Scheme of Studies for BS Chemistry Four Years Program
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credit hours</th>
<th>Semester - I</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG-100 English-I (Functional)</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>GEN-100 General-I</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>GEN-101 General-II</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>MATH-100 Mathematics-I Mathematics-I/Functional Biology</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>COMP-100 Computer and Its Applications in Chemistry</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>CHEM-151 Inorganic Chemistry</td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>18</strong></td>
<td></td>
<td></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credit hours</th>
<th>Semester - II</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG-200 English-II (Functional)</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>GEN-200 Islamic Studies / Ethics</td>
<td></td>
<td></td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>GEN-201 General-III</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>MATH-200 Mathematics-II/Functional Biology/University Optional</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>STAT-100 Statistics</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>CHEM-161 Organic Chemistry</td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
<td></td>
<td></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credit hours</th>
<th>Semester - III</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG-300 English-III (Report Writing)</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>GEN-300 Pakistan Studies</td>
<td></td>
<td></td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>GEN-301 General-IV</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>GEN-302 General-V</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>CHEM-141 Environmental Chemistry</td>
<td></td>
<td></td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>CHEM-171 Physical Chemistry</td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16</strong></td>
<td></td>
<td></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credit hours</th>
<th>Semester - IV</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG-400 English-IV / University Optional</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Course Title</td>
<td>Credit hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>--------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEN-400 General-VI</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEN-401 General-VII</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM-111 Analytical Chemistry</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM-121 Industrial Chemistry</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM-131 Biochemistry</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credit hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title</strong></td>
<td><strong>Credit hours</strong></td>
</tr>
<tr>
<td>Semester - V</td>
<td>Theory</td>
</tr>
<tr>
<td>CHEM-251 Inorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM-261 Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM-271 Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM-211 Analytical/-CHEM-231 Bio-Chemistry</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credit hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester - VI</td>
<td>Theory</td>
</tr>
<tr>
<td>CHEM-351 Inorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM-361 Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM-371 Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM-311 Analytical/-CHEM-331 Bio-Chemistry</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

| Semester - VII: Specialization                   | Theory | Practical |
| (Inorganic/Organic/Physical/Applied/Analytical/Bio Chemistry) |         |           |
| Paper-I                                          | 3       | 0         |
| Paper-II                                         | 3       | 0         |
| Paper-III                                        | 3       | 0         |
| Practical-I                                      | 0       | 1         |
| Elective Course-I (other than the field of specialization) | 3   | 0         |
| Research Project / Advanced Practical / Position Paper (literature survey) | 0 | 2 |
| **Total**                                        | **12**   | **3**     |

| Semester - VIII: Specialization                  | Theory | Practical |
| (Inorganic/Organic/Physical/Applied/Analytical/Bio-Chemistry) |         |           |
| Paper - IV                                       | 3       | 0         |
| Paper - V                                        | 3       | 0         |
| Paper - VI                                       | 3       | 0         |
| Practical - II                                   | 0       | 1         |
| Elective Course - II (other than the field of specialization) | 3   | 0         |
The list of general courses was also reviewed and approved as follows:

**List of General Courses:**

(Proposed in NCRC special meeting in Chemistry)

1. Social Psychology
2. Community Development
3. Environmental Sciences
4. Principles of management
5. Logic and Reasoning
6. Teaching and Learning
7. Social Issues of Pakistan
8. Entrepreneurship
10. Basic Financial Management
11. History of Human Civilization
12. History of Science

**OR**

Any other, including supportive science courses other than chemistry, depending upon the expertise available.
Scheme of Studies for M.Sc Two Years Program
### SCHEME OF STUDIES M.Sc TWO YEARS PROGRAM IN CHEMISTRY, PALOSA CAMPUS AWKUM

<table>
<thead>
<tr>
<th>Semester-I</th>
<th>Semester-II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S.NO</strong></td>
<td><strong>Paper</strong></td>
</tr>
<tr>
<td>1</td>
<td>Analytical Chem. paper-I</td>
</tr>
<tr>
<td>2</td>
<td>Biochemistry paper-I</td>
</tr>
<tr>
<td>3</td>
<td>Inorganic Chem. paper-I</td>
</tr>
<tr>
<td>4</td>
<td>Organic Chem. paper-I</td>
</tr>
<tr>
<td>5</td>
<td>Physical Chem. paper-I</td>
</tr>
<tr>
<td>6</td>
<td>Mathematics</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester-III (Specialization)</th>
<th>Semester-IV (Specialization)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S.NO</strong></td>
<td><strong>Paper</strong></td>
</tr>
<tr>
<td>1</td>
<td>Env. /Computational Chem. Paper-I</td>
</tr>
<tr>
<td>2</td>
<td>Specialization Paper-I</td>
</tr>
<tr>
<td>3</td>
<td>Specialization Paper-II</td>
</tr>
<tr>
<td>4</td>
<td>Specialization Paper-III</td>
</tr>
<tr>
<td>5</td>
<td>Specialization Paper-IV</td>
</tr>
<tr>
<td>6</td>
<td>Special practical/research</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

**Specialization papers:** Inorganic/analytical, Biochemistry, Organic and Physical Chemistry, the student will have to opt for one field of Specialization.
COURSE OUTLINES OF M.Sc TWO YEARS PROGRAM IN CHEMISTRY, AWKUM

M.Sc. 1st –Year, Semester -I

Course Title: Analytical Chemistry Paper-I  Code: CHEM-511
Credit Hours: 02  Marks: 100

Course Contents
Introduction to Analytical Chemistry, Classical methods of analysis, Analytical Sampling: Data handling: Stoichiometric calculations, Chemical Equilibrium, acid/base, Solubility and Complexation equilibria, Electroanalytical techniques, Classifications of Electroanalytical techniques, Potentiometry and conductometry with applications, Introduction to spectroscopic techniques.

Analytical Chemistry Practical  Cr. Hrs: 01
1. To determine the exact weight of materials and to analyze replicate measurement statistically.
2. To calibrate Volumetric Apparatus and to investigate errors in delivered volume.
3. To determine the concentration of strong acid solution by conductometric titration.
4. To determine the individual concentration of acid in the given binary mixture of strong/weak acid conductometrically.
5. To evaluate $K_{sp}$ for lead iodate by conductance method.
6. To determine the solubility product of Cadmium iodate titrimetrically.
7. To determine the constancy of the solubility product.
8. To estimate $Ca^{++}$ concentration in drinking water by EDTA Complexometric titration.
9. To determine the concentration of strong acid potentiometrically using first and second derivative method.
10. To determine $pK_a$ for the given set weak acids by potentiometric method.
11. To show independence of solubility on the amount of undissolved species.
12. To establish the stochiometric relation for the precipitation of silver chloride.

Books Recommended
- Robert D. Braun, Introduction to Chemical Analysis,
- David Harvey, Modern Analytical Chemistry

Course Title: Biochemistry Paper-I  Code: CHEM- 531
Credit Hours: 02  Marks: 100

Course Contents
Introduction, Importance and the scope of Biochemistry. Forms, functions and
brief classification of prokaryotes. Cellular architecture and diversity of eukaryotes.

**Physical aspects of biochemistry**

Water, ionization of water, pH, Acid-base reactions, Buffers.

**Water**


**Biomolecules**

Overview of Biomolecules and their structures including proteins, carbohydrates, lipids and nucleic acids.

**Nucleic Acids**

Nucleosides and Nucleotides, Purines and Pyrimidines. Introduction to DNA, RNA.

**Metabolism Pathways**

Glycolysis, Tricarboxylic acid Cycle, Gluconeogenesis.

**Evolution of life**

Prebiotic molecular evolution and rise of living systems. Review of the variety and ecology of the living world. Use and significance of Radioisotopes in Biochemistry.

**Books Recommended**


**Biochemistry Practical**

**Credit Hours:** 01

**Marks:** 50

1. Preparation of solutions
   
   - Preparation of Percent solutions (W/V, V/V and milligram percent).
- Preparation of Molar Solutions.
- Preparation of Normal / equivalent solutions.
- Preparation of Molal solutions.
- Preparation of ppm and ppb solutions.
- Preparation of solution from given stock solution by dilution method.

2. Standardization of given solution.

3. Determination of pH of different samples and body fluids.
   (pH meter, pH strip/paper and Titrimetric method)

4. Preparation of Buffers: Phosphate buffer, Acetate buffer, Citrate buffer, Universal buffer

**Books Recommended**


**Course Title:** Inorganic Chemistry Paper-1  **Code:** CHEM-551  
**Credit Hours:** 03  **Marks:** 100

**Non Aqueous Solvents**

Classification of solvents, types of reactions in different solvents, effect of physical and chemical properties of solvents on reactions, detailed study of liquid NH₃, liquid H₂S, liquid HF and liquid SO₂ as solvents.

**Coordination Compounds**

Study of coordination compounds regarding their historical back ground, nomenclature, geometry, theories i.e. Jorgensen theory, Werner's theory, valence bond theory, crystal field theory and molecular orbital theory. Properties of coordination compound i.e.
magnetic properties, stability and stereochemistry. Techniques for studying coordination compounds and their applications.

Books Recommended


Inorganic Chemistry Practical

Credit Hours: 01  
Marks: 50

1. Analysis of salts mixtures for anions and cations
2. Preparation of at least four coordination compounds in a pure state
3. Complexometric titrations

Course Title: Organic Chemistry Paper- I  
Code: CHEM- 161

Credit Hours: 03  
Marks: 100

Course Contents

Introduction to Organic Chemistry, chemistry of carbon compounds; organic chemistry, a historical perspective.

Chemical Bonding and Properties of Organic Molecules

Localized and delocalized chemical bonding; concept of hybridization leading to bond angles, bond lengths, bond energies and shape of organic molecules; dipole moment;
inductive and field effects; resonance; aromaticity; tautomerism; hyperconjugation; hydrogen bonding; acids and bases; factors affecting the strengths of acids and bases.

**Stereochemistry**

Introduction to Stereochemistry, stereoisomerism, geometrical isomerism, E/Z notations, chirality, enantiomers and diasteromers, meso compounds, optical isomerism, optical activity and specific rotation, absolute configuration and relative configuration, R/S nomenclature, conformations and conformational analysis ethane, n-butane and cyclohexane.

**Classes and Nomenclature of Organic Compounds**

Classification of organic compounds; development of systematic nomenclature of organic compounds; IUPAC nomenclature of hydrocarbons and heteroatom functional groups.

**Recommended Books**


**Organic Chemistry Practical**

**Marks: 50**

**Credit Hours: 01**

1. Laboratory Ethics and safety measures
2. Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations
3. Laboratory work illustrating topics covered in the lecture of Organic Chemistry Paper I

**Recommended Books**

Kinetic Theory of Gases


Chemical Thermodynamics


Chemical Kinetics


Physical Chemistry Practical

Credit Hours: 01                  Marks: 50

1. Equilibrium constant of the $KI + I_2 \rightarrow KI_3$ reaction.
2. Kinetics of saponification of ethyl acetate.
3. Study of the adsorption isotherms of acetic acid-charcoal system.
4. Determination of activation energy for the acid catalyzed hydrolysis of ethyl acetate.
5. Determination of partial molar volumes.
6. Characterization of the given compound by UV-Vis spectroscopy.
Books Recommended


5. Smith, E. Brain, “Basic Chemical Thermodynamics” 5\textsuperscript{th} ed., Imperial College Press (2004).


Course Title: Analytical Chemistry Paper-II  
Code: CHEM-211  
Credit Hours: 02  
Marks: 100

Course Contents

Analytical Chemistry Practical  
Credit Hours: 01
1. To verify Beer’s Law and to evaluate molar extinction coefficient.
2. Spectrophotometric determination of Ammonia.
3. To determine Iron by spectroscopic method using phenanthroline.
4. To determine the distribution coefficient of a given solute between an aqueous/non-aqueous system.
5. To determine Calcium by indirect volumetric method.
6. To determine Zinc by direct titration with EDTA.
7. Colometric determination of Iron(III) with Potassium thiocynate.
8. To separate and quantify Copper in Brass using constant-current electrolysis.
9. To estimate Lead amperometrically through titration with Potassium dichromate.

Books Recommended
3. Robert D. Braun, Introduction to Chemical Analysis,
5. David Harvey, Modern Analytical Chemistry.
Course Title: Inorganic Chemistry Paper-II  
Code: CHEM- 251

Credit Hours: 03  
Marks: 100

Course contents

Acceptor Complexes

Mononuclear and polynuclear metal carbonyls: Calculation of valance electrons, the eighteen electrons rule as applied to metal carbonyls, rationalization of molecular structure, evaluation of structures based on spectroscopic evidences, chemistry of metal carbonyls and their derivatives (nitrosyls, halides and hydrides)

Chemistry of f-Block Elements

**Lanthanides:** Electronic structure and position in the periodic table, Lanthanide’s contraction, oxidation states, spectral and magnetic properties, general characteristics, occurrence, extraction and general principles of separation, complexes and uses.

**Actinides:** Electronic structure and position in the periodic table, oxidation states, general characteristics, half life and decay law.

Books recommended


Inorganic Practical

Credit Hours: 01  
Marks: 50
1. Separation of cations and anions in a mixture by paper chromatography.

2. Redox Titration

3. Gravimetric estimation of $\text{Ba}^{2+}$ and $\text{Fe}^{3+}$ ions

Course Title: Organic Chemistry Paper- II  Code: CHEM- 261
Credit Hours: 03  Marks: 100

Course contents

**Functional Chemistry:** A brief introduction to the chemistry of hydrocarbons, alkyl, halides, alcohol, phenols, ethers, aldehydes, ketones and carboxylic acids and their derivatives.

**Reaction Mechanism:** Introduction to reaction mechanism, methods of determination of the reaction mechanism and comprehensive study on the mechanism of different types of substitution addition and elimination reaction with emphasis on their determination.

**Introductory organic Spectroscopy:** Introduction to UV, IR, $^1$HNMR and mass spectrometric methods and their uses for the structure determination of simple organic compounds.

**Recommended Books**


**Organic Chemistry Practical**

Credit Hours: 01  Marks: 50

Laboratory work illustrating topics covered in the lecture of Organic Chemistry Paper II
Recommended Books


Course Title: Physical Chemistry Paper-II Code: CHEM-271
Credit Hours: 03 Marks: 100

Electrochemistry

An introduction to electrochemistry, Ohm’s law, conductance, molar conductance and equivalent conductance, chemical reactions and redox potentials, electrochemical cells and types of electrodes. Ionic activity and Debye Huckle theory, Nernst equation and its applications.

Solution Chemistry

Solubility and Henry’s law, statistical thermodynamics of ideal solution and non ideal solutions, colligative properties and lowering of vapour pressure, elevation in boiling point, depression in freezing point, osmotic pressure and their applications in determination of molecular masses. Salt hydrolysis and determination of hydrolysis constant (K).

PRACTICAL

Credit Hours: 01 Marks: 50

**Recommended Books**


M.Sc, 2ND YEAR – SEMESTER- III

Course Title: Environmental Chemistry Paper-1  
Code: CHEM-

Credit Hours: 02+01  
Marks: 100

The atmosphere and air pollution:

Structure and properties of the atmosphere, temperature inversion and air pollution, atmosphere photochemistry, possible depletion of stratospheric ozone, natural vs polluted air, particulate matter, analysis and control of particulations, sulphur oxides, effects of sulphur dioxides and particulates, other industrial air pollutants, carbon monoxide, oxides of nitrogen photochemicals smog, airborne load, control of automobile emissions.

Water and water treatment:

Unique physical and chemical properties of water, criteria of water quality, natural water-eutrophiction, detergents and phosphates, importance of micro organisms in water purification, primary and secondary treatment of water, advanced waste water treatment, removal of nitrogen and phosphorus, sources of industrial water pollution, heavy metals and mercury.

The green revolution:

Pest control, pesticides, toxicity of pesticides, pest management.

Books Recommended:

3. S. K. Banerji, Environmental chemistry, Tata Publisher, Delhi.
4. Staneley E. Manahan, Environmental chemistry, Brooks, California

SPECIALIZATION IN ANALYTICAL CHEMISTRY

Title of Course: Elementary Analytical Chemistry Paper-1  
Code: CHEM-311

Credit Hours: 03  
Marks: 100

Course Contents

The task of statistics in chemical analysis: Theory of sampling, source of variation and error, Presentation of results and rounding off the data. Confidence limit for the mean and standard deviation, comparison of standard deviations, inference from the tests, fitting lines to data, correlation and regression.

Precipitation
Solubility and solubility product. Effects of salt, solvents, hydration, hydrolysis, pH changes, beginnings surface exchange, adsorption etc, on precipitates. Determination of error in gravimetric analysis, thermogravimetric methods for testing of thermal stability.

Complexation

Chelate formation; competing reactions in complexation. The computation of stability constant from various experimental data. The use of complexes in analytical chemistry as reagents. Masking agents. Indicators and metal ion buffers. Complexometric titrations.

Books Recommended

6. David Harvey, Modern Analytical Chemistry.

Title of Course: Chromatographic Techniques Paper-II  
Code: CHEM-312

Course Contents

Chromatography

Adsorption and distribution laws applied to chromatography, the displacement, frontal method of analysis and elution techniques: Column, paper and thin-layer chromatography, suitable systems for analysis of some simple organic substances, reversed phase chromatography, high pressure liquid chromatography.

Gas chromatography

GSC and GLC parameters governing gas phase separation, simple instrumentation for gas chromatography, suitable systems for analysis high temperature programmed analysis.

Introduction to HPLC

Books Recommended


**Course Title: Spectroscopy and Advanced Instrumentation Paper-III  Code: CHEM-313**

Credit Hours: 03  
Marks: 100

**Course Contents**

Ultraviolet, visible spectroscopy; Molecular absorption of radiation, effect of structure on absorption, quantitative absorption spectroscopy, application,

**Instrumentation**

Various sources of light. Types of prime and gratings. Monochromators and their efficiency. The construction and optics of typical spectrograph. The use of a spectrophotometer in the analysis of one component or multicomponent systems, source of error and optimum conditions.

**Atomic spectroscopy**

Atomic absorption spectrophotometers and atomic fluorescence spectrometer. Flame photometry. Mass spectrometry, basic principles, instrumentation and applications.

**Books Recommended**


---

**Course Title: Advanced Analytical Chemistry Paper-IV  Code: CHEM-314**

Credit Hours: 03  
Marks: 100

**Course Contents**

DTA and TGA Basic principles, instrumentation and applications, thermal analysis and calorimetry. Automation in analytical chemistry: Instrumental parameters for automated instrument, automated process and instruments in process control and clinical laboratory. Preparation of sample for the analysis.

**Books Recommended**


**Advance Analytical Chemistry Lab/Research.**

Credit Hours: 03
Marks: 100
SPECIALIZATION IN BIOCHEMISTRY BIO-CHEMISTRY

Course Title: Biochemistry Paper -II

Credit Hours: 03

Marks: 100

Biochemistry-1

Brief introduction to the history and scope of biochemistry.

Physical aspects of biochemistry

Water, ionization of water, pH, Acid-base reactions, Buffers.

Biomolecules-Carbohydrates


Proteins

Classification and properties of Amino acids. Overview of protein structure: Primary, Secondary, Tertiary and Quaternary structures. Protein denaturation and folding. Proteins classification, properties, functions and their biological role.

Lipids

Classification, Fatty acids and their properties. Biological significance of glycerides. Phospholipids, non-phospholipids and steroids.

Nucleic Acids

Introduction to DNA, RNA. Nucleosides and Nucleotides, Purines and Pyrimidines.

Enzymes


Metabolism Pathways

Glycolysis, Tricarboxylic acid Cycle, Gluconeogenesis.

Books Recommended


Course Title: Biochemistry Paper- III  Code: CHEM- 332
Credit Hours: 03  Marks: 100

Molecular biology
Gene theory, Gene, Allele, Structure of DNA, Chromosome, DNA replication, Transcription, Translation and post translational modification. DNA repair, Recombination, Gene expression and regulation, Genotype and Phenotype, Mutation and Types of mutation, DNA Sequencing.

Books Recommended

Course Title: Biochemistry Paper: IV

Credit Hours: 03
Marks: 100

Physical techniques in Biochemistry


Books Recommended

6. Hawk’s Physiological chemistry Mc Graw-Hill publishing company
Course Title: Biochemistry Paper- V

Credit Hours: 03

Molecular genetics

Mendelian and Non-Mendelian genetics, Patterns of Inheritance, Mutational Analysis, Recombination and Genetic Mapping, Linkage Analysis, Chromatin and Chromosome, Mitosis and Meiosis, Interaction of genes, Chromosomal basis of heredity, Sex chromosome and Sex determination, Chromosomal aberrations, Gene mutations, Genetic code.

Books Recommended


Advanced Biochemistry laboratory/Research thesis

Credit Hours: 03

1. Qualitative Analysis of carbohydrates of given unknown samples.
2. Extraction of starch from plant sources & its confirmative tests (Sources: Potato, Wheat, Rice, Pulses, Barely, Maize etc)
3. Extraction of Glycogen from animal sources & its confirmative tests. (Sources: Liver & Muscles etc)
4. Extraction of total Lipids from plant seeds (by iodometric flask method). (Sources: Sunflower seed, Cotton seed, Corn seed, Coconut, Neem Seed, sesame).
5. Extraction of Lipids from animal sources. Sources: Egg yolk & Animal tissues).
6. Qualitative tests of proteins & amino acids:
   Biuret Test, Niuhydrin Test, Xanthoproteic Test, Pauly’s Test, Hoplein’s Test,
   Ehrich’s Test, Sakaguchi Test, Sodium nitroprusside Test, Sullivan Test, Load sulphate Test, Phosphate Test, Aldehyde Test
7. Extraction of proteins from plant sources & their confirmative tests
   (Sources: Wheat, Rice Barely, Maize, Pulses etc)
8. Extraction of proteins from animal sources & their confirmative tests. (Sources: Egg White, Milk, Liver, Muscles etc)

9. Isolation of DNA from tissues

10. Extraction of plasmid DNA

11. Separation of DNA fragments by gel electrophoresis

12. Determination of melting temperature of DNA


14. Determination of sodium and potassium content in blood serum by flame photometer, Gel chromatography and ion exchange chromatography.

15. Determination of molecular weight of a given protein by gel filtration.

16. Separation of Hb and serum proteins by electrophoresis

Books Recommended


SPECIALIZATION IN INORGANIC CHEMISTRY

Course Title: Chromatographic Methods of Analysis Paper-III, Code: CHEM-351

Credit Hours: 03 Marks: 100

Course contents

Paper chromatography, thin layer chromatography, Theory and applications. Gas chromatography, basic principles, instrumentation and applications. High pressure liquid chromatography, partition chromatography, adsorption chromatography, liquid solid chromatography and Ion Exchange chromatography. Basic principles instrumentation and applications.

Recommended Books


Course Title: Nuclear Chemistry Paper-IV Code: CHEM-352

Credit Hours: 03 Marks: 100

Course contents

Nuclear Reactions

Nature of nuclear reactions, nuclear reaction mechanism, Nuclear cross sections, excitation functions, types of nuclear reactions, fission and fusion reactions and photonuclear reactions,

Radioactivity decay, detection and interaction of radiations


Books Recommended

**Course Title: Bio Inorganic Chemistry Paper-V  Code: CHEM-353**

Credit Hours: 03  
Marks: 100

Course contents

Biochemistry of selenium, Bio Chemistry of Organo selenium Compounds, Antioxidant Activity of Organoselenium Compounds, Toxicology of Organoselenium Compounds; The biochemistry of iron, Iron storage and transfer in bacteria, ion transport, haemoglobin and myoglobin, nature of haemo-dioxygen, Model systems, cytochromes, P/450 enzymes, iron sulphur protein, ferredoxins, haemoerthrins, the biochemistry of Zn, Cu, Co, Mg, F₂, I₂ and Alkaline earth metals.

**Books Recommended**


**Course Title: Spectroscopic Methods of analysis-Paper-VI  Code: CHEM-354**

Credit Hours: 03  
Marks: 100

Course contents

**General introduction to spectroscopy**

Atomic absorption spectroscopy, Origin of spectra, excitation methods spectrographs and its qualitative and quantitative applications.

**UV/Visible spectroscopy**

Basic instrumentation of U.V/visible spectrophotometers, Spectra of transition metal complexes, applications of the principles related to electronic transition. Structural evidence from electronic spectra

**Emission spectroscopy**

Atomic emission spectroscopy, qualitative and quantitative applications in inorganic chemistry.
Books Recommended


Advance Inorganic chemistry laboratory

Advance inorganic laboratory/research Credit Hours = 03
SPECIALIZATION COURSES IN ORGANIC CHEMISTRY

Course Title: Chemistry of Heterocycles Paper- III
Code: CHEM- 351

Credit Hours: 03
Marks = 100

Course contents

Introduction, significance and applications. Nomenclature of heterocyclic compounds according to IUPAC, Hantzsch-Widmann-Pettersen system and SMILES. Geometry and Stereochemistry of heterocyclic compounds

Saturated, Unsaturated and Aromatic Heterocycles, aromaticity, Tautomerism in small to large ring heterocycles. Chemistry of Furan, Thiophene and pyrrole; synthesis of indole and isoindoles; chemistry of pyridine, quinoline and isoquinoline; occurrence of heterocyclic compounds.

Photochemistry


Recommended Books


Course Title: Spectroscopic Methods in Organic Chemistry Paper- IV
Code: CHEM- 352

Credit Hours: 03
Marks: 100

Course Contents


Books Recommended
Course Title: Stereochemistry Paper- V                Code: CHEM- 353

Credit Hours: 03                                       Marks: 100

Course contents


Book Recommended

Course Title: Organic synthesis Paper-VI  

Code: CHEM- 354

Credit Hours: 03  
Marks: 100

Course contents

Oxidations/Reduction Reactions, an introduction to carbon-carbon bond synthesis, Reactive intermediates, Pericyclic reactions.

Books Recommended


Advance Organic Chemistry Laboratory/Research Thesis

Credit Hours: 03  
Marks: 100

Multistep synthesis of different types organic compounds, purification and identification of synthesized compounds by physical and chemical methods.

Books Recommended

SPECIALIZATION IN PHYSICAL CHEMISTRY

Course Title: Statistical Thermodynamics Paper-III       Code: CHEM- 371

Credit Hours: 03                  Marks: 100

Permutation and probability, Partition functions. The relationship of partition function to the various thermodynamic functions like translational energy, vibrational energy, rotational energy, entropy, heat, enthalpy, pressure, Gibbs free energy, Entropy of mixing of gases, heat capacity etc. Transitional, vibrational and rotational partitional functions and equilibrium constant.

Books Recommended


Course Title: Polymer Chemistry Paper-IV       Code: CHEM- 372

Credit Hours: 03                  Marks: 100


Recommended Books


Course Title: Quantum Chemistry Paper-V  
Code: CHEM- 373

Credit Hours: 03  
Marks: 100


Books Recommended

Course Title: Photochemistry Paper-VI  
Code: CHEM- 374

Credit Hours: 03  
Marks: 100

Books Recommended

Advanced Physical Laboratory
Credit Hours: 03 Marks: 100
Specific experiments may be set making use of the following instruments depending upon their availability. Special experiments may also be designed for which a specimen list of instruments is given below. For the innovative designing of experiments the Journal of Chemical Education may be consulted.

Instruments:
PH-meter, Conductivity meter, Dipole meters, Electrogravimetric apparatus, UV/Visible spectrometer
Infrared spectrophotometer, Atomic absorption spectrophotometer, Stopped flow spectrometers
Gas Chromatography, HPLC, Light Scattering Instruments

Practical
Determination of partial molar quantities.
Determination of free energy changes, standard free energies.
Verification of Kohlrausch law.
Study of temperature dependence of electrode potentials.
Determination of heat of solution, ionic reactions and other experiments from thermochemistry.

Determination of molecular weight of a polymer by viscosity method.

Precipitation value of electrolytes.

Measurement of IR spectra of simple compound and their interpretation.


Determination of dipole moment of an organic liquid.

Determination of percentage composition of $\text{KMnO}_4$-$\text{K}_2\text{Cr}_2\text{O}_7$ in given solution by spectrometry.

Evaluation of pKa value an indicator by spectrometric method.

Synthesis of metal oxide nanoparticles and their characterization using IR and XRD techniques.

**Books Recommended**


M.SC, 2ND YEAR, SEMESTER-IV (FINAL SEMESTER)

Course Title: Environmental Chemistry Paper-II  
Code: CHEM-

Credit Hours: 03  
Marks: 100

Fossil fuels and energy sources

Origin and development of coal: Origin and reserves of petroleum and natural gas, composition and classification of petroleum, refining, and environmental problems associated with petroleum, nuclear fission reactors, solar energy, power synthesis, tidal and geothermal energy, synthetic chemical fuels, the H economy, electrochemical energy conversion, conservation of free energy, the energy balance of the earth.

Soils and mineral resources

Estimating reserves of mineral resources of earth, extraction of metal-general principles, iron, steel, aluminium, copper and other metals, sulphur and nitrogen. Organic matter in soil, soil nutrients, ion exchange in soils, solid pH and nutrients availability.

Books Recommended


3. S. K. Banerji, Environmental chemistry, Tata Publisher, Delhi.

4. Staneley E. Manahan, Environmental chemistry, Brooks, California.
SPECIALIZATION ANALYTICAL CHEMISTRY SEMESTER- IV

Course Title: Advanced Analytical Chemistry Paper-VI Code: CHEM-411
Credit Hours: 03 Marks: 100
Course Contents
1. DTA and TGA: Basic principles, instrumentation and applications, thermal analysis and calorimetry.
2. Automation in analytical chemistry: Instrumental parameters for automated instrument, automated process and instruments in process control and clinical laboratory.
3. Preparation of sample for the analysis.

Books Recommended

Course Title: Electro-Analytical Techniques Paper-VII Code: CHEM-412
Credit Hours: 03 Marks: 100
Course Contents
1. Electrode Phenomenon: The electrochemical cell. Oxidation and reductions potentiometric methods, various types of electrodes and their use, over potentials membrane potentials, some well known redox reactions of analytical importance, ion selective electrodes, direct potentiometric measurement, potentiometric titration.
2. Voltammetry: Principal of voltammetry, Instrumentation, different modes of polarography. Application of the inorganic and organic analysis, Principles of stripling voltammetry, types of stripling voltammetry and application analysis of cation and anions.
3. Introduction to Coulometry and Amperometry.
4. Electrophoresis; Basic theory, instrumentation and applications
5. Radiochemical methods: Neutron activation analysis, isotopic dilution method, radiometric methods, application

Books Recommended
Course Title: Spectroscopy and Advanced Instrumentation Paper-VIII
Code: CHEM-413
Credit Hours: 03  Marks: 100
Course Contents:
Principles of molecular fluorescence, instrumentation, analytical parameters and analytical applications. Principles of flame photometry, instrumentation, application of flame photometry and interferences. Principles of atomic fluorescence, instrumentation, analytical parameters and analytical application. NMR Spectroscopy, principles and interpretation of spectra. Introduction to X-Rays spectroscopy
Books Recommended
Advanced Instrumental Chemistry Practical/Research Project  Credit Hours: 03 Marks: 100
SPECIALIZATION IN BIOCHEMISTRY

Course Title: Cell Biology Paper-VI  

Credit Hours: 03  
Marks: 100

Course Content

Cell theory; Structure and chemical composition of cell, Introduction to Prokaryotes and Eukaryotes,

Cell organelles

Lysosome, Micro-bodies, Mitochondrial structure and the conservation of chemical energy, Chloroplast structure, Plasma membrane, Cell wall, Mechanism of photosynthesis, Separation of cell organelles, Functions of cell organelles.

Membrane transport

The concept of the unit membrane, Fluid mosaic model, Surface receptors and membrane mediated control., Active and Passive transport, Actin filaments, Microtubules, Intermediate filaments.

Cell movements

Structure and function of cytoskeleton, Centriole, Cilia and Flagella, Mitotic apparatus.

Cell surface and cell communication,

Cell adhesion and junctions, Signal transduction and receptor functions, Cell membrane receptors.

Cell division

Eukaryotic cell cycle, Mitosis and meiosis. Apoptosis and Necrosis.

Books Recommended


Credit Hours: 03 
Marks: 100

Introduction

Historical background, general concepts of the immune system. Innate and adaptive immunity; Inflammation - general properties. Structure, properties and functions of the immune cells & organs. Hematopoiesis, T and B-lymphocytes, NK cells; Monocytes and macrophages; Neutrophils, eosinophils, and basophils. Mast cells and dendritic cells. Thymus and Bone marrow; Lymph nodes, spleen, MALT, GALT and CALT.

Antigens and haptens


Antibodies

Structure, function and properties of the antibodies; Different classes and biological activities of antibodies; Antibody as B cell receptor, antigenic determinants on antibodies (isotype, allotype and idotype). Genesis of antibody variability (definitions of combinatorial joining, junctional flexibility, somatic hypermutation, class switching, allelic exclusion, immunoglobulin superfamily). Hybridoma technology, monoclonal antibodies and abzymes. Introduction to antibody engineering (definitions of chimeric and hybrid monoclonal antibodies). Major histocompatibility gene complex Organization of MHC. Structure and cellular distribution of HLA antigens.

Complement system

Components of the complement activation - classical, alternative and lectin pathways. Biological consequence of complement activation and names of complement deficiencies. An overview of maturation and activation of B and T cells. B-cell maturation in bone marrow, humoral immune response, primary and secondary immune response, generation of plasma and memory B cells. T cell maturation in thymus, thymic selection, self MHC restriction of T cells, T cell receptor complex, T cell activation, co-stimulatory signals, clonal expansion, generation of effector and memory T cells. Antigen presenting cells, antigen processing and presentation pathway (cytosolic and endocytic).

Cell mediated immunity

Cell types (CTLs, NK cells, macrophages and TDTH cells), effector mechanisms and effector molecules of cell mediated reactions. Assessment of cell-mediated cytotoxicity. Cytokine properties and functions of IL-1 to IL-5, IL-10, IL-12, IFN-γ.

Regulation and modulation of immune response A general account. Adjuvants, tolerance, immunopotentiation and immunosuppression Immunological principles of various reactions and techniques. Affinity and avidity, cross reactivity, precipitation, agglutination, immunodiffusion, immunoelectrophoresis, ELISA (indirect, sandwich,
competitive, chemiluminescence, ELISPOT assay), western blotting, immunofluorescence, flow cytometry and fluorescence, and immunoelectron microscopy.

**Hypersensitivity**
Types and mechanism of hypersensitive reactions.

**Autoimmunity**
Mechanisms of induction of organ specific (Hashimoto’s thyroiditis, autoimmune anemias, Goodpasture’s syndrome, IDDM), and systemic (SLE, multiple sclerosis and rheumatoid arthritis) autoimmune diseases. Therapeutic approach

**Transplantation immunology**
Types of grafts, immunologic basis of graft rejection, properties and types of rejection, tissue typing, immunosuppressive therapy and transplants to immunologically privileged sites.

**Immunity and tumors**
Types of tumors, tumor antigens (TSTA and TAA), immune response to tumors.
Tumor evasion of the immune system. Immunotherapy for tumors.

**Immunodeficiency disorders**
Animal models of primary immunodeficiency (nude mouse and SCID mouse).
Specific impaired functions in lymphoid lineage (SCID, Waldanstorm agamaglobulinemia, DiGeorge syndrome, common variable immunodeficiency), myeloid lineage (CGD, congenital neutropenia, Chediak-Higashi Syndrome and leucocyte adhesion deficiency).

**Books Recommended**
2. Immunology, 6th Editon. by I. Riott, J. Brostoff, & D. Male. Publisher: C. V. Mosby.
Course Title: Enzymology Paper- VIII          Code: CHEM- 433

Credit Hours: 03                           Marks: 100

Nomenclature, Effect of various factors on rate of reaction, Ribonucleoase, General characteristics of enzymes.

Classification of enzymes

Oxidoreductases, transferases, hydrolases, lyases, isomerases, ligases

Enzyme catalysis

Covalent catalysis, Acid base catalysis, Substrate specificity, Isozymes, Coenzymes, Cofactors, Enzyme activity, Regulation of enzyme activity, Proximity and orientation.

Enzyme kinetics

Lineweaver-Burk Plots, Michaelis-Menten equation, Multienzyme system, Bisubstrate reactions, Catalytic mechanisms, Regulatory enzymes, Immobilised enzyme, Enzyme activity.

Enzyme Inhibition

Enzyme inhibitors, Types of inhibition, Feedback inhibition, Allosteric inhibition

Books Recommended

Course Title: Molecular Evolution Paper- IX  

Credit Hours: 03  
Marks: 100

Introduction to Evolution, Systematics, Patterns of Evolution, Macroevolution: Fossils 
Microevolution: Natural Selection, Species and Speciation, Conflict and Cooperation 
Evolution and Society

Books Recommended


Course Title: Advanced Biochemistry Lab/Research Project

Credit Hours: 03  
Marks: 100

1. Enzyme-linked immunosorbent assay (ELISA).

2. Study of cell structure using compound microscope and elucidation of ultra-structure from electron microphotographs.

3. Cell structure in the staminal hair of Tradescantia.
5. Extraction and estimation of enzymes from plant source. Acid and enzymatic hydrolysis of glycogen and starch
7. Effect of Temperature, Substrate concentration and Enzyme concentration on enzyme activity.
8. Analysis of normal and abnormal constituents in urine
9. Analysis of organic and inorganic constituents of blood
10. Estimation of different vitamins
11. Separation of subcellular fractions in cells
12. Enzymes: Purification and kinetic studies of invertase, lactic dehydrogenase, and peroxidase
13. Electrophoresis of plasma proteins, polyacrylamide gel electrophoresis, Agarose electrophoresis of DNA.
14. Cultivation of microorganisms in laboratory using solid and liquid culture media, test tube, Petri plates

Books Recommended

SPECIALIZATION IN INORGANIC CHEMISTRY

Course Title: Advanced Spectroscopic Methods of analysis-Paper- VII     Code: CHEM-451

Credit Hours: 03     Marks: 100

Course contents

Infra red spectroscopy: Basic instrumentation and Applications to the determination of structure of inorganic compounds.

Raman spectroscopy: Basic instrumentation and Applications.

Nuclear magnetic resonance spectroscopy: Basic principles and instrumentation and applications to structure determination.

Books Recommended


Course Title: Inorganic Reaction mechanism Paper- VIII, Code: CHEM-45

Credit Hours: 03     Marks: 100

Course contents

Ligand replacement reactions

D, ID, Ia and A mechanisms, activation parameter, order and rates of reaction, formation of complexes from equations, acid and base hydrolysis, displacement reaction in square complexes , trans effect, substitution reactions and mechanism of substitution in tetrahedral complexes.

Electron transfer processes

“Outer sphere” reactions, ligand bridge (inner sphere) reactions, two electron transfer and redox reactions.

Theories of Acid-Base

Acid-Base and Donor-Acceptor Chemistry: Acid and Base Strength; Hard and Soft. Acids and Bases;

Books Recommended

**Course Title:** Elementary group theory Paper- IX  
**Code:** CHEM-453

**Credit Hours:** 03  
**Marks:** 100

**Course contents**
Symmetry elements and symmetry operations, point groups, properties of groups, matrices, transformation of matrices, character tables and their applications in hybridization, IR and Raman spectroscopy.

**Books recommended**

**Course Title:** Organometallics and Catalysis Paper- X  
**Code:** CHEM-454

**Credit Hours:** 03  
**Marks:** 100

**Course contents**
Definition and classification of organometallic compounds, sigma bonded organometallic compounds (Metal alkyls and Grignard reagents). Synthesis, properties and nature of bonding in pi complexes such as $\eta^2$-$\eta^7$. Catalysis, Types of catalysis, Organic synthesis via transition metal complexes (Hydroformylation, olefin hydrogenation, polymerization of ethene and oxidation of ethene to acetaldehyde).

**Books Recommended**
Advance Inorganic Laboratory/ Research Project
Credit Hours = 03 Marks : 100

SPECIALIZATION COURSES IN ORGANIC CHEMISTRY

Organic Chemistry Semester- IV
Course Title: Natural Product Chemistry Paper - VII Code: CHEM- 461
Credit Hours: 03 Marks: 100

Course contents
Introduction to Natural Product: Primary and Secondary Metabolite and drug discoveries from Natural Products,

Alkaloids
Introduction; classification; isolation; general methods for structure elucidation; discussion with particular reference to structure and synthesis of ephedrine, nicotine quinine, and morphine.

Terpenoids
Introduction; classification; isolation; general methods for structure elucidation; discussion with particular reference to structure and synthesis of citral, α-terpineol, α-pinene and camphor.

Steroids
Introduction; nomenclature and stereochemistry of steroids; structure determination of cholesterol and bile acids; introduction to steroidal hormones with particular reference to adrenal cortical hormones.

Books Recommended
Course Title: Retro Chemistry Paper -VIII  Code: CHEM- 462

Credit Hours: 03  Marks: 100

Course Contents

Introduction to retrosynthesis: concepts of synthons and retrosynthetic approach synthesis and uses: alkyl halides, alkenes, alkynes, alcohols, ethers, aromatic compounds, carbonyl and nitrogen compounds. Bond formations; C-C, C-N, and C-O bond formation. Difuctionalised compounds, 1,2; 1,3; 1,4; and 1,6 cyclizations, simple intramolecular reactions such as aldol, claisen condensation an robinson annulations reaction leading to cyclic structures. Application of the concepts to target molecules.

Books Recommended


Course Title: Name Organic Reactions Paper IX  Code: CHEM- 463

Credit Hours: 03  Marks: 100

Course Contents

Name Organic Reactions: Recent developments, mechanistic, stereochemical aspects and synthetic applications of various Name reactions: Aldol Condensation, Diels-alder reaction, Michael Addition, Robinson annulations, Knoevenagal Condensation, Clasien Condensation, Dickmann Condensation, Mannich Reaction, Wittig reaction, Peterson reaction, Heck Reaction, Friedal-Craft reaction, Favorski rearrangement, Husdiecker reaction and fischer indole synthesis, pinacole Rearrangement, Birgmann,s cyclisation,Birch reduction,

Recommended Books


Course Title: Interpretive Spectroscopy Paper- X Code: CHEM- 464
Credit Hours: 03 Marks: 100

Course Contents

Recommended Books
Course Title: Advance Organic Chemistry Laboratory/ Research Project

Course Code: Practical/ Research

Credit Hours: 03

Marks: 100

Course Contents

Synthesis and characterization of some commercially important polymers, isolation, purification and identification of natural products, synthesis of some pharmaceutically important heterocyclic compounds.

Recommended Books

SPECIALIZATION IN PHYSICAL CHEMISTRY

Course Title: Chemical Kinetics Paper-VII, Code: CHEM-471

Credit Hours: 03  
Marks: 100


Recommended Books


Course Title: Molecular Spectroscopy Paper-VIII, Code: CHEM-472

Credit Hours: 03  
Marks: 100


Books Recommended


Course Title: Surface Chemistry and Catalysis Paper - IX , Code: CHEM- 473
Credit Hours: 03 Marks: 100


Books Recommended

Course Title: Nuclear Chemistry Paper-X Code: CHEM- 474
Credit Hours: 03 Marks: 100

Course Contents
Radioactivity, elemental particles, isotopes, isobars, isotones, transmutation and artificial radioactivity, Bohar,s theory of nuclear reaction, classification of nuclear reactions, nuclear reactions vs chemicals reactions, mass defect and binding energy, nuclear fusion and nuclear fission, Q.value of nuclear reaction. Atomic nucleus, nuclides, nuclear stability, nuclear energetic, nuclear models (shell + liquid drop model), non-spontaneous nuclear processes, nuclear reactors, beta decay systematic, nuclear spins. Atomic bomb, hydrogen bomb, uses of radioisotopes in reaction mechanism, in diagnosis of diseases, in industry, in agriculture. Determination of the age of the earth by rock dating method, determination of the age of recent objects by radioactive carbon dating method.

Books Recommended


Advanced Physical Lab/Research Project

Credit Hours: 03

Marks: 100

- Study of multistep reactions.
- Sugar analysis and inversion studies by polarimetry.
- Study of isotherms and experiments of surface chemistry.
- Kinetics of fading of phenolphthalein in alkaline solution.
- Study of the effect of pH on the rate constant of the reaction between iodide and persulphate ions.
- Study of the salt effect on the rate constant of the reaction between similar charges of ions.
- Kinetics of autocatalytic reaction between permanganate and oxalate ions.
- Determination of energy of activation of the reaction between similar chargers of ions.
- Kinetics of the reaction between methyl orange and peroxodisulphate ions in presence of bromide ions.
- Stoichiometry of a complex in solution by Job’s method.

Books Recommended


