the surface tension and viscosity of liquids.*

### ***Section A: Inorganic Chemistry***

1. Semi-micro qualitative analysis using H<sub>2</sub>S of mixtures - not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

*Cations:* NH<sub>4</sub><sup>+</sup>, Pb<sup>2+</sup>, Ag<sup>+</sup>, Bi<sup>3+</sup>, Cu<sup>2+</sup>, Cd<sup>2+</sup>, Sn<sup>2+</sup>, Fe<sup>3+</sup>, Al<sup>3+</sup>, Cr<sup>3+</sup>, Co<sup>2+</sup>, Ni<sup>2+</sup>, Mn<sup>2+</sup>, Zn<sup>2+</sup>, Ba<sup>2+</sup>, Sr<sup>2+</sup>, Ca<sup>2+</sup>, Na<sup>+</sup>, K<sup>+</sup>

*Anions:* CO<sub>3</sub><sup>2-</sup>, S<sup>2-</sup>, SO<sub>3</sub><sup>2-</sup>, S<sub>2</sub>O<sub>3</sub><sup>2-</sup>, NO<sub>2</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, PO<sub>4</sub><sup>3-</sup>, C<sub>2</sub>O<sub>4</sub><sup>2-</sup>

*(Spot tests should be carried out wherever feasible).*

2. Gravimetric estimation of nickel present in a given solution as bis(dimethylglyoximate) nickel(II) and aluminium as oxinate in a given solution.
3. Draw calibration curve (absorbance at  $\lambda_{\max}$  vs. concentration) for various concentrations of a given coloured compound (KMnO<sub>4</sub>/ CuSO<sub>4</sub>) and estimate the concentration of the same in a given solution.
4. Determination of the composition of the Fe<sup>3+</sup>-salicylic acid complex solution by Job's method.
5. Estimation of (i) Mg<sup>2+</sup> or (ii) Zn<sup>2+</sup> by complexometric titrations using EDTA.
6. Estimation of total hardness of a given sample of water by complexometric titration.
7. Determination of concentration of Na<sup>+</sup> and K<sup>+</sup> using Flame Photometry.

### ***Section B: Physical Chemistry***

- I. Surface tension measurement (use of organic solvents excluded).
  - a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
  - b) Study of the variation of surface tension of a detergent solution with concentration.
- II. Viscosity measurement (use of organic solvents excluded).
  - a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
  - b) Study of the variation of viscosity of an aqueous solution with concentration of solute.
  - c)



(For examinations to be held in May 2022, 2023 & 2024)

### III. Chemical Kinetics

Study the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
  - a) Acid hydrolysis of methyl acetate with hydrochloric acid.
  - b) Saponification of ethyl acetate.
  - c) Compare the strengths of HCl and H<sub>2</sub>SO<sub>4</sub> by studying kinetics of hydrolysis of methyl acetate

#### Reference Books:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

#### DISTRIBUTION OF MARKS

A.	Daily evaluation of practical records/vivavoce/attendance, etc.	Attendance: 05 marks
		Practical Test: 08 marks
		Day to day performance: 12 marks
B.	External Examination (100% syllabus)	Examination: 20 marks (Two practicals of 10 marks each)
		Viva-voce: 05 marks

-----

Course No.: UCHTS 401 (Skill Theory Course SEC-2)      Theory: 30 Lectures  
(For examinations to be held in May 2022, 2023 & 2024)

Title: PESTICIDE CHEMISTRY

Maximum Marks: 50

Course No.: UCHTS 401

Credits: 02

External Examination: 40 marks

Time: 02 Hrs

Internal Assessment: 10 marks

**Objectives:** Keeping the importance of pesticides in mind this course is aimed to introduce students to synthesis and application of pesticides.

**Learning outcomes:**

After the completion of course, the students will be able to:

- Understand the basic role of pesticide in everyday life, various ingredients and their role in controlling the pest.
- Educate the farmers/gardeners to choose the appropriate pesticides for their crop production.

**Section A: Introduction to Pesticides (15 Lectures)**

General introduction to pesticides.

Natural and synthetic pesticides.

Benefits and adverse effects of both natural and synthetic pesticides.

Changing concepts of pesticides, structure activity relationship.

**Section A: Synthesis of Pesticides (15 Lectures)**

Synthesis, technical manufacture and uses of Organochlorines (DDT, Gammexene).

Synthesis, technical manufacture and uses of Organophosphates (Malathion, Parathion).

Synthesis, technical manufacture and uses of Carbamates (Carbofuran and carbaryl).

Synthesis, technical manufacture and uses of Quinones (Chloranil) and Anilides (Alachlor and Butachlor).

**Reference Book:**

- Cremllyn, R. *Pesticides. Preparation and Modes of Action*, John Wiley & Sons, New York, 1978.
- Bost, G. A. and Ruthven, A. D.; *Pesticides-Developments, Impacts & Control*.
- Rakshit, A.; De, R. N.; *Manures, Fertilizers & Pesticides: Theory & Applications*.

(For examinations to be held in May 2022, 2023 & 2024)

**NOTE FOR PAPER SETTERS**

**Internal Assessment (Total Marks: 10; Time Duration: 45 minutes)**

The internal assessment test shall be held on completion of about 40% of the prescribed syllabus. The question paper will consist of eight short answer type questions of two marks each. The candidate will have to attempt any five questions (Total: 10 marks).

**External End Semester Examination (Total Marks: 40; Time Duration: 2 hours)** The question paper will have three sections.

Section A will consist of four short answer type questions (with explanation having 70 to 80 words) of two marks each, covering the entire syllabus selecting two questions from each section. The candidate shall have to attempt all the questions (Total: 08 marks).

Section B will consist of four medium answer type questions (with explanation having 250 to 300 words) of five marks each, covering the entire syllabus selecting two questions from each section. The candidate shall have to attempt all the questions (Total: 20 marks).

Section C will consist of three long answer type questions (with detailed explanation having 500 to 600 words) of twelve marks each, covering the entire syllabus (1.5 questions to be set from each section). The candidate shall have to attempt any one question (Total marks: 12).

-----

## SEMESTER-IV

**Course No.: UCHPS 401 (Skill Practical Course SEC-2)**  
**(For examinations to be held in May 2022, 2023 & 2024)**

**Title: Laboratory Course**

**Maximum Marks: 50**

**Credits: 02**

**External Examination: 25 marks**

**Time: 04 Hrs**

**Internal Assessment: 25 marks**

*Learning outcomes: The students will be trained in finding the various parameters of the pesticides as per BIS specification as well as they will be given useful information about pesticide labeling indicating the toxicity of the product.*

### **Section A**

1. Calculate the acidity of a given sample of a pesticide formulation as per BIS specification.
2. Calculate the alkalinity of a given sample of a pesticide formulation as per BIS specification.
3. Check water solubility of pesticides.
4. Qualitative analysis of following radical: carbonate, nitrite, sulphide, sulphite, nitrate, sulphate, phosphate and borate.
5. Useful information on label of packaging regarding: Toxicity, LD50, Side effects and Antidotes

### **Section B**

1. Preparation of pesticides in the laboratory.
2. Preparation of insecticides in the laboratory.
3. Preparation of herbicides in the laboratory.
4. Preparation of organic pesticides in laboratory which are active against nematodes.
5. Preparation of organic pesticides in laboratory for fungal diseases.
6. List of pesticides active against ants, caterpillars, mealy bugs, aphids, planthoppers, grasshoppers, mites, thrives and whitefly.

### **Reference Books:**

- Cremlyn, R.; *Pesticides. Preparation and Modes of Action*, John Wiley & Sons, New York, 1978.
- Jackson, P.; *Organic Pest Control, The Practical Guide*.
- Mandava, N. B.; *Handbook of Natural Pesticides, Methods, Theory, Practice and Detection, Volume 1*.

(For examinations to be held in May 2022, 2023 & 2024)

### DISTRIBUTION OF MARKS

A.	Daily evaluation of practical records/vivavoce/attendance, etc.	Attendance: 05 marks
		Practical Test: 08 marks
		Day to day performance: 12 marks
B.	External Examination (100% syllabus)	Examination: 20 marks (Two practicals of 10 marks each)
		Viva-voce: 05 marks

-----

---

**GOVERNMENT COLLEGE FOR WOMEN, PARADE GROUND, JAMMU**  
**(An Autonomous College)**

---

**Syllabi and courses of study in chemistry for B.Sc. Semester V for the examinations  
to be held in Dec. 2022, 2023 and 2024**

**Course No. :- UCHTDSE 501**

**Theory: 60 Lectures**

**Title:- SPECTROSCOPY, PHOTOCHEMISTRY, ORGANOMETALLICS AND  
BIOINORGANIC CHEMISTRY**

**Credits: 04**

**Maximum Marks: 100**

**Time: 03 Hrs**

**External Examination: 80 marks**

**Internal Assessment: 20 marks**

**Objectives:** *To provide basic knowledge of spectroscopy and its applications, photochemistry, polarization and magnetic properties, important transition metal compounds, organometallic chemistry and bioinorganic chemistry.*

**Learning outcomes:**

*After the completion of course, the students will be able to:*

- *Understand the underlying principles involved in transitions (rotational, vibrational), interpretation of the corresponding spectra and applications.*
- *Understand the laws of absorption of light energy by molecules and the subsequent photochemical reactions.*
- *Understand polarization, dipole moment and magnetic properties of molecules.*
- *Understand the chemistry of  $K_2Cr_2O_7$ ,  $KMnO_4$ ,  $K_4[Fe(CN)_6]$ , sodium nitroprusside,  $[Co(NH_3)_6]Cl_3$ ,  $Na_3[Co(NO_2)_6]$ .*
- *Understand the structure and properties of important organometallic compounds like methyl lithium, Zeise's salt, Ferrocene and metal carbonyls.*
- *Understand the applications of EAN rule and back bonding in metal carbonyls.*
- *Understand the role of metal ions present in the biological systems with particular reference to the working of the sodium-potassium pump in organisms, role of  $Mg^{2+}$  ions in energy production, role of  $Ca^{2+}$  in blood clotting, stabilization of protein structures and structural role (bones).*

(For examinations to be held in Dec. 2022, 2023 & 2024)

### ***Section A: Physical Chemistry-IV***

#### **Molecular Spectroscopy:**

**(10 Lectures)**

Characteristics of electromagnetic radiations, Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

Rotational spectroscopy: Rigid diatomic rotor, Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules.

#### **Photochemistry**

**(10 Lectures)**

Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry, quantum yield, photophysical process (Jablonski diagram), photosensitised reactions, quenching.

#### **Physical properties and Molecular Structure:**

**(10 Lectures)**

Optical activity, Polarization – (Clausius-Mossotti equation), Orientation of dipoles in an electric field, Dipole moment, Induced dipole moment, Measurement of dipole moment: temperature method and refractivity method, Dipole moment and structure of molecules, Magnetic properties: paramagnetism, diamagnetism and ferromagnetism.

### ***Section B: Inorganic Chemistry-III***

#### **Chemistry of 3d metals**

**(6 Lectures)**

Oxidation states displayed by Cr, Fe, Co and Cu.

A study of the following compounds (including preparation and important properties);

$K_2Cr_2O_7$ ,  $KMnO_4$ ,  $K_4[Fe(CN)_6]$ ,  $Na_2[Fe(CN)_6]$ ,  $[Co(NH_3)_6]Cl_3$ ,  $Na_3[Co(NO_2)_6]$ .

(For examinations to be held in Dec. 2022, 2023 & 2024)

### **Organometallic Compounds**

**(12 Lectures)**

Definition and classification with appropriate examples based on nature of metal-carbon bond (ionic,  $\sigma$ ,  $\pi$ , and multicentre bonds). Structures of methyl lithium, Zeise's salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals.  $\pi$ -acceptor behaviour of carbon monoxide. Synergistic effects (VB approach)- (MO diagram of CO).

### **Bio-Inorganic Chemistry**

**(12 Lectures)**

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to  $\text{Na}^+$ ,  $\text{K}^+$  and  $\text{Mg}^{2+}$  ions: Na/K pump; Role of  $\text{Mg}^{2+}$  ions in energy production and chlorophyll. Role of  $\text{Ca}^{2+}$  in blood clotting, stabilization of protein structures and structural role (bones).

### **Reference Books:**

- 1) Banwell, C. N., McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4<sup>th</sup> Ed. Tata McGraw-Hill: New Delhi (2006).
- 2) Kakkar, R. *Atomic & Molecular Spectroscopy: Concepts & Applications*, Cambridge University Press (2015).
- 3) Huheey, J. E., Keiter, E., Keiter, R. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
- 4) Miessler, G.L., Tarr, D. A. *Inorganic Chemistry*, Pearson Publication.
- 5) Lee, J.D., *A New Concise Inorganic Chemistry*, E.L.B.S.
- 6) Cotton, F.A., Wilkinson G. *Basic Inorganic Chemistry*, John Wiley & Sons

### **NOTE FOR PAPER SETTERS**

#### **Internal Assessment (Total Marks: 20; Time Duration: 1 hour)**

- The internal assessment test shall be held on completion of about 40% of the prescribed syllabus. The question paper will consist of eight short answer type questions of three marks each. The candidate will have to attempt any five questions (Total: 15 marks).
- Weightage for attendance – 5 marks

#### **External End Semester Examination (Total Marks: 80; Time Duration: 3 hours)**

The question paper will have three sections.



(For examinations to be held in Dec. 2022, 2023 & 2024)

Section A will consist of five short answer type questions (with explanation having 70 to 80 words) of three marks each, covering the entire syllabus. The candidate shall have to attempt all the questions (Total: 15 marks).

Section B will consist of five medium answer type questions (with explanation having 250 to 300 words) of seven marks each, covering the entire syllabus. The candidate shall have to attempt all the questions (Total: 35 marks).

Section C will consist of five long answer type questions (with detailed explanation having 500 to 600 words) of fifteen marks each, covering the entire syllabus. The candidate shall have to attempt any two questions (Total marks: 30).

---

## SEMESTER-V

Course No. :- UCHPDSE 501 (Practicals)

(For examinations to be held in Dec. 2022, 2023 & 2024)

**Title:- Laboratory Course: Chemistry-V**

**Maximum Marks: 50**

**Credits: 02**

**External Examination: 25 marks**

**Time: 4 Hrs**

**Internal Examination: 25 marks**

*Objectives: To train students in determining the absorbance using spectrophotometer and finding the unknown concentration using colorimeter.*

### ***Section A: Physical Chemistry - Colorimetry***

- I. Verify Lambert-Beer's law and determine the concentration of  $\text{CuSO}_4/\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$  in a solution of unknown concentration.
- II. Determine the concentrations of  $\text{KMnO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$  in a mixture.
- III. Determine the dissociation constant of an indicator (phenolphthalein).
- IV. Analyse the given vibration-rotation spectrum of  $\text{HCl}(\text{g})$ .

### ***Section B: Inorganic Chemistry - UV/Visible spectroscopy***

- 1) Study the 200-500 nm absorbance spectra of  $\text{KMnO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$  (in 0.1 M  $\text{H}_2\text{SO}_4$ ) and determine the  $\lambda_{\text{max}}$  values. Calculate the energies of the two transitions in different units ( $\text{J molecule}^{-1}$ ,  $\text{kJ mol}^{-1}$ ,  $\text{cm}^{-1}$ , eV).
- 2) Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of  $\text{K}_2\text{Cr}_2\text{O}_7$ .
- 3) Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

### **Reference Books**

- 1) Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- 2) Khosla, B. D., Garg, V. C., Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- 3) Garland, C. W., Nibler, J. W., Shoemaker, D. P. *Experiments in Physical Chemistry 8<sup>th</sup> Ed.*; McGraw-Hill: New York (2003).
- 4) Halpern, A. M., McBane, G. C. *Experimental Physical Chemistry 3<sup>rd</sup> Ed.*; W.H. Freeman & Co.: New York (2003).
- 5) Yadav J.B. *Advance Practical Physical Chemistry*, Goel Publication, Meerut.
- 6) Vishwanathan, B., Raghvan, P.S.; *Practical Physical Chemistry*, Viva Books Pvt. Ltd.

(For examinations to be held in Dec. 2022, 2023 & 2024)

### DISTRIBUTION OF MARKS

A.	Daily evaluation of practical records/viva-voce/attendance, etc.	Attendance: 05 marks
		Practical Test: 08 marks
		Day to day performance: 12 marks
B.	External Examination (100% syllabus)	Examination: 20 marks (Two practicals of 10 marks each)
		Viva-voce: 05 marks

---

**GOVERNMENT COLLEGE FOR WOMEN, PARADE GROUND, JAMMU**  
**(An Autonomous College)**

---

**Syllabi and courses of study in chemistry for B.Sc. Semester V for the examinations  
to be held in Dec. 2022, 2023 & 2024**

**Course No.: UCHTDSE 511**

**Theory: 60 Lectures**

**Title: QUANTUM MECHANICS, POLYMERIC MATERIALS, INDUSTRIAL METALLURGY & ENVIRONMENT**

**Credits: 04**

**Maximum Marks: 100**

**Time: 03 Hrs**

**External Examination: 80 marks**

**Internal Assessment: 20 marks**

**Objectives:** *To provide basic knowledge of Quantum chemistry, polymer chemistry, metallurgy and environment to the students.*

**Learning outcomes:**

*After the completion of course, the students will be able to:*

- *Understand the limitations of classical mechanics in dealing with the microscopic system.*
- *Understand the postulates of quantum chemistry and apply them to derive equations of various models.*
- *Understand the synthesis, properties and applications of polymers.*
- *Understand the different mechanisms of polymerization and finding out average molecular weight of polymers.*
- *Understand the chemistry involved in the extraction of metals from their ores.*
- *Understand the environment and its segments.*
- *Understand the air and water pollution.*
- *To train students in determining the molecular weight of polymer, dissolved oxygen in water, Chemical Oxygen Demand, Biological Oxygen Demand, Percentage of available chlorine in bleaching powder.*

**Section A: Physical Chemistry-IV (30 lectures)**

**Quantum Mechanics-I**

**(18 lectures)**

Black-body radiation and Planck's radiation law, Photoelectric effect, Heat capacity of solids, Bohr's model of hydrogen atom and its defects, Compton effect, Zeeman effect, de Broglie hypothesis, Heisenberg's uncertainty principle.

(For examinations to be held in Dec. 2022, 2023 & 2024)

## **Quantum Mechanics-II**

Schrodinger wave equation and its importance, Physical interpretation of the wave function, Concept of operators, Hamiltonian operator, Postulates of quantum mechanics, Discussion of solutions of the Schrodinger equation to some model systems viz; Particle in one dimensional box, Particle in three dimensional box, Concept of degeneracy.

## **Introduction and history of polymeric materials: (12 lectures)**

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and Chemical bonding in polymers,

## **Kinetics of Polymerization:**

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques

**Determination of molecular weight of polymers** ( $M_n$ ,  $M_w$ , etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

## ***Section B: Inorganic Chemistry-III (30 lectures)***

### **Industrial Metallurgy - General Principles of Metallurgy (10 lectures)**

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent.

Hydrometallurgy, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

### **Environment and its segments (20 lectures)**

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

**Air Pollution:** Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of

(For examinations to be held in Dec. 2022, 2023 & 2024)

ozone, Major sources of air pollution. Pollution by SO<sub>2</sub>, CO<sub>2</sub>, CO, NO<sub>x</sub>, H<sub>2</sub>S and other foul smelling gases. Methods of estimation of CO, NO<sub>x</sub>, SO<sub>x</sub> and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

**Water Pollution :** Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impact of water pollution on hydrological and ecosystems.

Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc.

### Reference Books:

- 1) Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001).
- 2) House, J. E. *Fundamentals of Quantum Chemistry* 2<sup>nd</sup> Ed. Elsevier: USA (2004).
- 3) Lowe, J. P. & Peterson, K. *Quantum Chemistry*, Academic Press (2005).
- 4) Seymour, R.B. & Carraher, C.E. *Polymer Chemistry: An Introduction*, Marcel Dekker, Inc. New York, 1981.
- 5) Odian, G. *Principles of Polymerization*, 4th Ed. Wiley, 2004.
- 6) Billmeyer, F.W. *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971.
- 7) Ghosh, P. *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991
- 8) Munk P.; Aminabhavi, T.M. *Introduction to Macromolecular Science*, 2nd ed. John Wiley & Sons (2002)
- 9) Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- 10) Felder, R.M., Rousseau, R.W. *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- 11) Kent J. A. *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- 12) Dara, S. S. *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
- 13) De, K. *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
- 14) Khopkar, S. M. *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.
- 15) Manahan, S.E. *Environmental Chemistry*, CRC Press (2005).
- 16) Miller, G.T. *Environmental Science* 11th edition. Brooks/ Cole (2006).
- 17) Mishra, A. *Environmental Studies*. Selective and Scientific Books, New Delhi (2005).

(For examinations to be held in Dec. 2022, 2023 & 2024)

### **NOTE FOR PAPER SETTERS**

#### **Internal Assessment (Total Marks: 20; Time Duration: 1 hour)**

- The internal assessment test shall be held on completion of about 40% of the prescribed syllabus. The question paper will consist of eight short answer type questions of three marks each. The candidate will have to attempt any five questions (Total: 15 marks).
- Weightage for attendance – 5 marks

#### **External End Semester Examination (Total Marks: 80; Time Duration: 3 hours)**

The question paper will have three sections.

Section A will consist of five short answer type questions (with explanation having 70 to 80 words) of three marks each, covering the entire syllabus. The candidate shall have to attempt all the questions (Total: 15 marks).

Section B will consist of five medium answer type questions (with explanation having 250 to 300 words) of seven marks each, covering the entire syllabus. The candidate shall have to attempt all the questions (Total: 35 marks).

Section C will consist of five long answer type questions (with detailed explanation having 500 to 600 words) of fifteen marks each, covering the entire syllabus. The candidate shall have to attempt any two questions (Total marks: 30).

-----

## SEMESTER-V

**Course No. :- UCHPDSE 511 (Practicals)**

**(For examinations to be held in Dec. 2022, 2023 & 2024)**

**Title:- Laboratory Course: Chemistry-V**

**Maximum Marks: 50**

**Credits: 02**

**External Examination: 25 marks**

**Time: 4 Hrs**

**Internal Examination: 25 marks**

*Course Objectives: The students will be trained in determining the absorbance using spectrophotometer and finding the unknown concentration using colorimeter.*

### ***Section A: Physical Chemistry***

- 1) Determination of molecular weight of different polymers by viscometry:
  - (a) Polyacrylamide-aq. NaNO<sub>2</sub> solution
  - (b) Poly vinyl propylidene (PVP) in water
- 2) Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of “head-to-head” monomer linkages in the polymer.
- 3) Estimation of the amount of HCHO in the given solution by sodium sulphite method
- 4) Testing of mechanical properties of polymers.
- 5) Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
- 6) Determination of hydroxyl number of a polymer using colorimetric method.

### ***Section B: Inorganic Chemistry***

- 1) Determination of dissolved oxygen in water.
- 2) Determination of Chemical Oxygen Demand (COD)
- 3) Determination of Biological Oxygen Demand (BOD)
- 4) Percentage of available chlorine in bleaching powder.
- 5) Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO<sub>3</sub> and potassium chromate).
- 6) Estimation of total alkalinity of water samples (CO<sub>3</sub><sup>2-</sup>, HCO<sub>3</sub><sup>-</sup>) using double titration method.

### **Reference Books**

- 1) Stevens, M.P. *Polymer Chemistry: An Introduction*, 3<sup>rd</sup> Ed., Oxford University Press, 1999.
- 2) Allcock, H.R., Lampe, F.W., J.E. Mark, *Contemporary Polymer Chemistry*, 3<sup>rd</sup> ed. Prentice-Hall (2003)
- 3) Billmeyer, F.W. *Textbook of Polymer Science*, 3<sup>rd</sup> ed. Wiley-Interscience (1984)
- 4) Fried, J.R. *Polymer Science and Technology*, 2<sup>nd</sup> ed. Prentice-Hall (2003)
- 5) Munk, P., Aminabhavi, T.M. *Introduction to Macromolecular Science*, 2<sup>nd</sup> ed. John Wiley & Sons (2002)



(For examinations to be held in Dec. 2022, 2023 & 2024)

- 6) Sperling, L. H. *Introduction to Physical Polymer Science*, 4<sup>th</sup> ed. John Wiley & So (2005)
- 7) Stevens, M.P. *Polymer Chemistry: An Introduction* 3<sup>rd</sup> ed. Oxford University Press (2005).
- 8) Carraher, Jr. C. E. *Polymer Chemistry*, 9<sup>th</sup> ed. (2013).
- 9) Stocchi, E.: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- 10) Felder, R.M., Rousseau, R.W. *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- 11) Kent, J. A. Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- 12) Dara, S. S. *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
- 13) De, A. K. *Environmental Chemistry*: New Age International Pvt. Ltd, New Delhi.
- 14) Khopkar, S. M. *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.

### DISTRIBUTION OF MARKS

A.	Daily evaluation of practical records/viva-voce/attendance, etc.	Attendance: 05 marks
		Practical Test: 08 marks
		Day to day performance: 12 marks
B.	External Examination (100% syllabus)	Examination: 20 marks (Two practicals of 10 marks each)
		Viva-voce: 05 marks

## SEMESTER-V

**Course No.:** UCHTS 501 (skill Theory Course, SEC-3)      **Theory: 30 Lectures**  
(For examinations to be held in Dec. 2022, 2023 & 2024)

**Title: COSMETICS, PERFUMES AND MEDICINAL AGENTS FROM NATURAL SOURCES**      **Maximum Marks: 50**

**Credits: 02**      **External Examination: 40 marks**

**Time: 02 Hrs**      **Internal Assessment: 10 marks**

*Course Objectives: Keeping in view the tremendous potential which the cosmetic industry has today around the globe, this course will be useful for introducing students to the world of cosmetic chemistry. This has been designed to impart the theoretical and practical knowledge on basic principles of cosmetic chemistry, manufacture, formulation of various cosmetic products.*

### **Learning Outcomes:**

*On completion of the course, the student will be able to:*

- *Understand cosmetics, various cosmetic formulation, ingredients and their roles in cosmetic products.*
- *Learn the use of safe, economic and body-friendly cosmetics.*
- *Prepare new innovative formulations.*

### **Section A: Cosmetics and Perfumes**

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.

Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenylethyl alcohol, Jasmone, Civetone, Muscone.

Study of mineral ingredients. Kaolin, Bentonite, Talc., Fuller's earth.

### **Section B: Medicinal Agents from Natural Sources**

Different systems of classification of drugs of natural origin, their merits & demerits.

Study of the following with reference to their sources, characters, chemical constituents, identification tests and cosmetic uses.

i) Carbohydrate – Starches, Agar, Gum Acacia.

ii) Lipids – A study of following: Caster oil, Linseed oil, Sesame oil, Coconut oil.

iii) Wheat germ oil, Jojoba oil, rice bran oil, Spermaceti.

Cosmeceuticals – study of hair care herbs and skin care herbs as active ingredients.

Tannins – Classification, identification and study of the following – Black Catechu, Tannic acid, Amla, Behra, Hirda, Arjun, Ashok.

(For examinations to be held in Dec. 2022, 2023 & 2024)

### **Reference Books:**

- 1) Stocchi, E. Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
- 2) Jain, P.C., Jain, M. Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
- 3) Sharma, B.K., Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut(1996).
- 4) Trease, Evan. Text book of Pharmacognosy –
- 5) Clasu, Tayler. Pharmacognosy
- 6) Wallis, T.E. Text Book of Pharmacognosy
- 7) Nadkarni, Materia Medica.

### **NOTE FOR PAPER SETTERS**

#### **Internal Assessment (Total Marks: 10; Time Duration: 45 minutes)**

The internal assessment test shall be held on completion of about 40% of the prescribed syllabus. The question paper will consist of eight short answer type questions of two marks each. The candidate will have to attempt any five questions (Total: 10 marks).

#### **External End Semester Examination (Total Marks: 40; Time Duration: 2 hours)**

The question paper will have three sections.

Section A will consist of four short answer type questions (with explanation having 70 to 80 words) of two marks each, covering the entire syllabus selecting two questions from each section. The candidate shall have to attempt all the questions (Total: 08 marks).

Section B will consist of four medium answer type questions (with explanation having 250 to 300 words) of five marks each, covering the entire syllabus selecting two questions from each section. The candidate shall have to attempt all the questions (Total: 20 marks).

Section C will consist of three long answer type questions (with detailed explanation having 500 to 600 words) of twelve marks each, covering the entire syllabus (1.5 questions to be set from each section). The candidate shall have to attempt any one question (Total marks: 12).

## SEMESTER-V

**Course No.: UCHPS 501 (Skill Practical Course SEC-3)**  
**(For examinations to be held in Dec. 2022, 2023 & 2024)**

**Title: Laboratory Course**

**Credits: 02**

**Time: 04 Hrs**

**Maximum Marks: 50**

**External Examination: 25 marks**

**Internal Assessment: 25 marks**

### ***Learning outcomes:***

- *Utilize concepts of functional classes of raw materials in sourcing and selection of ingredients for synthetic, natural and organic cosmetic products.*
- *Ability to apply knowledge and understanding*
- *To provide basic knowledge of the Natural Herbs & Plants*
- *The ability to formulate cosmetic and personal care product types*
- *Formulate and evaluate various cosmeceutical products.*
- *Know the key components used in different cosmeceutical products.*
- *Recognize the role of ingredients and herbs used in cosmeceutical products.*

### ***Section A***

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.

### ***Section B***

1. Test for carbohydrates, proteins and lipids.
2. Check viscosity of various oils (coconut oil, jojoba oil, sesame oil, linseed oil, castor oil, wheat germ oil, rice bran oil etc) and make a list of their viscosities
3. Identify and study following cosmeceuticals – Black Catechu, Tannic Acid, Amla, Behra, Hirda, Arjun, Ashok
4. Make a list of cosmeceutical ingredients, their purported action and natural sources
5. Know about difference between cosmetics and cosmeceuticals

(For examinations to be held in Dec. 2022, 2023 & 2024)

**Reference Books:**

- 1) Stocchi, E. Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
- 2) Jain, P.C., Jain, M. Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
- 3) Sharma, B.K., Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut(1996).
- 4) Trease, Evan. Text book of Pharmacognosy –
- 5) Clasu, Tayler. Pharmacognosy
- 6) Wallis, T.E. Text Book of Pharmacognosy
- 7) Nadkarni, Materia Medica.

**DISTRIBUTION OF MARKS**

A.	Daily evaluation of practical records/vivavoce/attendance, etc.	Attendance: 05 marks
		Practical Test: 08 marks
		Day to day performance: 12 marks
B.	External Examination (100% syllabus)	Examination: 20 marks (Two practicals of 10 marks each)
		Viva-voce: 05 marks

---

**GOVERNMENT COLLEGE FOR WOMEN, PARADE GROUND, JAMMU**  
**(An Autonomous College)**

---

**Syllabi and courses of study in chemistry for B.Sc. Semester VI for the examinations  
to be held in May 2023, 2024 & 2025**

**Course No.:** UCHTDSE 601

**Theory:** 60 Lectures

**Title:-** INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE AND ORGANIC SPECTROSCOPY

**Credits:** 04

**Maximum Marks:** 100

**Time:** 03 Hrs

**External Examination:** 80 marks

**Internal Assessment:** 20 marks

**Course Objectives:** To provide basic knowledge of *s*- and *p*-block elements, fertilizers, batteries, catalysis, chemical explosives, active methylene compounds and various tools and techniques for identifying and characterizing the organic compounds through their interactions with electromagnetic radiations viz. UV-Visible, IR and NMR spectroscopy.

**Learning Outcomes:**

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

- Understanding the important properties of *s*- and *p*-block elements.
- Understand the suitability of fertilizers for different kinds of crops and soil.
- Understand the principle, working and applications of different batteries.
- Understand the different types of catalysis and their industrial applications.
- Understand the chemistry behind different chemical explosives like lead azide, PETN, cyclonite (RDX).
- Use spectroscopic techniques to determine structure of known and unknown compounds.

**Section A: Inorganic Chemistry-IV (30 Lectures)**

**Recapitulation of *s*- and *p*-Block Elements**

**(4 Lectures)**

Periodicity in properties of *s*- and *p*-block elements, electronegativity (Pauling, Mulliken, and Alfred-Rochow scales). Allotropy in C, S, and P.

Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

(For examinations to be held in May 2023, 2024 & 2025)

**Fertilizers: (8 Lectures)**

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

**Batteries: (8 Lectures)**

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid battery, Li-battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

**Catalysis: (6 Lectures)**

General principles and properties of catalysts, homogenous catalysis (catalytic steps) and heterogenous catalysis (catalytic steps, Ziegler–Natta catalyst) and their industrial applications, Deactivation or regeneration of catalysts.

**Chemical explosives: (4 Lectures)**

Origin of explosive properties in organic compounds, preparation and explosive properties of TNT, lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

***Section B: Organic Chemistry-IV (30 Lectures)***

**Active methylene compounds: (6 Lectures)**

Preparation: Claisen ester condensation. Keto-enol tautomerism.

Reactions: Synthetic uses of ethylacetoacetate (2-hexanone, 4-methyl-2-pentanone, 3-methyl-2-pentanone, pentanoic acid, 2-methylbutanoic acid and succinic acid).

**Organic Spectroscopy**

**A. UV-Visible Spectroscopy (8 Lectures)**

Electromagnetic radiations - Brief introduction and characteristics, electromagnetic spectrum, spectroscopy and its types.

Ultraviolet (UV) absorption spectroscopy – absorption laws (Beer Lambert law), molar absorptivity, types of electronic transitions. Concept of Chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts, effect of solvents, effect of conjugation. UV spectra of conjugated enes and enones (Woodward - Fieser rules).

(For examinations to be held in May 2023, 2024 & 2025)

**B. Infrared Spectroscopy (6 Lectures)**

Infrared (IR) absorption spectroscopy – molecular vibrations. Hooke's law, selection rules, intensity and position of IR bands, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds (benzaldehyde, benzoyl chloride, acetophenone, benzamide, salicylic acid, p-hydroxybenzoic acid, p-nitroaniline, p-nitrophenol, benzonitrile,  $\alpha,\beta$ -unsaturated ketones).

**C. Nuclear Magnetic Resonance Spectroscopy (10 Lectures)**

Nuclear magnetic resonance (NMR) spectroscopy. Proton magnetic resonance ( $^1\text{H}$  NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.

**Reference Books:**

- 1) Felder, R. M., Rousseau, R. W. *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- 2) Kent, J. A. Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- 3) Gopalan, R., Venkappayya, D., Nagarajan, S. *Engineering Chemistry*, Vikas Publications, New Delhi.
- 4) Sharma, B. K. *Engineering Chemistry*, Goel Publishing House, Meerut.
- 5) Lee, J.D. *A New Concise Inorganic Chemistry*, E.L.B.S.
- 6) Cotton, F.A., Wilkinson, G. *Basic Inorganic Chemistry*, John Wiley & Sons.
- 7) Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
- 8) Dyer, J. R. *Applications of Absorption Spectroscopy of Organic Compounds*, Prentice Hall.
- 9) Silverstein, R.M., Bassler, G.C., Morrill, T.C. *Spectroscopic Identification of Organic Compounds*, John Wiley & Sons.
- 10) Morrison, R.T., Boyd, R.N. *Organic Chemistry*, Prentice Hall.
- 11) Sykes P. *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
- 12) Bahl, A.; Bahl, B. S. *Advanced Organic Chemistry*, S. Chand.
- 13) Ahluwalia, V.K., Parashar, R.K.: *Organic Reaction Mechanism*, Narosa.
- 14) Kemp, W. *Organic Spectroscopy* 3<sup>rd</sup> edition; Red Globe Press.



(For examinations to be held in May 2023, 2024 & 2025)

**NOTE FOR PAPER SETTERS**

**Internal Assessment (Total Marks: 20; Time Duration: 1 hour)**

- The internal assessment test shall be held on completion of about 40% of the prescribed syllabus. The question paper will consist of eight short answers type questions of three marks each. The candidate will have to attempt any five questions (Total: 15 marks).
- Weightage for attendance – 5 marks

**External End Semester Examination (Total Marks: 80; Time Duration: 3 hours)**

The question paper will have three sections.

Section A will consist of five short answers type questions (without detailed explanation having 70 to 80 words) of three marks each, covering the entire syllabus. The candidate shall have to attempt all the questions (Total: 15 marks).

Section B will consist of five medium answers type questions (with explanation having 250 to 300 words) of seven marks each, covering the entire syllabus. The candidate shall have to attempt all the questions (Total: 35 marks).

Section C will consist of five long answers type questions (with detailed explanation having 500 to 600 words) of fifteen marks each, covering the entire syllabus. The candidate shall have to attempt any two questions (Total marks: 30).

-----

## SEMESTER-VI

**Course No.: UCHPDSE 601 (Practicals)**

**(For examinations to be held in May 2023, 2024 & 2025)**

**Title:- Laboratory Course: Chemistry-VI**

**Maximum Marks: 50**

**Credits: 02**

**External Examination: 25 marks**

**Time: 4 Hrs**

**Internal Examination: 25 marks**

***Learning Outcomes:** The students will be trained in estimating calcium, phosphoric acid indifferent fertilizers and analysis of Cu/Ni, Cu/Zn in alloy or synthetic samples.*

### ***Section A: Inorganic Chemistry***

- 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) Electrode less metallic coatings on ceramic and plastic material.

### ***Section B: Organic Chemistry***

- 1) Systematic qualitative analysis of organic compounds and preparation of suitable derivatives (including osazone formation in carbohydrates).
- 2) Separation of binary mixture of organic compounds using water, sodium bicarbonate, sodium hydroxide & hydrochloric acid.

### **Preparations**

- 1) p-Nitroaniline from acetanilide
- 2) p-Bromoaniline from acetanilide
- 3) m-Nitroaniline from nitrobenzene
- 4) Synthesis of di-benzalacetone from benzaldehyde (Claisen-Schmidt condensation)
- 5) Synthesis of benzyl alcohol and benzoic acid from benzaldehyde (Cannizaro reaction)

### **Reference Books:**

- 1) Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- 2) Felder, R. M., Rousseau, R.W. *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.

(For examinations to be held in May 2023, 2024 & 2025)

- 3) Kingery, W. D., Bowen, H. K., Uhlmann, D. R. *Introduction to Ceramics*, Wiley Publishers, New Delhi.
- 4) Kent, J. A. Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- 5) Jain, P. C., M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- 6) R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
- 7) Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- 8) *Experimental Organic Chemistry – Principles and practice* by Laurence M. Harwood and Christopher J. Moody (Blackwell Scientific Publications).
- 9) *Laboratory Manual of Organic Chemistry* by Raj K. Bansal (New Age Publications).
- 10) *Advanced Practical Chemistry* by Jagdamba Singh and others (Pragati Prakashan).
- 11) *Practical Organic Chemistry* by N.K. Vishnoi (New Age Publications).
- 12) *Experimental Organic Chemistry*, Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
- 13) *Laboratory Manual in Organic Chemistry*, R.K. Bansal, Wiley Eastern.
- 14) *Vogel's Textbook of Practical Organic Chemistry*, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
- 15) *Experiments in General Chemistry*, C.N.R. Rao and U.C. Agarwal, East-West Press.

#### DISTRIBUTION OF MARKS

A.	Daily evaluation of practical records/viva-voce/attendance, etc.	Attendance: 05 marks
		Practical Test: 08 marks
		Day to day performance: 12 marks
B.	External Examination (100% syllabus)	Examination: 20 marks (Two practicals of 10 marks each)
		Viva-voce: 05 marks

---

**GOVERNMENT COLLEGE FOR WOMEN, PARADE GROUND, JAMMU**  
**(An Autonomous College)**

---

**Syllabi and courses of study in chemistry for B.Sc. Semester VI for the examinations  
to be held in May 2023, 2024 & 2025**

**Course No.: UCHTDSE 611**

**Theory: 60 Lectures**

**Title: ANALYTICAL METHODS, ELECTRONIC AND MAGNETIC PROPERTIES  
OF TRANSITION METALS AND SYNTHETIC ORGANIC CHEMISTRY**

**Credits: 04**

**Maximum Marks: 100**

**Time: 03 Hrs**

**External Examination: 80 marks**

**Internal Assessment: 20 marks**

***Course Objectives:** To provide basic knowledge of s- and p-block elements, fertilizers, batteries, catalysis, chemical explosives, active methylene compounds and various tools and techniques for identifying and characterizing the organic compounds through their interactions with electromagnetic radiation viz. UV-Visible, IR and NMR spectroscopy.*

***Learning Outcomes:***

*On completion of the course, the student will be able to:*

- *Understand the chemistry of heteronuclear and polynuclear aromatic compounds*
- *Understand the criterion of aromaticity with reference to polynuclear hydrocarbons and heterocyclic compounds and trends in basicity of heterocyclic Nitrogen containing compounds*
- *Understand the separation of analytes by chromatography and solvent extraction.*
- *Understand the electronic and magnetic properties of transition metal complexes.*
- *Understand the chemistry behind organomagnesium, organolithium and organo zinc organometallic compounds.*
- *Understand the reactions involving enolate chemistry.*
- *Understand the synthesis and applications of various types of dyes.*

***Section A: Inorganic Chemistry-IV (30 Lectures)***

**Separation techniques:**

**(15 lectures)**

**Solvent extraction:** Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions.

Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.

(For examinations to be held in May 2023, 2024 & 2025)

**Chromatography:** Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.

**Magnetic Properties of Transition Metal Complexes (8 lectures)**

Types of Magnetic behaviour, methods of determining magnetic susceptibility( Guoy's and Faraday's methods) spin only formula, L-S coupling and correlation of values, orbital contribution to magnetic moments, application of magnetic moment data for structure analysis of 3d-metal complexes.

**Electronic Spectra of Transition Metal Complexes (7 lectures)**

Types of electronic transition, selection rules for d- d transitions, spectroscopic ground states, spectro-chemical series, Orgel-energy level diagram for  $d^1$  and  $d^9$  states in octahedral and tetrahedral systems, discussion of the electronic spectrum of  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  complex ion.

**Section B: Organic Chemistry-IV (30 Lectures)**

**Polynuclear and Heteronuclear aromatic compounds: (10 Lectures)**

Method of synthesis and electrophilic and nucleophilic reactions of naphthalene and anthracene. Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and mechanism of electrophilic substitution reactions. Mechanism of nucleophilic substitution reactions in pyridine. Comparison of basicity of pyridine, piperidine and pyrrole.

**Organic Synthesis via enolates: (8 Lectures)**

Acidity of  $\alpha$ -hydrogens, alkylation of ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1,3-dithianes, alkylation and acylation of enamines.

(For examinations to be held in May 2023, 2024 & 2025)

**Organometallic compounds of Mg, Li & Zn**

**(9 Lectures)**

Organomagnesium compounds: Grignard reagents – formation, structure and chemical reactions.

Organozinc compounds: formation and chemical reactions.

Organolithium compounds: formation and chemical reactions.

**Synthetic dyes**

**(3 Lectures)**

Synthesis of Methyl orange, Malachite green. Crystal violet, Phenolphthalein and Indigo.

**Reference Books:**

- 1) Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
- 2) Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- 3) Christian, G.D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
- 4) Harris, D. C. *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
- 5) Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age, International Publisher, 2009.
- 6) Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- 7) Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood
- 8) Series on Analytical Chemistry, John Wiley & Sons, 1979.
- 9) Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.
- 10) Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S. 52
- 11) Morrison R.T., Boyd, R.N. *Organic Chemistry*, Prentice Hall.
- 12) Sykes, P. *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
- 13) Bahl, A., Bahl, B. S. *Advanced Organic Chemistry*, S. Chand.
- 14) Solomons, *Fundamentals of Organic Chemistry*, John Wiley.
- 15) Carey, F.A. *Organic Chemistry*, McGraw Hill Inc.
- 16) Stritwieser, Heathcock, Kosover, *Introduction to Organic Chemistry*, Macmillan

(For examinations to be held in May 2023, 2024 & 2025)

### **NOTE FOR PAPER SETTERS**

#### **Internal Assessment (Total Marks: 20; Time Duration: 1 hour)**

- The internal assessment test shall be held on completion of about 40% of the prescribed syllabus. The question paper will consist of eight short answers type questions of three marks each. The candidate will have to attempt any five questions (Total: 15 marks).
- Weightage for attendance – 5 marks

#### **External End Semester Examination (Total Marks: 80; Time Duration: 3 hours)**

The question paper will have three sections.

Section A will consist of five short answers type questions (without detailed explanation having 70 to 80 words) of three marks each, covering the entire syllabus. The candidate shall have to attempt all the questions (Total: 15 marks).

Section B will consist of five medium answers type questions (with explanation having 250 to 300 words) of seven marks each, covering the entire syllabus. The candidate shall have to attempt all the questions (Total: 35 marks).

Section C will consist of five long answers type questions (with detailed explanation having 500 to 600 words) of fifteen marks each, covering the entire syllabus. The candidate shall have to attempt any two questions (Total marks: 30).

-----

## SEMESTER-VI

**Course No.: UCHPDSE 611 (Practicals)**

**(For examinations to be held in May 2023, 2024 & 2025)**

**Title:- Laboratory Course: Chemistry-VI**

**Maximum Marks: 50**

**Credits: 02**

**External Examination: 25 marks**

**Time: 4 Hrs**

**Internal Examination: 25 marks**

### ***Section A: Inorganic Chemistry***

#### **Separation Techniques**

1. Chromatography (Separation of Mixture): Paper chromatographic separation of  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ , and  $\text{Cr}^{3+}$ .
2. To separate a mixture of  $\text{Ni}^{2+}$  &  $\text{Fe}^{2+}$  by complexation with DMG and extracting the  $\text{Ni}^{2+}$  DMG complex in chloroform, and determine its concentration by spectrophotometry.
3. Analysis of soil.
  - i. Determination of pH of soil.
  - ii. Total soluble salt
  - iii. Estimation of calcium, magnesium, phosphate, nitrate
4. Ion exchange:
  - i. Determination of exchange capacity of cation exchange resins and anion exchange resins.
  - ii. Separation of metal ions from their binary mixture.
  - iii. Separation of amino acids from organic acids by ion exchange chromatography

### ***Section B: Organic Chemistry***

1. Systematic qualitative analysis of organic compounds and preparation of suitable derivatives (including osazone formation in carbohydrates).
2. Separation of binary mixture of organic compounds using water, sodium bicarbonate, sodium hydroxide & hydrochloric acid.



(For examinations to be held in May 2023, 2024 & 2025)

### Preparations

- 1) p-Nitroaniline from acetanilide
- 2) p-Bromoaniline from acetanilide
- 3) m-Nitroaniline from nitrobenzene
- 4) Synthesis of di-benzalacetone from benzaldehyde (Claisen-Schmidt condensation)
- 5) Synthesis of benzyl alcohol and benzoic acid from benzaldehyde (Cannizzaro reaction)

### Reference Books

- 1) Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
- 2) Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7<sup>th</sup> Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- 3) Christian, Gary D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
- 4) Harris, Daniel C: *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
- 5) Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age, International Publisher, 2009.
- 6) Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- 7) Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
- 8) Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.
- 9) Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry Orient-Longman*, 1960,
- 10) Laurence M. Harwood and Christopher J. Moody, *Experimental Organic Chemistry – Principles and practice*, Blackwell Scientific Publications.
- 11) Bansal, R. K., *Laboratory Manual of Organic Chemistry*, New Age Publications.
- 12) Singh, J., *Advanced Practical Chemistry*, Pragati Prakashan.
- 13) Vishnoi, N.K., *Practical Organic Chemistry*, New Age Publications.
- 14) Singh, P.R., Gupta, D.S., Bajpai, K.S. *Experimental Organic Chemistry*, Vol. I & II, Tata McGraw Hill.
- 15) Bansal, R.K. *Laboratory Manual in Organic Chemistry*, Wiley Eastern.
- 16) Furniss, B.S., Hannaford, A.J., Rogers, V., Smith, P.W.G., Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry*, ELBS.
- 17) Rao, C.N.R., Agarwal, U.C. *Experiments in General Chemistry*, East-West Press.

(For examinations to be held in May 2023, 2024 & 2025)

### DISTRIBUTION OF MARKS

A.	Daily evaluation of practical records/viva-voce/attendance, etc.	Attendance: 05 marks
		Practical Test: 08 marks
		Day to day performance: 12 marks
B.	External Examination (100% syllabus)	Examination: 20 marks (Two practicals of 10 marks each)
		Viva-voce: 05 marks

## SEMESTER-VI

**Course No.: UCHTS 601 (Skill Theory Course SEC-4)      Theory: 30 Lectures**  
**(For examinations to be held in May 2023, 2024 & 2025)**

**Title: GREEN METHODS IN CHEMISTRY      Maximum Marks: 50**

**Credits: 02      External Examination: 40 marks**

**Time: 02 Hrs      Internal Assessment: 10 marks**

*Course Objectives: To inspire the students about the chemistry which is good for human health and environment and to make students aware about the benefits of using green chemistry.*

### ***Learning Outcomes:***

*On completion of the course, the student will be able to:*

- *Understand the basic principles of green chemistry.*
- *Understand how to design and develop materials and processes that reduce the use and generation of hazardous substances in industry.*
- *Understand how chemicals can have an adverse/potentially damaging effect on human and vegetation.*

### ***Section A: Theory and Hand-on Experiments***

Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity, green solvents, Green catalysis, alternative green sources of energy. Chemistry and sustainability.

### ***Section B: Green solutions***

Real world Cases in Green Chemistry:

- 1) Surfactants for carbon dioxide – Replacing smog producing and ozone depleting solvents with CO<sub>2</sub> for precision cleaning and dry cleaning of garments.
- 2) Designing of environmentally safe marine antifoulant.
- 3) Right fit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments.

- 4) An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

(For examinations to be held in May 2023, 2024 & 2025)

### Reference Books:

- 1) Anastas, P.T., Warner, J.K. *Green Chemistry- Theory and Practical*, Oxford University Press (1998).
- 2) Matlack, A.S. *Introduction to Green Chemistry*, Marcel Dekker (2001).
- 3) Cann, M.C., Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington (2000).
- 4) Ryan, M.A., Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington (2002).
- 5) Sharma, R.K., Sidhwani, I.T., Chaudhari, M.K. *Green Chemistry Experiments: A monograph* I.K. International Publishing House Pvt Ltd. New Delhi, Bangalore.
- 6) Lancaster, M. *Green Chemistry: An introductory text* RSC publishing, 2nd Edition.
- 7) Sidhwani, I.T., Saini, G., Chowdhury, S., Garg, D., Malovika, Garg, N. Wealth from waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated "A Social Awareness Project", *Delhi University Journal of Undergraduate Research and Innovation*, **1(1)**: 2015.

### NOTE FOR PAPER SETTERS

#### **Internal Assessment (Total Marks: 10; Time Duration: 45 minutes)**

The internal assessment test shall be held on completion of about 40% of the prescribed syllabus. The question paper will consist of eight short answer type questions of two marks each. The candidate will have to attempt any five questions (Total: 10 marks).

#### **External End Semester Examination (Total Marks: 40; Time Duration: 2 hours)**

The question paper will have three sections.

Section A will consist of four short answer type questions (with explanation having 70 to 80 words) of two marks each, covering the entire syllabus selecting two questions from each section. The candidate shall have to attempt all the questions (Total: 08 marks).

Section B will consist of four medium answer type questions (with explanation having 250 to 300 words) of five marks each, covering the entire syllabus selecting two questions from each section. The candidate shall have to attempt all the questions (Total: 20 marks).

Section C will consist of three long answer type questions (with detailed explanation having 500 to 600 words) of twelve marks each, covering the entire syllabus (1.5 questions to be set from each section). The candidate shall have to attempt any one question (Total marks: 12).

---

## SEMESTER-VI

**Course No.: UCHPS 601 (Skill Practical Course SEC-4)**

**(For examinations to be held in May 2023, 2024 & 2025)**

**Title: Laboratory Course**

**Credits: 02**

**Time: 04 Hrs**

**Maximum Marks: 50**

**External Examination: 25 marks**

**Internal Assessment: 25 marks**

### ***Learning outcomes:***

*The students will have*

- *An understanding to perform synthesis under solvent-free conditions.*
- *A functional understanding of the field of green chemistry.*
- *A working understanding of the 12 principles of green chemistry.*
- *An appreciation of how the practice of green chemistry enhances competitiveness, innovation and faster time of reactions.*

### ***Section A:***

1. Acetylation of aniline and phenol using basic alumina as a solid support.
2. Benzoylation of aniline and phenol under solvent-free conditions using alumina as a solid support.
3. Preparation and characterization of biodiesel from vegetable oil.
4. Extraction of D-limonene from orange peel.

### ***Section B:***

1. Mechano chemical solvent free synthesis of azomethine.
2. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II),  $[\text{Cu}(\text{C}_{16}\text{H}_8\text{N}_4)_2]$
3. Friedel-Crafts acylation in solvent-free conditions.
4. Solvent free benzylic oxidation using Urea-Hydrogen peroxide (UHP).

(For examinations to be held in May 2023, 2024 & 2025)

**Reference Books:**

- 1) Anastas, P.T. & Warner, J.K. *Green Chemistry- Theory and Practical*, Oxford University Press (1998).
- 2) Matlack, A.S. *Introduction to Green Chemistry*, Marcel Dekker (2001).
- 3) Cann, M.C. & Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington (2000).
- 4) Ryan, M.A. & Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington (2002).
- 5) Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. *Green Chemistry Experiments: A monograph* I.K. International Publishing House Pvt Ltd. New Delhi, Bangalore.

**DISTRIBUTION OF MARKS**

A.	Daily evaluation of practical records/vivavoce/attendance, etc.	Attendance: 05 marks
		Practical Test: 08 marks
		Day to day performance: 12 marks
B.	External Examination (100% syllabus)	Examination: 20 marks (Two practicals of 10 marks each)
		Viva-voce: 05 marks

-----