# MAHARSHI DAYANAND SARASWATI UNIVERSITY AJMER

# पाठ्यक्रम

## SYLLABUS

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

**B.Sc. with Chemistry**

B. Sc. Semester I & II Examination

( w.e.f. 2023-24)

B. Sc. Semester III & IV Examination

( w.e.f. 2024 -25)

B. Sc. Semester V & VI Examination

( w.e.f. 2025 -26)

□□□□□□□ 2023

महर्षि दयानन्द सरस्वती विश्वविद्यालय, अजमेर

MAHARSHI DAYANAND SARASWATI UNIVERSITY, AJMER

(Dr C. P. PORHARNA)

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6.6.2024

(R.S. Chauhan)

B.Sc. Course Structure

Semester I To VI

Semester I

| Type of course | Course code | Title of the course | Credits | Internal Assessment | External Examination | Total |
|---|---|---|---|---|---|---|
| DCC | CHE 5.5 01T-CO | Atomic Structure, Bonding, General Organic Chemistry & Hydrocarbons | 4 | 30 | 70 | 100 |
| DCC Practical | CHE 5.5 01 P-CO | Practical | 2 | | 50 | 50 |

Semester -II

| Type of course | Course code | Title of the course | Credits | Internal Assessment | External Examination | Total |
|---|---|---|---|---|---|---|
| DCC | CHE 5.5 02T-CE | Chemical Energetics, Equilibria & Functional Organic Chemistry | 4 | 30 | 70 | 100 |
| DCC Practical | CHE 5.5 01 P-CE | Practical | 2 | | 50 | 50 |

Semester -III

| Type of course | Course code | Title of the course | Credits | Internal Assessment | External Examination | Total |
|---|---|---|---|---|---|---|
| DCC | CHE5.503T-CO | Advance Physical And Organic Chemistry | 4 | 30 | 70 | 100 |
| SEC | CHE5.503T-SEC 1 | Basic skills of chemistry laboratory | 2 | 30 | 70 | 100 |
| DCC Practical | CHE5.503P-CO | Practical | 2 | - | 50 | 50 |

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Semester -IV

| Type of course | Course code | Title of the course | Credits | Internal Assessment | External Examination | Total |
|---|---|---|---|---|---|---|
| DCC | CHE5.504T-CE | Coordination Chemistry, States of Matter & Chemical Kinetics | 4 | 30 | 70 | 100 |
| SEC | CHE5.504T-SEC 2 | Water Quality Assessment | 2 | 30 | 70 | 100 |
| DCC Practical | CHE5.504P-CE-IV | Practical | 2 | | 50 | 50 |

Semester -V

| Type of course | Course code | Title of the course | Credits | Internal Assessment | External Examination | Total |
|---|---|---|---|---|---|---|
| DSE (A) | CHE5.505T-CO (A) | Catalysis And Enzymes | 4 | 30 | 70 | 100 |
| DSE (B) | CHE5.505T-CO (B) | Spectroscopy and separation techniques | 4 | 30 | 70 | 100 |
| DSE (C) | CHE5.505T-CO (C) | Heterocyclic compounds, polynuclear hydrocarbons, And synthetic dyes oil, Fats, detergents | 4 | 30 | 70 | 100 |
| DSE Practical (A) | CHE5.505P-CO (A) | Practical | 2 | | 50 | 50 |
| DSE Practical (B) | CHE5.505P-CO (B) | Practical | 2 | | 50 | 50 |
| DSE Practical (C) | CHE5.505P-CO (C) | Practical | 2 | | 50 | 50 |
| SEC | CHE 5.505 - SEC-3 | Basic analytical analysis | 2 | 30 | 70 | 100 |

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Semester -VI

| Type of course | Course code | Title of the course | Credits | Internal Assessment | External Examination | Total |
|---|---|---|---|---|---|---|
| DSE (A) | CHE5.506T-CE (A) | Chemistry Of Polymers | 4 | 30 | 70 | 100 |
| DSE (B) | CHE5.506T-CE (B) | Photochemistry, Chemical Kinetics and Quantum Chemistry | 4 | 30 | 70 | 100 |
| DSE (C) | CHE5.506T-CE (C) | Molecules of Life | 4 | 30 | 70 | 100 |
| DSE Practical (A) | CHE5.506P-CE (A) | Practical | 2 | | 50 | 50 |
| DSE Practical (B) | CHE5.506P-CE (B) | Practical | 2 | | 50 | 50 |
| DSE Practical (C) | CHE5.506P-CE (C) | Practical | 2 | | 50 | 50 |
| SEC | CHE 5.506 T-CE-SEC-4 | Spot Tests of Cations, Anions and Metal Poisons | 2 | 30 | 70 | 100 |

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# B.Sc. (Pass Course)
# CHEMISTRY
## General Instructions

1. The B.Sc. (Pass Course), a 3-year UG Programme, consists of six Semesters, with two Semesters per Year. Each Semester includes One Theory Course divided into three independent units, and One Practical Course, each with a unique Course Code Number and Course Title, totalling 06 Credits (04 Theory + 02 Practical's). A Theory Course comprises 60 periods of one hour each and is worth 04 credits, while a Practical Course consists of 30 periods of two hours each, contributing 02 credits. One Skill enhancement course from Semester III to Semester VI with 02 credits is compulsory. Successful candidates will receive the Degree of the three-year UG Programme upon meeting the minimum credit requirement according to university policy.

2. Each Semester end Examination carries a maximum of 150 marks (06 credits), with Theory accounting for 100 marks (04 Credits) (70 from external assessment and 30 from internal assessment), one skill enhancement course(SEC from SEM II To SEM VI only) for 100 marks (02 Credits) (70 for end semester exam and 30 marks for internal assessment) and Practical's for 50 marks. The Theory Examination at the end of each Semester lasts three hours and is graded out of 70 marks, while the Practical Examination lasts four hours and is graded out of 50 marks (02 Credits). Internal Assessment of 30 marks is conducted continuously for each Theory Course at the Department/College level, while External Assessment of 70 marks takes place at the end of each Semester at the University level. Candidates must pass both the Internal and External Assessments separately for each Theory Course. In Practical courses, External Assessment occurs only at the end of each Semester. Passing both theory and practical examinations separately is mandatory. The pass percentage criteria and grading system adhere to university policies.

3. Internal Assessment of **30 marks** of all courses with **credits 04(from semester I to semester VI)** are distributed as follows:

| | |
|---|---|
| 1. One Written Test | 20 marks |
| 2. One Assignment / project including creative skill | 05 marks. |
| 3. Attendance | 05 marks |

   i. for 75% attendance - 3 marks.
   ii. up to 90% attendance -04 marks and
   iii. from 91 to 100% attendance - 05 marks

4.Student has to choose one skill enhancement course (SEC) from the three offered disciplines of the Semester.

5.In Semester V and VI student has to opt any one DSE Course from (A to C ) aongwith corresponding Practical Course.

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## SCHEME OF EXAMINATION

Each theory course consists of four periods (one Hour each) per week, while each Practical Course is allocated two continuous periods, (each one hour).. The end-of-semester examination scheme applicable to all undergraduate courses (Pass Course) for the Theory Examination, is structured as follows: The semester end examination question paper for Disciplinary Centric Core Courses (DCC), Discipline-specific Electives (DSE) **For DCC , DSE & SEC** **Max. marks -70**

**Part-A** will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks. **Total 20 Marks**

**Part-B** will consist of 10 questions, at least three questions from each unit, Student has to answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks.

**Total 50 Marks**

**The examination scheme for the Practical Examination, for SEM I TO SEM VI is out of 50 marks, and it is conducted at the end of each Semester.**

**Scheme of Practical Examination & Distribution of Marks**

**Max. Marks: 50** **Time: 4 hours.**

1. Major Exercise (A) 15 marks
2. Minor Exercise (B) 10 marks
3. Minor Exercise (C) 10 marks
4. Record 05 marks.
5. Viva-voce 10 marks.

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# SEMESTER-III

## COURSE TITLE: ADVANCE PHYSICAL & ORGANIC CHEMISTRY

### COURSE CODE: CHE5.503T-CO

| | |
|---|---|
| **CREDITS -04 (Max. Marks -100)**<br>**Internal Assessment: Max. marks :30**<br>**Semester End Exam.: Max marks :70** | **TOTAL LECTURES -60**<br>**(One Hour each)** |

***Instructions:*** *Part-A will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.* ***20 Marks***

*Part-B will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks.* ***50 Marks***

**Course Objectives**: the main aim of this course is to Understand Solutions, conductance, and electrochemistry and to study the solutions, partial miscibility and phase equilibrium and potentiometric titrations. organic chemistry: objectives include understanding organic functional groups, reactions, mechanisms of carboxylic acids, their derivatives, amines and diazonium compounds

## UNIT I

**Solutions**: Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapor pressure-composition and temperature- composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. 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**: 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 involving eutectics, congruent and incongruent melting points (lead-silver, $FeCl_3$-$H_2O$, and Na-K only).

**(20 Lectures)**

## UNIT II

**Conductance**: 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).

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**Electrochemistry:** 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: $\Delta G$, $\Delta H$ and $\Delta S$ from EMF data, Calculation of 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).

**(20 Lectures)**

## UNIT III

**Carboxylic acids and their derivatives (aliphatic and aromatic)**

Preparation: Acidic and alkaline hydrolysis of esters.

Reactions: Hell-Volhard Zelinsky reaction, acidity of carboxylic acids, effect of substitution on acid strength.

**Carboxylic acid derivatives (aliphatic):**

Preparation: Acid chlorides, anhydrides, esters and amides from acids and their interconversion, Claisen condensation Reaction, Reformatsky reaction, Perkin condensation, Relative reactivities of acid derivatives towards nucleophiles

**Amines (aliphatic & aromatic) and Diazonium Salts**

Amines: Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction, Hofmann vs Saytzeff elimination, carbylamine test, Heinsberg test, reaction with $HNO_2$, Schotten-Baumann reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation, basicity of amines.

**Diazonium salt**

Preparation: from aromatic amines, Reactions conversions to benzene, phenol, dyes.

**(20 Lectures)**

**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


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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 7th Ed.*, W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.

**Learning outcome:**

- Describe the characteristics of solutions, phase equilibria, and the partial miscibility of liquids.
- Explain the principles and concepts of conductance, electrochemistry, and pH.
- Discuss the structural properties, synthesis methods, reaction mechanisms, and chemical properties of carboxylic acids (aliphatic and aromatic) and their derivatives.
- Understand the synthesis pathways, reaction mechanisms, and physical properties of amines.
- Explore the reactions and properties of diazonium salts, including their applications in organic synthesis.
- Apply their knowledge to analyze and solve problems related to solutions, electrochemistry, and organic compounds containing carboxylic acids, amines, and diazonium salts.

## SEMESTER -III

## COURSE TITLE: BASICS SKILLS OF CHEMISTRY LABORATORY
## COURSE CODE: CHE5.503T-SEC 1

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|---|---|
| **CREDITS -02 (Max.Marks -100)**<br>**Internal Assessment: Max. marks :30**<br>**Semester End Exam.: Max marks :70** | **TOTAL LECTURES -30**<br>**(One Hour each)** |
| ***Instructions: Part-A** will consist of 10 compulsory questions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.* ***20 Marks***<br>***Part-B** will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 200 words. Each question in Part-B will carry ten marks.* ***50 Marks*** | |
| **Course Objectives**: To learn laboratory operations, safety and first aid, use of different glass wares, Basic concepts of Concentrations, Titrimetric analysis, Calibration of analytical Instruments | |

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## Unit -I

**Laboratory operations:** Laboratory safety & First Aid, use of different glassware (pipette, burette, standard measuring flasks, distillation apparatus. filtration techniques, weighing on electronic balances.

**Basic concepts of Concentrations:** Method of expressing concentrations, weight percentage, weight by volume, weight by weight, mole concept, molarity, molality, Normality, mole fraction, ppm, ppb, ppt, oxidation numbers, equivalent weights, mass conversion between different units.

**(10 Hours)**

## Unit -II

**Titrimetric analysis:** Fundamental concepts of primary & secondary standard solutions, Making of simple and complex solutions, calculations and preparation of Normal, molar and Molal, ppm, ppb, ppt and percent solutions from solid solutes and liquid stock solutions, dilutions, serial dilutions.

**Acid base titrations:** Titration curve, pH indicators, **Redox titrations** involving $MnO^{4-}$, $Cr_2O_7^{2-}$ Redox indicators, **complexometric titrations**-EDTA titrations titration curves, metal ion indicators.

**(10 hours)**

## UNIT -III

**Calibration of analytical Instruments:** definition, requirement & verification of calibration, general principles of calibration, Calibration materials, when to calibrate instruments, different steps involved in calibration.

Calibration of analytical balances, calibration of volumetric flasks and burette, pipettes, calibration of pH meter, TDS- conductivity meter, colorimeter, UV-VIS spectroscopy systems

**(10 hours)**

**HANDS ON EXPERIMENTS:**

- **To find the amount of solute in solution of given percentage.**
- **To find the volume of solutions that contains the amount of solute given in percentage.**
- **To find the amount of solute in a solution of given ppm.**
- **To Prepare o standard solutions of $KMnO_4$, $K_2Cr_2O_7$, NaOH**
- **Calibration of pH meter & Conductivity meter.**

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References:


1. F.J. Welcher-Standard methods of analysis.
2. A.I. Vogel -a textbook of quantitative Inorganic analysis-ELBS
3. H.H. Willard and H. Deal -Advanced quantitative analysis -van Nostrand co.
4. F.D. Snell & F.M. Biffen -Commercial methods of analysis -D.B. Taraporavala & Sons.
5. J.J. Elving and I.M. Kolthoff-Chemical analysis -a series of monographs on analytical chemistry and its applications-Inter Science -Vol I to VIII.


Learning outcome:

- **To provide the basic knowledge behind the chemistry experiments, lab safety.**
- **To make the students understand about laboratory glassware and their calibrations.**
- **To make to understand about different ways to express concentration.**
- **To prepare standard solutions, dilution of solutions.**
- **Basic understanding about volumetric analysis.**
- **Basic knowledge of calibrating different laboratory instruments**

# SEMESTER-III

## COURSE TITLE: CHEMISTRY PRACTICALS-III

### COURSE CODE: CHE5.503P-CO

| | |
|---|---|
| **CREDITS -02**<br>**Semester End Exam.: Max marks :50** | **TOTAL LECTURES -30**<br>**(Two Hour each)** |
| **Course Objectives**: The aim of this course is to develop some experimental skills among the students on the topics like thermochemistry, phase rule, enthalpy, heat of neutralization, acid base and complexometric titrations, Paper and thin layer chromatography | |

**(A). Major exercises: (15 marks)**

**Qualitative Analysis: Identification of an organic compound (Solid or liquid) by chemical analysis (physical tests, element test, functional group analysis. M.P. detection and**

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specific tests) & preparation of suitable derivatives.

(B) Minor exercise: Gravimetric estimation (10 marks)

a) Estimation of barium as barium sulphate
b) Estimation of nickel as nickel di methyl glyoxime
c) Estimation of lead as lead chromate
d) Estimation of copper as copper thiocyanide.

(C) Minor exercise: Laboratory Techniques (10 marks)

a) Preparation of standard solution of NaOH and its dilution
b) Preparation of standard solution of KMnO4/ K2cr2O7 and its dilution
c) Preparation of standard solution of HCl and its dilution.

Reference books:


1. J. Mendham, R.C. Denney, J. D. Barnes; Pearson Education, New Delhi, 2009.
2. Advanced Practical Physical Chemistry; Eighteenth Edition; J.B. Yadav; Goel Publishing House, Meerut, 2015.
3. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
4. 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


Learning out comes

- Students acquire the skill of preparing standard solutions.
- They also acquire the ability to identify specific organic compounds through chemical analysis methods.
- Students are taught the technique of gravimetric estimation for various metals.

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## SEMESTER IV

## COURSE TITLE: COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS

## COURSE CODE: CHE5.504T-CE

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|---|---|
| **CREDITS -04 (Max.Marks -100)**<br>**Internal Assessment: Max. marks :30**<br>**Semester End Exam.: Max marks :70** | **TOTAL LECTURES -60**<br>**(One Hour each)** |
| *Instructions: Part-A will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.* *20 Marks*<br>*Part-B will consist of 10 questions, at least three questions from each unit, Student has to answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks.* *50 Marks* | |
| **Course Objectives**: To inculcate the basic understanding of transition elements, Lanthanoids and actinoids their properties, coordination chemistry, crystal field theory states of matter and chemical kinetics and its interdisciplinary applications among the students. | |

### UNIT- I

**Transition Elements (3d series), Lanthanoids and actinoids.**

General group trends with special reference to electronic configuration, variable valency, d-d transition and charge transfer spectra colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer & pour bax diagrams) for Mn, Fe and Cu. **Lanthanoids and actinoids**: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, actinide contraction, separation of lanthanides (ion exchange method only).

**(10 Lectures)**

**Coordination Chemistry**

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.

**(10 Lectures)**

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## UNIT –II

### Crystal Field Theory

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects 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. Jahn-Teller distortion, Square planar coordination.

**(7 Lectures)**

### Liquids

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).

**(6 Lectures)**

### Solids

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. Glasses and liquid crystals.

**(7 Lectures)**

## UNIT –III

### Kinetic Theory of Gases

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. Andrew's isotherms of CO2. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these

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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).

**(10 Lectures)**

**Chemical Kinetics**

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).

**(10 Lectures)**

**Reference Books:**


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


**Learning Outcomes:** By the end of this course, students will be able to-

1. Understand the scope of chemical kinetics,
2. Factors affecting rate of reaction,

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3. Integrated rate law for different order reactions,
4. Theories of chemical kinetics.
5. Different states of matter, properties
6. Coordination Compounds, CFT

## SEMESTER IV

## COURSE TITLE: CHEMISTRY PRACTICALS - IV

## COURSE CODE: CHE5.504P-CE

| | |
|---|---|
| CREDITS -02<br>Semester End Exam.: Max marks :50 | TOTAL LECTURES -30<br>(Two Hour each) |
| **Course Objectives:** The aim of this course is to develop some experimental skills among the students on the topics like thermochemistry, phase rule, enthalpy, heat of neutralization, acid base and complexometric titrations, Paper and thin layer chromatography | |

**A. Major Exercise: (15 Marks)**

1. Determination of the transition temperature of the given substance by thermometric /dilatometric method (e.g. $MnCl_2.4H_2O$ / $SrBr_2.2H_2O$)
2. To study the effect of a solute (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system)
3. To determine the solubilities of benzoic acid at different temperatures and to determine $\Delta H$ of the dissolution process.
4. To determine the enthalpy of neutralization of a weak acid weak base verses strong acid and strong base and determine the enthalpy of ionization of the weak acid/weak base.

**B. Minor Exercise: (10 Marks)**

1. Determination of acetic acid in commercial vinegar using acid base titrimetry.
2. Determination of alkali content in antacid tablet using acid base titrimetry.
3. Estimation of calcium content in chalk as calcium oxalate by redox titration.
4. Estimation of hardness of water by complexometric method.

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**C. Minor Exercise : (10 Marks)**

1. Separation value of mixture of two organic compound by paper chromatography
2. Separation of a mixture of two dyes by TLC / paper Chromatography
3. Separation of mixture of two amino acids by paper chromatography

**Books Suggested:**


1. Practical Chemistry: Giri Bajpai and Pandey, S. Chand & Co. Ltd., New Delhi
2. Practical Chemistry (Hindi Ed.): Suresh Ameta & P. B. Punjabi, Himanshu Publication


## Semester-IV

### COURSE TITLE: WATER QUALITY ASSESSMENT

### COURSE CODE: CHE5.504T-SEC 2

| | |
|---|---|
| CREDITS -02 (Max.Marks -100)<br>Internal Assessment: Max. marks :30<br>Semester End Exam.: Max marks :70 | TOTAL LECTURES -30<br>(One Hour each) |
| *Instructions: Part-A will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.* 20 Marks<br>*Part-B will consist of 10 questions, at least three questions from each unit, Student has to answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 200 words. Each question in Part-B will carry ten marks.* 50 Marks | |
| **Course Objectives:** Aim The course intends to prepare a student to acquire skills on the art of water monitoring and quantitative analysis of critical water quality parameters. It also brings in those aspects of chemistry which are important for water quality management and pollution control. | |

## Unit-I

**Water Quality Fundamentals:** Chemistry of water, Physical and chemical properties, Water recourses, Impurities in water. Meaning of the terms: Portability, Sewage, Affluent, Sample, Contamination, Eutrophication, Pollutants, water pollution, Source of water pollution, Major water pollutants. Types of water pollution: Ground water pollution. Fresh water pollution, Surface water pollution (River pollution, Pond and Lake pollution), Marine pollution (Oil Spills). Effects of pollution on water quality and aquatic life, Health Hazards, Control measures.

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(10 hours)

## Unit-II

**Water Quality parameters and water analysis I -** Physical parameters, Chemical parameters, Bacteriological parameters. Water Quality parameters: Physical parameters, Chemical parameters, Bacteriological parameters. Hardness of water: Formation of hard water, Types of hardness. Degree of hardness. Units of hardness. Determination of hardness: Soap solution method. Complexometric titration method using EDTA. Disadvantages of hard water: Domestic purposes, Industrial purposes. Alkalinity of water: Types of Alkalinities, Significance of Alkalinity, Estimation of Alkalinity

(10 hours)

## Unit-III

**Water Analysis-II**

Dissolved oxygen, Biological Oxygen Demand, Chemical Oxygen Demand. Total Solids. Determination of Chlorides by Argentometric method. Determination of Fluorides by SPADNS method. Determination of Nitrate by Phenol Di -sulphonic method. Determination of Sulphate by Gravimetric method. Determination of Dissolved Oxygen by Winkler's method.

**Municipal Water and Wastewater Treatment Techniques** Municipal Water: Specifications for Drinking water. Treatment of water for Domestic purposes: Pre-treatment, Removal of Suspended impurities, Method of Disinfection of water.

**Waste water:** Introduction, Characteristics of Wastewater, need for Wastewater treatment. Preliminary treatment: Grit Chamber, Floatation, Skimming Tank, Screening. Primary, secondary, and tertiary treatments,

(10 hours)

## Hands on Practice:

- Determination of pH and conductivity,
- Test for acidity and alkalinity,
- Test for total hardness,
- Test for chloride, calcium, iron etc.,
- calculation of magnesium content and total solids.

## Reference Books:

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1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
2. Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry 6th Ed.*, Saunders College Publishing, Fort Worth (1992).
3. Pollution and Bioremediation- P.C Trivedi
4. An Introduction to Environmental pollution- B.K.Sharma
5. Environmental science; S.C. Santra, New Central Book Agency.
6. A text book of environmental studies; D.K. Asthan, S. Chand &Camp Ltd.
7. Environmental studies: Dr. K. Mukkanti, S. Chand & Camp Ltd.
8. 'Water and waste water engineering; R.C. Rangwala.
9. Water and wastewater engineering (Vol. II) Fair/ Geyer/ Okum.
10. Methodology of water analysis; M.S. Kodarkar, IAAB Publication, Hyderabad.
11. Wastewater engineering; Metcalf and Eddy, Inc. Pub.
12. Chemical and biological method for water pollution R.K. Trivedi and P.K. Geol, Environ. Pub.

## Learning Outcomes:

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

1. Explain the general properties of water and understand water resources and water conservation.
2. Develop awareness about water quality criteria and standards, and their relation to public health and environment.
3. Understand important parameters for measuring water quality.
4. Know about the methods for the determination of water quality parameters.
5. Learn how to run accurate water quality tests and to determine how the parameters relate to each other.

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SEMESTER-V

COURSE TITLE: CATALYSTS & ENZYMES

COURSE CODE: CHE5.5 05 T-CO

DSE -A (ELECTIVE PAPER)

| | |
|---|---|
| **CREDITS -04 (Max. Marks -100)**<br>**Internal Assessment: Max. marks :30**<br>**Semester End Exam.: Max marks :70** | **TOTAL LECTURES -60**<br>**(One Hour each)** |
| ***Instructions: Part-A** will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.*<br>***20 Marks***<br>***Part-B** will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks.*<br>***50 Marks*** | |
| **Course Objectives:** The paper is designed in such a way that it will enrich students with the knowledge of various types of catalyst such as organometallic catalyst, biocatalyst, and photocatalyst and uses of metalloenzymes. The paper has been drafted to impart the theoretical and practical knowledge of catalysts with the view of their industrial applications. | |

## UNIT -I

**Introduction of Catalyst**: General principles of catalysis, properties of catalysts, Mode of action of catalyst, Types of catalyst (homogeneous and heterogeneous catalysis), Deactivation and regeneration of catalysts, catalytic poison, Promoter, Turnover frequency, Turnover number, Specificity, and selectivity

**Catalysis**: Theories of catalysis, Intermediate formation theory, steady state method, Enzyme Catalysis-mechanism. Effect of temperature on enzyme catalysis. Michaelis-Menten equation

**(20 Lectures)**

## Unit-II

**Catalytic action of enzymes**: catalytic action enzymes, industrial catalysis. Metal ion catalysis, industrial importance of their compounds as catalysts, catalysts for refining and petrochemical industries

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**Catalysis by Organometallic Compounds:** Study of the following industrial processes, catalytic cycle, and their mechanism: Alkene hydrogenation (Wilkinson's Catalyst), Synthetic gasoline (Fischer Tropsch reaction), Polymerisation of ethene using Ziegler-Natta catalyst.

**(20 Lectures)**

## UNIT-III

**Biocatalysts:** Introduction, Kinetics of enzyme–catalysed reactions, Industrial process with biocatalyst, Aspartame through enzymatic peptide synthesis, 4-Hydroxyphenoxypropionic acid as herbicide intermediate

**Uses of Metalloenzymes** (Carbonic anhydrase. Carboxypeptidase) Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes and their applications, use of enzymes in food industry, brewing and cheese making, high fructose corn syrup, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes, and recombinant DNA technology

**(20 Lectures)**

References


1. Enzyme Chemistry: Impact & Applications: Ed. Collin J Suckling. Chapman and Hall.
2. Fundamental of Enzymology: N.C. Price and I. Stevens: Oxford University Press 3th Edn 2006
3. Immobilized Enzymes: An introduction and Application in Biotechnology: Michael D. Trevan. John Wiley.
4. Enzyme Structure and Mechanism: A Fersht, W.H, Freeman.
5. Homogeneous Catalysis, G.W. Persons, John Wiley N.Y. 1990
6. Principles & Application of Homogeneous Catalysis. A. Kira Nakamura Minoru Tstsui, John Wiley N.Y. 1980
7. Introduction to the Principles of Homogenous Catalysis, J.M. Thomas & W.J. Thomas, Academic Press London 1967
8. Biology of Chemists, Dr. P.K. Agarwal, PragatiPrakashan
9. Biochemistry, John K joseph
10. Enzymes, S.K. Singh M2AC10-CP-02 PRACTICAL Dura
11. Huheey, J. E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), **Inorganic Chemistry-**
12. Jens Hagen (2015) **Industrial Catalysis: A Practical Approach** Wiley-VCH Verlag
13. GmbH & Co Bioorganic Chemistry: A Chemical Approach to Enzyme Action (Springer Verlag) : Hermes Dugas and C Penny Understanding Enzymes (Prentice Hall), Trevor Palmer
14. Biochemistry: The Chemical Reactions of living cells (Academic Press), De Metzler


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15. Catalysis, concept, and green application: Gadi Rothenberg: Cambridge University Press

Understanding Enzyme. Trevor Palmer: Prentice Hall

## Learning outcome:

By the end of this course, students will be able to:

1. Establish an appreciation of the role of catalyst in industrial applications.
2. Gain sound knowledge of various types of catalyst.
3. Get skilled in the scientific method of planning, developing, conducting, reviewing and reporting experiments.
4. Get skilled concepts of industrial catalysis which will help them to explore new innovative areas of research.

# SEMESTER-V

## COURSE TITLE: SPECTROSCOPY& SEPARATION TECHNIQUES

## COURSE CODE: CHE5.5 05 T-CO

### DSE – B (ELECTIVE PAPER)

| | |
|---|---|
| **CREDITS -04 (Max. Marks -100)**<br>**Internal Assessment: Max. marks :30**<br>**Semester End Exam.: Max marks :70** | **TOTAL LECTURES -60**<br>**(One Hour each)** |
| ***Instructions:*** *Part-A will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.* ***20 Marks***<br>*Part-B will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks.* ***50 Marks*** | |
| **Course Objectives:** The objective of this course is to introduce the students to the concepts and basic principles of UV-Visible spectroscopy, IR spectroscopy, NMR spectroscopy and separation techniques, its applications and to establish the relation between structure and spectra. To understand different types of spectroscopy ,Sseparation techniques, solvent extraction and chromatography. | |

### UNIT-I

**Spectroscopy:** Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law: Electromagnetic radiation and its interaction with matter. Difference between atomic and molecular spectra. Born- Oppenheimer approximation: Separation of molecular energies into translational, rotational, vibrational, and electronic components.

**UV-Visible Spectrometry:** Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instruments. Electronic excited states. Free electron model and its application to electronic spectra of polyenes. chromophores, auxochromes,

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bathochromic and hypochromic shifts Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

**Infrared Spectrometry:** Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instruments. sampling techniques. Selection rules, IR spectra of diatomic molecules. Structural information derived from vibrational spectra. Effect of hydrogen bonding (inter- and intramolecular) and substitution on vibrational frequencies. Structural illustration through interpretation of data, Effect and importance of isotope substitution.

**(20 Lectures)**

## UNIT -II

**Nuclear Magnetic Resonance Spectroscopy:** Principle of nuclear magnetic resonance, number of signals, peak areas equivalent & non-equivalent protons, positions of signals, chemical shift. Shielding & deshielding of protons, proton counting, splitting of signals & coupling constants, magnetic equivalence of protons. Discussion of PMR spectra of molecules : ethyl bromide, n propyl bromide, isopropyl bromide 1,1-dibromoethane 1,1,2- tribromo ethane, ethanol, toluene, acetaldehyde, acetophenone. Simple problems on PMR spectroscopy for structure determination of organic compounds. **(20 Lectures)**

## UNIT-III

**Separation techniques:**

**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. **Chromatography:** Classification, types and basic principle of chromatography and their applications (paper chromatography column, GLC, TLC and HPLC, Ion exchange)

**(20 Lectures)**

**References:**


1. Banwell, C.N.; McCash, E.M. (2006), **Fundamentals of Molecular Spectroscopy,** Tata McGraw- Hill.
2. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry,** McGraw Hill Education, ,Vol 4, 5th Edition, McGraw Hill Education.
3. Dua A and Tyagi P, **Molecular Spectroscopy: Quantum to Spectrum,** (2022) Atlantic Publishers & Distributors Pvt Ltd.
4. B.K.Sharma, Instrumental methods of Chemical Analysis


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**Learning outcome:**

By the end of the course, the students will be able to:

- . Understand and use basic concepts of IR and UV-VIS spectroscopy for interpretation of spectra.
- Understand the basics and structure elucidation of NMR spectroscopy.
- Understand and use basic concepts of separation techniques.

## SEMESTER-V

## HETROCYCLIC COMPOUNDS, POLYNUCLEAR HYDROCARBONS AND SYNTHETIC DYES, OIL, FATS, DETERGENTS

## COURSE CODE: CHE5.5 05 T-CO

### DSE - C (ELECTIVE PAPER)

| | |
|---|---|
| **CREDITS -04 (Max. Marks -100)**<br>**Internal Assessment: Max. marks :30**<br>**Semester End Exam.: Max marks :70** | **TOTAL LECTURES -60**<br>**(One Hour each)** |
| ***Instructions:*** ***Part-A*** *will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.* ***20 Marks***<br>***Part-B*** *will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks.* ***50 Marks*** | |
| **Course Objectives:** The course aims to impart knowledge about reactions and structures of heterocyclic compounds, polynuclear hydrocarbons, active methylene compounds and dyes.To Gain fundamental knowledge of chemistry involved in the oils/ fats. To understand the basics of soaps, surfactants and detergents. | |

### UNIT-I

**Heterocyclic compounds:** Molecular orbital picture and aromatic characteristics of pyrrole, furane, thiophene and pyridine, methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution reactions, mechanism of nucleophilic substitution reactions in pyridine derivatives, comparison of basicity of pyrrole, piperidine, and pyridine,

Introduction to condensed five and six membered heterocycles: preparation and reactions of indole, quinoline, and isoquinolines with special reference to Fisher Indole synthesis, Skraup synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquionline

**(20 LECTURES)**

### UNIT II

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UNIT- II

**Active methylene compounds:** Preparation: Claisen ester condensation. Keto-enol tautomerism. Reactions: Synthetic uses of ethyl acetoacetate (preparation of non-heteromolecular having up to 6 carbon)

**Polynuclear Hydrocarbons:** Nomenclature, Synthesis & reactions of Naphthalene, Anthracene & Phenanthrene. Relative reactivity of these compounds at various positions with reference to electrophilic and nucleophilic substitution

**Dyes:** Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes –structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples

**(20 LECTURES)**

**Unit III**

**Oils and Fats:** General idea, Classification, Occurrence, Basic idea of the function of oils and fats, Physical and chemical properties of oils and fats, Applications of oils and fats. Analysis of oils and fats: Determination of physical constants like M.P. and B.P., Specific gravity, Refractive index, Total volatile matter, Determination of Acid value, Iodine value, Saponification value, R.M. value and Polenske number.

**Soaps and detergents:** Idea of common soaps, cleansing action of soaps, Varieties of soaps and their uses, Idea of detergents, Hazards of soaps and detergents Analysis of soaps and detergents: Determination of Matter insoluble in alcohol, Free alkali and free acids, Matter insoluble in water, Glycerol content (Dichromate method), Foaming capacity and its comparison in different samples of soaps and detergents, Effect of sodium carbonate on the foaming capacity of soap.

**(20 LECTURES)**

**References:**


1. Methods of Sampling and Test for oils and fats, I.S.I, New Delhi
2. Methods of Sampling and Test for soaps and detergents, I.S.I, New Delhi
3. Organic Chemistry by Kapoor, Singh and Mukherjee
4. Organic Chemistry of Natural Products Vol. I and II by: Chatwal
5. Chemistry in Engineering and Technology by: Kuriacose and Raja Ram
6. W. W. Porterfield. (1993). Inorganic Chemistry: A Unified Approach, 2nd ed. Academic Press, San Diego, CA.


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**Learning outcome:**

1. On completion of this course, student shall be able to:
2. Understand reactions and structures of heterocyclic compounds, polynuclear hydrocarbons.
3. Able to understand structure and reactions of reactive methylene groups
4. Gain fundamental knowledge on basics of chemistry involved in the oils/ fats especially in context of drying Oils. Implement different modes of derivatizations of oils/ fatty acids along with studying the basic process of analysis of oils\ fats.
5. Understand the basics of soaps, surfactants and detergents and Able to explain the composition of soaps and detergents. Interpret the effect of use of new generation of surfactants in formulation and comment on quality standards of soaps, surfactants and detergents.
6. Gains knowledge about synthetic dyes, their structure and action.

## PRACTICALS

## SEMESTER-V

## COURSE TITLE: CHEMISTRY PRACTICALS (V-A)

## COURSE CODE: CHE5.5 05 P-CO (A )

| | |
|---|---|
| CREDITS -02<br>Semester End Exam.: Max marks :50 | TOTAL LECTURES -30<br>(Two Hour each) |
| **Course Objectives:** The aim of this course is to perform some physical experiments, synthesis of inorganic complexes and some laboratory techniques. | |

### Major exercise: (15 Marks)

(A) Physical Experiments :

a. To determine the activation parameters for the acid catalysed hydrolysis of an ester
b. To determine the catalytic coefficient for the acid catalysed hydrolysis of an ester.
c. To study complex formation & determine stability constant by Mole-ratio method.
d. To determine the relative strengths of 1N hydrochloric acid and N/2 hydrochloric acid.

### Minor exercise (10 Marks)

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(B) Synthesis of following complexes (10 Marks)

1. Synthesis of sodium trioxalato ferrate (III) $Na_3[Fe(C_2O_4)_3]$
2. Synthesis of Nickel dimethyl Glyoximate complex $Ni(DMG)_2$
3. Synthesis of copper tetraamine complex $[Cu(NH_3)_4]SO_4$

**Minor exercise (10 Marks)**

(C) Laboratory techniques and spectroscopy

1. Steam distillation and separation of naphthalene from its suspension in water
2. Clove oils from cloves
3. To verify Beer-Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of the given solution of the substance.

Suggested Books.


1. 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.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,* Universities Press.
5. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.


**Learning outcomes:**

- Spectroscopy experiments
- Physical chemistry experiments.
- Learn methods of synthesis of inorganic complexes

## PRACTICALS

## SEMESTER-V

## COURSE TITLE: CHEMISTRY PRACTICALS (V-B)

## COURSE CODE: CHE5.5 05 P-CO (B)

| | |
|---|---|
| **CREDITS -02**<br>**Semester End Exam.: Max marks :50** | **TOTAL LECTURES -30**<br>**(Two Hour each)** |
| **Course Objectives:** The aim of this course is to learn analysis of binary organic mixture, their separation and identification of organic compounds, paper, thin layer and column chromatography and some laboratory techniques and stereochemistry. | |

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## Major exercise: (15 Marks)

(A) Analysis of an organic mixture containing two solid components using water / NaOH separation and preparation of suitable derivatives.

## Minor exercise (10 Marks)

(B) Chromatography (At least two)

1. Separation of ortho and para nitro phenols by thin layer chromatography
2. Separation of fluorescein and methylene blue by Column Chromatography
3. Separation of leaf pigments from spinach leaves by Column Chromatography
4. Separation of leaf pigments from spinach leaves by Paper Chromatography

**Minor exercise (10 Marks)**

(C) Laboratory techniques & stereochemistry

1. Steam Distillation of Naphthalene from its suspension in water.
2. Stereochemical studies of organic compounds via models.
   a) R and S configuration of optical isomers
   b) E and Z configuration of geometrical isomers
   c) Configurational analysis of cyclohexane and substituted cyclohexane

## Suggested Books.


1. 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.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,* Universities Press.
5. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.


**Learning outcomes:**

- Understand the various concepts of geometrical isomerism and optical isomerism. Describe CIP rules to assign E, Z notations and R& S notations.
- Explain D and L configuration and *threo* and *erythro* nomenclature.
- Learn separation and identification of organic compounds.
- Learn synthesis of derivatives of organic compounds.
- Thin layer, paper and column chromatography.

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# PRACTICALS

## SEMESTER-V

## COURSE TITLE: CHEMISTRY PRACTICALS-V-C

## COURSE CODE: CHE5.5 05 P-CO (C )

| | |
|---|---|
| CREDITS -02<br>Semester End Exam.: Max marks :50 | TOTAL LECTURES -30<br>(Two Hour each) |
| **Course Objectives:** The aim of this course is to learn analysis oil, synthesis of organic compounds and some laboratory techniques. | |

### (A)Major exercise: (15 Marks)

Analysis of an oil /Fat

a. To estimate the acid value of given Oil/Fat sample.
b. To Estimate the iodine value of given Oil/Fat sample
c. To estimate the saponification value of given Oil/Fat sample.

### (B)Minor exercise (10 Marks)

Synthesis of following compounds (10 Marks)

a. Preparation of acetanilide from aniline and acetyl chloride
b. Synthesis of p -Nitro acetanilide from Acetanilide
c. Synthesis of p- Bromo Acetanilide from acetanilide.
d. Preparation of m -dinitrobenzene from nitro benzene.

### (C)Minor exercise (10 Marks)

Laboratory techniques & stereochemistry

1. Steam distillation and separation of naphthalene from its suspension in water.
2. Separation of Ortho and Para nitro phenols by thin layer chromatography.
3. Stereochemical studies of organic compounds via models
   a. R and S configuration of optical isomers
   b. E and Z configuration of geometrical isomers
   c. Configurational analysis of cyclohexane and substituted cyclohexane

Suggested Books.


1. 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.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman,


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1960.

3. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,* Universities Press.
5. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
6. Advanced Experimental Chemistry, Vol I Physical, J.N. Gurtu and R Kappor, S Chand & Co.
7. Selected Experiments in Physical Chemistry, N.G. Mukherjee, J.N. Ghose & Sons.
8. Experiments in Physical Chemistry, J.C. Ghosh, Bharati Bhavan.

**Learning outcomes:**

- Understand the various concepts of geometrical isomerism and optical isomerism. Describe CIP rules to assign E, Z notations and R& S notations.
- Explain D and L configuration and *threo* and *erythro* nomenclature.
- Learn methods of synthesis of organic compounds.
- Learn the analysis of oil or fat sample.
- Learn the thin layer Chromatography.

## SEMESTER V

### COURSE TITLE: BASIC ANALYTICAL ANALYSIS

### COURSE CODE: CHE5.5 05 -SEC -3

| | |
|---|---|
| **CREDITS -02 (Max.Marks -100)**<br>**Internal Assessment: Max. Marks :30**<br>**Semester End Exam.: Max Marks :70** | **TOTAL LECTURES -30**<br>**(One Hour each)** |
| ***Instructions: Part-A** will consist of 10 compulsory questions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.* ***20 Marks***<br>***Part-B** will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks.* ***50 Marks*** | |
| **Course Objectives:** To learn laboratory operations, safety and first aid, use of different glass wares, Basic concepts of Concentrations, Titrimetric analysis, Calibration of analytical Instruments | |

### UNIT -I

**Introduction:** Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision, and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

**Analysis of soil:** Composition of soil. Concept of pH and pH measurement.

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Complexometric titrations, Chelation, Chelating agents, use of indicators **(10 Lectures)**

## UNIT -II

**Analysis of food products:** Nutritional value of foods, idea about food processing and food preservations and adulteration. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.

Analysis of preservatives and colouring matter. **(10 Lectures)**

## UNIT -III

**Analysis of cosmetics:** Major and minor constituents and their function Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration **(10 Lectures)**

**HANDS ON PRACTICE:**

1. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
2. Determination of pH of soil samples.
3. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration
4. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
5. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink.

**Reference Books:**


- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry 6th Ed.*, Saunders College Publishing, Fort Worth (1992).
- Harris, D. C. *Quantitative Chemical Analysis*, W. H. Freeman.
- Dean, J. A. *Analytical Chemistry Notebook*, McGraw Hill.
- Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India.
- Freifelder, D. *Physical Biochemistry 2nd Ed.*, W.H. Freeman and Co., N.Y. USA (1982).
- Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA. 16 (1977).
- Vogel, A. I. *Vogel's Qualitative Inorganic Analysis 7th Ed.*, Prentice Hall.
- Vogel, A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.*, Prentice Hall.
- Robinson, J.W. *Undergraduate Instrumental Analysis 5th Ed.*, Marcel Dekker, Inc., New York (1995)


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## SEMESTER -VI

## COURSE TITLE: CHEMISTRY OF POLYMERS

### COURSE CODE: CHE5.506T-CE

### ELECTIVE: DSE (A)

| | |
|---|---|
| CREDITS -04 (Max. Marks -100)<br>Internal Assessment: Max. marks :30<br>Semester End Exam.: Max marks :70 | TOTAL LECTURES -60<br>(One Hour each) |

*Instructions: Part-A will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.* **20 Marks**

*Part-B will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks.* **50 Marks**

**Course Objectives:** The course aims to strengthen the conceptual knowledge of Polymers, their structure, physical properties, synthetic methods, mechanisms and their applications of polymer chemistry. It helps the students to invent, design, make and use materials for products, processes, and services. depth understanding of polymer processing, the structure of polymer and their properties, including the intricate relationships between them.

## Unit I

**Polymers:** Introduction, history, classification, nomenclature, molecular forces and chemical bonding, texture of polymers. Type of polymerization: Condensation, addition polymerization, and their mechanism. Ziegler-Natta polymerization of alkenes. Mechanism of cationic, anionic and free radical addition polymerization.

**Kinetics of polymerization:** Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

**Functionality and its importance:** Formation of synthetic polymer, classification of polymerization processes, relationships between functionalities, extent of reaction and degree of polymerization, bifunctional systems, poly-functional systems.

**(20 Lectures)**

## UNIT II

**Crystallization and Crystallinity:** Determination of crystalline melting point and degree of crystallinity, morphology of crystalline polymers, factors affecting crystalline melting point.

**Nature and structure of polymers-** Structure Property relationships.

**Determination of molecular weight of polymers** (Mn, Mw, *etc.*) by end group analysis, viscometry, light scattering and osmotic pressure methods, molecular weight distribution and

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its significance, polydispersity index.

**Polymer Solution:** Criteria for polymer solubility, solubility parameter, thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, lower and upper critical solution temperatures

**(20 Lectures)**

## UNIT- III

**Synthesis and applications of Polymers:** Preparation and applications of Plastics - thermosetting (phenol-formaldehyde, polyurethanes) and thermos softening (PVC, polythene); **Fabrics** -natural (cellulose and synthetic derivatives of cellulose like rayon and viscose); **synthetic polymers:** (acrylic, polyamide, polyester); Rubbers-natural and synthetic: Buna-N, Buna-S, Neoprene, silicon rubber; Vulcanization; Polymer additives. Preparation, structure, properties, and application of the following polymers- polyolefins, polystyrene and styrene copolymers, poly (vinyl chloride) and poly (vinyl acetate), acrylic polymers, polyamides. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers.

**(20 Lectures)**

**Reference:**


1. Seymour, R.B. &Carraher, C.E. *Polymer Chemistry: An Introduction,* Marcel Dekker, Inc. New York, 1981.
2. Odian, G. *Principles of Polymerization*, 4th Ed. Wiley, 2004.
3. Billmeyer, F.W. *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971.
4. Ghosh, P. *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991.
5. Lenz, R.W. *Organic Chemistry of Synthetic High Polymers.* Interscience Publishers, New York, 1967.
6. Seymour, R.B. &Carraher, C.E. *Polymer Chemistry: An Introduction,* Marcel Dekker, Inc. New York, 1981.
7. Odian, G. *Principles of Polymerization*, 4th Ed. Wiley, 2004.
   Billmeyer, F.W. *Textbook of Polymer Science*, 2nd Ed. Wiley In


**Learning Outcomes:**

By the end of this course the students will be able to:

- Learn about the chemistry of natural and synthetic polymers including fabrics and rubbers.
- Understand the kinetics of polymerization and determination of molecular weight of polymers.

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SEMESTER -VI

**COURSE TITLE: PHOTOCHEMISTRY, CHEMICAL KINETICS AND QUANTUM CHEMISTRY**

**COURSE CODE: CHE5.506T-CE**

**ELECTIVE: DSE (B)**

| | |
|---|---|
| **CREDITS -04 (Max. Marks -100)**<br>**Internal Assessment: Max. marks :30**<br>**Semester End Exam.: Max marks :70** | **TOTAL LECTURES -60**<br>**(One Hour each)** |
| ***Instructions: Part-A** will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.* ***20 Marks***<br>***Part-B** will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks.* ***50 Marks*** | |
| **Course Objectives:** This course is designed to deliver information about the chemistry of photochemistry, chemical kinetics, and quantum chemistry. Key emphasis is placed on understanding the principles of photochemistry, performance of chemical reaction and quantum chemistry. | |

## Unit I

**Photochemistry:** Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus-Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the exited sate. qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, actinometry, photosensitized reactions-energy transfer processes (simple examples). **(Lectures: 20)**

## Unit II

**Chemical Kinetics**

Rate of reaction, factors influencing the rate of reaction. Concentration dependence of rates, mathematical derivation of zero order, first order, second order, pseudo-order reactions, half-life and mean life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Experimental methods of chemical kineties conductometric, potentiometric and spectrophotometric. Theories of chemical kinetics: effect of temperature on rate of reaction. Arrhenius equation, concept of activation

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energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis) and Expression for the rate constant. Complex reaction kinetics, parallel reaction, reversible reaction and consecutive reaction. **(Lectures: 20)**

## UNIT-III

**Quantum Chemistry:** Introduction, Black-body radiation, photo electric effect, Planck's radiation law, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect, de-Broglie hypothesis, Heisenberg's uncertainty principle, Sinusoidal wave equation, Schrodinger wave equation and its importance, postulates of quantum mechanics, operators, Hamiltonian operator, eigen function and eigen values, physical interpretation of the wave function.

**Applications of quantum mechanics:** Particle in one dimensional and two-dimensional box, Schrodinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial and angular wave functions, selection rule and spectra of hydrogen atom. **(Lectures: 20)**

**Books Suggested:**


1. Physical Chemistry, G.M. Barrow. International Student Edition, McGraw Hill.
2. Basic Programming with Application, V.K. Jain. Tata McGraw Hill.
3. University General Chemistry, C.N.R Rao, Mac Millan.
4. Physical Chemistry, RA. Alberty, Wiley Eastern Ltd.
5. A Textbook of Physical Chemistry: A. S. Negi and S. C. Anand
6. Kundu and Jain Organic Chemistry, Morrison and Boyd, Prentice Hall.
7. Organic Chemistry, L.G. Wade Jr. Prentice Hall.


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Semester VI

COURSE TITLE: MOLECULES OF LIFE

COURSE CODE: 5: CHE5.506T-CE

ELECTIVE: DSE (C)

| | |
|---|---|
| **CREDITS -04 (Max. Marks -100)**<br>**Internal Assessment: Max. marks :30**<br>**Semester End Exam.: Max marks :70** | **TOTAL LECTURES -60**<br>**(One Hour each)** |
| ***Instructions: Part-A** will consist of 10 compulsory questions., The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.* ***20 Marks***<br>***Part-B** will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 400 words. Each question in Part-B will carry ten marks.* ***50 Marks*** | |
| **Course Objectives:** The course aims to strengthen the conceptual knowledge of carbohydrates, amino acids and Enzymes. It also focuses on comprehensive relationship between structure and function as well as nucleic acid structure and properties of lipids. | |

## UNIT I

**Carbohydrates:** Classification of carbohydrates, reducing and non-reducing sugars, general properties of glucose and fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of glucose (Fischer), cyclic structure of glucose and fructose, Haworth projections. Linkage between monosaccharides, structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

**(20 Lectures)**

## UNIT II

**Amino Acids, Peptides and Proteins:** Classification of amino acids, Zwitter ion structure and isoelectric point. Overview of primary, secondary, tertiary and quaternary structure of proteins, determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (up to dipeptides) by N-protection (t-butyl oxy carbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.

**Enzymes:** Introduction, mechanism of enzyme action, factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive and noncompetitive inhibition including allosteric inhibition).



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(20 Lectures)

## UNIT III

**Nucleic Acids:** Components of nucleic acids- adenine, guanine, thymine, cytosine and uracil (structure only), other components of nucleic acids, nucleosides and nucleotides (nomenclature), structure of polynucleotides, structure of DNA (Watson-Crick model) and RNA (types of RNA), genetic code, biological roles of DNA and RNA- replication, transcription and translation.

**Lipids:** Introduction to lipids, classification, oils and fats- common fatty acids present in oils and fats, omega fatty acids, trans fats, hydrogenation, saponification value, iodine number, iodine value, acid value. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

(20 Lectures)

**Reference Books:**


1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt.Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
3. Finar, I. L. *Organic Chemistry* (*Volume 2*), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
4. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*, W. H.Freeman.
5. Berg, J.M., Tymoczko, J.L. &Stryer, L. *Biochemistry*, W.H. Freeman, 2002.


**Course Learning Outcomes:**

1. To offer detailed knowledge of biomolecules for living systems
2. To understand sugars from monosaccharides to polysaccharides
3. To provide basic concepts of structural organization and characterization of proteins
4. To acquire knowledge on physicochemical properties and characterization of lipids
5. To understand the structure of DNA and RNA and their types

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SEMESTER VI

CHEMISTRY PRACTICALS- A

COURSE CODE: CHE5.506P-CE (A)

| CREDITS -02<br>Semester End Exam.: Max marks :50 | TOTAL LECTURES -30<br>(Two Hour each) |
|---|---|
| **Course Objectives:** The aim of this course is to develop practical skills of conductometric titrations, Potentiometric titrations Inorganic synthesis and colorimetric experiments and lab techniques. | |

**Major exercise: (15 Marks)**

**(A) Any two of the following experiments:**

1. Determination of Hydroxyl value of a polymer/resin
2. Determination of iodine value of a polymer/ Resin
3. Determination of Saponification value of polyesters/Alkyl resin
4. Determination of carbonyl value of polymer/Resin
5. Determination of amine value of Polymer /resin
6. Determination of molecular weight of polymer by viscometry

**(B) Minor exercise (10 Marks)**

**Synthesis of following Organic Polymers**

1. Preparation of nylon 6,6
2. Redox polymerization of acrylamide
3. Preparation of urea-formaldehyde resin
4. Preparation of Phenol -Formaldehyde Resin.
5. Precipitation polymerization of acrylonitrile
6. Preparations of novalac resin/resole resin.

**(C) Minor exercise (10 Marks)**

Lab technique

1. Polymer characterization: Identification of polymers By solubility tests.
2. Preparation of standard solutions.
3. Dilution of 0.1M to 0.001 M solution.
4. Calibration of Volumetric flasks, burettes, pipettes

**Learning outcomes:**

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- Understand the various concepts of synthesis of organic compounds.
- Learn methods of synthesis of organic compounds.
- Learn physical experiments using various instruments.
- Learn preparation of solutions used in experiments of physical chemistry.

**Suggested Books.**


1. 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.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,* Universities Press.
5. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
6. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman


## SEMESTER VI

## CHEMISTRY PRACTICALS-B

## COURSE CODE: CHE5.506P-CE (B)

| | |
|---|---|
| CREDITS -02<br>Semester End Exam.: Max marks :50 | TOTAL LECTURES -30<br>(Two Hour each) |
| **Course Objectives:** The aim of this course is to develop practical skills of conductometric titrations, Inorganic synthesis, colorimetric experiments and lab techniques. | |

**Major exercise: (15 Marks)**

**(A) Any Four of the following experiments:**

1. Determination of cell constant of a given conductivity cell.
2. Determination of equivalent conductance of a weak electrolyte at different concentration and the dissociation constant of the electrolyte.
3. Study the kinetics of saponification of ethyl acetate by NaOH at two temperatures by conductance measurements and hence determine the energy of activation of the reaction.
4. Perform the following conductometric titrations:



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a. Strong acid vs. strong base
b. Weak acid vs. strong base
c. Mixture of strong acid and weak acid vs. Strong base
d. Strong acid vs. Weak base

5. Perform the following potentiometric titrations:
(a) Strong acid vs. strong base
(b) Weak acid vs. strong base
(c) Dibasic acid vs. strong base

**(B) Minor exercise: (10 Marks)**

Synthesis of following compounds **(Any three)**

1. Preparation of Hexaammine Cobalt (Iii) Hexanitro Cobaltate (III)
2. Preparation Of Turnbull's Blue.
3. Preparation Of Prussian Blue.
4. Preparation Of Bis (Dimethylglyoxamato) Nickel (II)
5. Preparation Of Hexaammine Nickel (II) Chloride

**(C) Minor exercise: (10 Marks)**

Laboratory techniques:

1. Preparation of buffer solution and determination of their pH (Any five buffer solutions)
2. Preparation of standard solutions.
3. Dilution of 0.1M to 0.001 M solution.
4. Calibration of Volumetric flasks, burettes, pipettes

**Learning outcomes:**

- Learn methods of synthesis of Inorganic compounds.
- Learn physical experiments using various instruments.
- Learn preparation of solutions used in experiments of physical chemistry.

**Suggested Books.**


1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
2. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.


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SEMESTER VI

CHEMISTRY PRACTICALS-C

COURSE CODE: CHE5.506P-CE (C)

| | |
|---|---|
| CREDITS -02<br>Semester End Exam.: Max marks :50 | TOTAL LECTURES -30<br>(Two Hour each) |
| **Course Objectives:** The aim of this course is to develop practical skills of organic synthesis, qualitative and quantitative estimation of Amino Acids, carbohydrates. | |

**Major exercise: (15 Marks)**

**(A) Any three of the following experiments:**

1. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer Chromatography (TLC)
2. Separation and identification of the amino acids present in the given mixture by paper chromatography. Reporting the Rf values
3. TLC separation of a mixture of dyes (fluorescein and methylene blue.
4. Paper chromatographic separation of a mixture containing 2/3 amino acids
5. To determine the concentration of glycine solution by formylation method
6. Estimation of glucose by Fehling's solution.
7. Determination of total sugar content by ferricyanide method (volumetric/colorimetric method).
8. Isolation caffeine from tea leaves or coffee.
9. Isolation of Piperine from black pepper.
10. Separation of monosaccharides: A mixture of D -Galactose and D- fructose by paper chromatographyusing n- butanol: acetone;water (4;5:1), spray reagent Aniline Hydrogen Phtahlate

**(B) Minor exercise (10 Marks)**

**Synthesis of following organic compounds (Any three)**

1. Acetylation of aniline, /aspirin, /glucose
2. benzoylation of aniline and phenol
3. Preparation of iodoform from ethanol and acetone
4. Preparation of methyl orange / methyl red

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5. Preparation of benzoic acid from toluene (oxidation)
6. Preparation of aniline from nitrobenzene
7. Preparation of nitro aniline from m -dinitrobenzene
8. Preparation of paracetamol.
9. Preparation of Aspirin.

**(C) Minor exercise (10 Marks)**

1. Tests to differentiate between reducing/ non reducing sugar.
2. Synthesis of Osazones.
3. Determination of protein by the Biuret reaction.
4. Qualitative tests for amino acids

**Learning outcomes:**

- Understand the various concepts of synthesis of organic compounds.
- Learn methods of synthesis of organic compounds.

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**Suggested Books.**


1. 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.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,* Universities Press.
4. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
5. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman


## SEMESTER - VI

## COURSE TITLE: SPOT TESTS OF CATIONS, ANIONS AND METAL POISONS

## COURSE CODE: CHE 5.5 06 T-CE-SEC-4

| | |
|---|---|
| **CREDITS -02 (Max.Marks -100)**<br>**Internal Assessment: Max. Marks :70**<br>**Semester End Exam.: Max Marks :30** | **TOTAL LECTURES -30**<br>**(One Hour each)** |

***Instructions:*** ***Part-A*** *will consist of 10 compulsory questions. The answer to each question should be limited to a maximum of 50 words. Each question in Part-A will carry two marks.* ***20 Marks***

***Part-B*** *will consist of 10 questions, at least three questions from each unit, Student must answer five questions, selecting at least one question from each unit. The answer to each question should be limited to a maximum of 200 words. Each question in Part-B will carry ten marks.* ***50 Marks***

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**Course Objectives:** The aim of this course is to impart knowledge about spot tests, procedure, and its applications to metal, cation and anion analysis.

## Unit-I

Introduction. Chemical analysis, types of Qualitative inorganic analysis. Classification of anions & cations into groups. Group reagents & reactions for cations only. Role of complexation in identification of cations. **Spot – Test Analysis:** Definition, Types of spot tests, basic principles, Advantages, and disadvantages, spot test procedures, special aids used in spot analysis.

**(10 lectures)**

## Unit-II

**Applications of spot tests in identification of some anions: principle, procedure, and applications of spot test in identification of some anions viz**

**(10 lectures)**

$CO_3^{2-}$, $SO_4^{2-}$, $PO_4^{3-}$, $SCN^-$, $Cl^-$, $NO_3^-$,

## Unit-III

**Applications of spot tests in identification of some cation of,** Aluminum, copper, Iron, zinc, Mn, Mg etc. spot tests to identify the various cations in a sample.

**Applications of spot tests in identification of some metal poisons: test and analysis of various metals copper, cadmium, arsenic ,cobalt in minerals, salts, and biological samples**

**(10 lectures)**

**Reference:**

**1.Spot analysis,F. Feigel. V. Anger**

**Learning outcome:**

The process of qualitative analysis assumes that each chemical test for an ion is unique to that ion. The students will learn chemical reactions that are used in the anion, cation and metal poisons spot tests.

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