**DEPARTMENT OF CHEMISTRY**
**(2017 – 2020)**

**Aim**

To impart theoretical knowledge, develop practical skills and create interest for higher studies in chemistry so as to promote research.

**Objectives**

1. Gain knowledge on the fundamental principles of the different branches of chemistry.
2. Provide a firm foundation in chemical concepts, laws and theories.
3. Relate chemistry with medicine, food, environment and polymer science.
4. Develop and sharpen the scientific knowledge.
5. Impart theoretical knowledge about practical and skill doing chemical analysis.

**Eligibility Norms for admission**

Those who seek admission to B.Sc Chemistry course must have passed the Higher Secondary Examinations conducted by the Board of Higher Secondary Examinations, Tamil Nadu with Chemistry as one of the subjects or a course of studies recognized and approved by the syndicate of the Manonmaniam Sundaranar University, Tirunelveli.

**Duration of the programme**: 3 Years
**Medium of instruction**: English
**Passing Minimum**:

A minimum of 40% in the external examination and an aggregate of 40% are required. There is no minimum pass mark for the Continuous Internal assessment.

**Components of the B.Sc Chemistry Major Programme**
**Part III (Major and Allied)**

**Major**

Theory papers:

| | | |
|---|---|---|
| Core - Theory papers (10 x 100) | | 1000 |
| Practical (Core applied) | (4x 50) + (3x 100) | 500 |
| Elective- Theory papers | (4 x100) | 400 |
| **Major – Total marks** | | **1900** |

**Allied (I & II)**

Theory

| | | |
|---|---|---|
| Allied Mathematics / Botany | 2 x 100 | 200 |
| Allied Physics | 2 x 100 | 200 |

Practical

| | | |
|---|---|---|
| Botany 1 x 100 | | 100 |
| Physics 1 x 100 | | 100 |
| Total marks for Botany allied | | 600 |
| For Mathematics allied | | 500 |

Total marks for Part III

For Botany allied (1900 + 600 = 2500)

For Maths allied (1900 + 500 = 2400)

All theory papers and Allied practicals carry 100 marks each.
Major practical during I and II year carry 50 marks each.
Major practical during III year carry 100 marks each.

Practical examinations will be conducted at the end of even semesters

**UG – Course Structure**
**Distribution of Hours and Credits**

| Course | Sem. I | Sem. II | Sem. III | Sem. IV | Sem. V | Sem. VI | Total | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Hours | Credits |
| Language | 6 (3) | 6 (3) | 6 (3) | 6 (3) | - | - | 24 | 12 |
| English | 6 (3) | 6 (3) | 6 (3) | 6 (3) | - | - | 24 | 12 |
| Major Core - Theory | 4 (4) | 4 (4) | 4 (4) | 4 (4) | 5+5+6 (5+5+5) | 5+5+6 (5+5+5) | 48 | 46 |
| Major Core - Practical | 2 | 2 (4) | 2 | 2 (4) | 3+3+2 | 3+3+2 (10) | 24 | 18 |
| Elective | - | - | 4 (3) | 4 (3) | 4 (3) | 4 (3) | 16 | 12 |
| Allied -Theory | 4 (4) | 4 (4) | 4 (4) | 4 (4) | - | - | 16 | 16 |
| Allied Practical | 2 | 2 (2) | 2 | 2 (2) | - | - | 8 | 4 |
| AECC/EVS | 2 (2) | 2 (2) | - | - | - | - | 4 | 4 |
| SBC / Project | - | - | 2 (2) | 2 (2) | 2 (2) | 2 (2) | 8 | 8 |
| NMEC | 4 (2) | 4 (2) | - | - | - | - | 8 | 4 |
| *FC – 1 (Values for Life) | - | (1) | - | - | - | - | - | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FC – II (Personality Development) | - | - | - | (1) | - | - | - | 1 |
| * FC – III (HRE) | - | - | - | - | (1) | - | - | 1 |
| * FC – IV (WS) | - | - | - | - | - | (1) | - | 1 |
| *SDP - Certificate Course | - | (1) | - | - | - | - | - | 1 |
| *SLP –Extension Activity (RUN) | - | - | (1) | - | - | - | - | 1 |
| *STP – Clubs & Committees / NSS | - | - | - | (1) | - | - | - | 1 |
| **Total** | **30 (18)** | **30 (26)** | **30 (20)** | **30 (27)** | **30 (21)** | **30 (31)** | **180** | **140 + 3** |

**Total number of hours = 180**

**Total number of credits = 140 + 3**

*** Courses / Programmes conducted outside the regular working hours**

## UG – Courses offered

| Semester | Course | Subject code | Paper | Hours/ week | Credits |
|---|---|---|---|---|---|
| **I** | **Part I** | TL1711/ FL1711 | Language | 6 | 3 |
| | **Part II** | GE1711/GE1712/ GE1713/ GE1714 | General English (A Stream / B Stream/ C Stream/ B. Com & Com. Sc.) | 6 | 3 |
| | **Part III** | CC1711 | Major Core I – Inorganic Chemistry - I | 4 | 4 |
| | | CC17P1 | Major Practical I – Volumetric Analysis - I | 2 | - |
| | | CA1711 | Allied I –Theory: General Chemistry | 4 | 4 |
| | | CA17P1 | Allied I – Practical – Volumetric and Organic Analysis | 2 | - |
| | **Part IV** | AEC171 | AECC – Ability Enhancement Compulsory Course: | 2 | 2 |
| | | | English Communication | | |
| | | CNM171 | NMEC – Molecules of Life | 4 | 2 |

| | | | | | |
|---|---|---|---|---|---|
| | | VEC171 | Foundation course – Value Education - I | - | - |
| **II** | **Part I** | TL1721/<br>FL1721 | Language | 6 | 3 |
| | **Part II** | GE1711/GE1712/<br>GE1713/<br>GE1714 | General English (A Stream / B Stream/ C Stream/ B. Com & Com. Sc.) | 6 | 3 |
| | **Part III** | CC1721 | Major Core II – Physical Chemistry - I | 4 | 4 |
| | | CC17P1 | Major Practical I - Volumetric Analysis – I | - | 2 |
| | | CC17P2 | Major Practical II - Volumetric Analysis - II | 2 | 2 |
| | | CA1721 | Allied I – Theory: Inorganic and Physical Chemistry | 4 | 4 |
| | | CA17P1 | Allied I – Practical : Volumetric and Organic Analysis | 2 | 2 |
| | **Part IV** | *AEC172* | AECC – Ability Enhancement Compulsory Course:<br>*Environmental Studies* | 2 | 2 |
| | | CNM172 | *NMEC –Fuel Chemistry* | 4 | 2 |
| | | VEC172 | Foundation course – Value Education - I | - | 1 |
| | **Part V** | CER172 | Certificate Course | - | 1 |
| **III** | **Part I** | TL1731/<br>FL1731 | Language | 6 | 3 |
| | **Part II** | GE1731/<br>GE1732/<br>GE1733 | General English (A Stream / B Stream/ C Stream) | 6 | 3 |
| | **Part III** | CC1731 | Major Core III – Organic Chemistry - I | 4 | 4 |
| | | CC1732 | Major – Elective - I<br>(a) Dairy Chemistry<br>(b)Nutritional Chemistry<br>(c) Applied Electro Chemistry | 4 | 3 |
| | | CC17P3 | Major Practical III – Organic Preparation and Determination of Physical Constants | 2 | - |
| | | CA1731 | Allied II – Theory: General Chemistry | 4 | 4 |

| | | | | | |
|---|---|---|---|---|---|
| | | CA17P1 | Allied II – Practical : Volumetric and Organic Analysis | 2 | - |
| | **Part IV** | SBC173/<br>SBC174 | SBC – Yoga / Computer Education | 2 | 2 |
| | | VE173 | Foundation course – Value Education – II | - | - |
| | **Part V** | SLP173 | Service Learning Programme (SLP): RUN | - | 1 |
| **IV** | **Part I** | TL1741/<br>FL1741 | Language | 6 | 3 |
| | **Part II** | GE1731/<br>GE1732/<br>GE1733 | General English (A Stream / B Stream/ C Stream) | 6 | 3 |
| | **Part III** | CC1741 | Major Core IV – Organic Chemistry - II | 4 | 4 |
| | | CC1742 | Major – Elective - II<br>(a) Industrial Chemistry<br>(b) Polymer Chemistry<br>(c) Pharmaceutical Chemistry | 4 | 3 |
| | | CC17P3 | Major Practical III – Organic Preparation and Determination of Physical Constants | - | 2 |
| | | CC17P4 | Major Practical IV – Organic Analysis | 2 | 2 |
| | | CA1741 | Allied II – Theory: Inorganic and Physical Chemistry | 4 | 4 |
| | | CA17P1 | Allied II – Practical – Volumetric and Organic Analysis | 2 | 2 |
| | **Part IV** | SBC173/<br>SBC174 | SBC – Yoga / Computer Education | 2 | 2 |
| | | VEC174 | Foundation course – Value Education - II | - | 1 |
| | **Part V** | STP174 | Student Training Programme (STP) | - | 1 |
| | **Part III** | CC1751 | Major Core V-Organic Chemistry - III | 5 | 5 |
| | | CC1752 | Major Core VI - Inorganic Chemistry - II | 5 | 5 |
| | | CC1753 | Major Core VII - Physical Chemistry - II | 6 | 6 |
| | | CC1754 | Major – Elective - III(a) Green Chemistry | 4 | 3 |
| **V** | | | (b) Applied Chemistry<br>(c) Leather Chemistry | | |

| | | | | | |
|---|---|---|---|---|---|
| | | CC17P5 | Major Practical V & VI – Organic Estimation and Inorganic Semi-micro Analysis | 8 | - |
| | **Part IV** | CSK175 | *SBC – Chemistry for Competitive Exam | 2 | 2 |
| | | HRE175 | Foundation Course - Human Rights Education (HRE) | - | 1 |
| **VI** | **Part III** | CC1761 | Major Core VIII -Organic Chemistry -IV | 6 | 5 |
| | | CC1762 | Major Core IX - Inorganic Chemistry -III | 5 | 5 |
| | | CC1763 | Major Core X -Physical Chemistry - III | 5 | 5 |
| | | CC1764 | Major – Elective – IV (a) Bio Chemistry<br>(b) Instrumental methods<br>(c) Forensic Chemistry | 4 | 3 |
| | | CC17P5 | (a) & (b) Major Practical V – Organic Estimation and Inorganic Semi-micro Analysis | - | 4 |
| | | CC17P6 | Major Practical VI– Gravimetric Analysis and Inorganic complex preparation | 4 | 3 |
| | | CC17P7 | Major Practical VII – Physical Chemistry | 4 | 3 |
| | **Part IV** | CSK176 | *SBC – Project | 2 | 2 |
| | | WSC176 | Foundation Course - Women's Studies (WS) | - | 1 |
| | | | **TOTAL** | **180** | **150** |

**SBC for the V & VI semesters is offered by the departments for their students**

There is a subject oriented skill based course namely Chemistry for Competitive Exam during the V semester and a subject based group project during the VI semester for two hours each per week. There will be an individual viva voce for the group project.

As NMEC we offer Molecules of Life during I semester and Fuel chemistry during II semester.

**Self Learning – Extra Credit Course**

| Semester | Subject code | Title of the paper | Hours/ week | Credits |
|---|---|---|---|---|
| **III/V** | CC17S1 | Soil Science and Agricultural Chemistry | - | 2 |
| **IV/ VI** | CC17S2 | Chemistry of Cosmetics | - | 2 |

**UG – Instruction for Course Transaction**

## Theory (Major Core) paper hours

| Type | Sem. I | Sem. II | Sem. III | Sem. IV | Sem. V | Sem. VI |
|---|---|---|---|---|---|---|
| Lecture hours | 50 | 50 | 50 | 50 | 60 / 75 | 60 / 75 |
| Assignment / Group discussion | 5 | 5 | 5 | 5 | 5 | 5 |
| CIA (Test, Quiz) | 5 | 5 | 5 | 5 | 5 | 5 |
| Seminar | - | - | - | - | 5 | 5 |
| Total Hours / semester | 60 | 60 | 60 | 60 | 75 / 90 | 75 / 90 |

**Theory (Elective/ Allied) paper hours**

| Type | Elective | | | | Allied | |
|---|---|---|---|---|---|---|
| | Sem. III | Sem. IV | Sem. V | Sem. VI | Sem. I/III | Sem. II / IV |
| Lecture hours | 50 | 50 | 50 | 50 | 50 | 50 |
| Assignment/ Group discussion | 5 | 5 | 5 | 5 | 5 | 5 |
| CIA (Test, Quiz) | 5 | 5 | 5 | 5 | 5 | 5 |
| Total Hours | 60 | 60 | 60 | 60 | 60 | 60 |

## Practical Hours

| | Semester | Hours per week | Total hours / semester |
|---|---|---|---|
| Major | **I / II / III / IV** | 2 | 30 |
| | **V / VI** | 4 + 4 = 8 | 120 |
| Allied | **I / II / III / IV** | 2 | 30 |

## Value Added Courses

| S.No. | Name of the course | Total hours | Credit |
|---|---|---|---|
| **I** | Food Science | **30** | **1** |
| **II** | Rubber Technology | **30** | **1** |

**1. Value added course 1:**Food Science deals with the important nutrients in the food and also to identify the adulterants added into it.

**2. Value added course 1I:**Rubber Technology deals with the processing of latex and how it is converted into various other products.

## Examination Pattern

**Ratio of Internal and External:**

| | | | | | |
|---|---|---|---|---|---|
| **(Major / Elective / Allied)** | | **25:75** | | **NMEC** | **40: 60** |
| **Components of Internal:** | Test | :15 | Test | : | 20 |
| | Quiz | : 5 | Quiz | : | 10 |
| | Assignment | : 5 | Assignment | : | 10 |
| | **Total** | **: 25** | **Total** | **:** | **40** |

## Question Pattern (Major / Allied/ Elective)

| Internal Test | Marks | External Exam | Marks |
|---|---|---|---|
| Part A4x1 (No Choice) | 4 | Part A10x1 (No Choice) | 10 |
| Part B2x5 (Internal Choice) | 10 | Part B5x5 (Internal Choice) | 25 |
| Part C2x8 (Internal Choice) | 16 | Part C5x8 (Internal Choice) | 40 |
| **Total** | **30** | **Total** | **75** |

## Question Pattern (NMEC)

| Internal Test | Marks | External Exam | Marks |
|---|---|---|---|
| Part A4x1 (No Choice) | 4 | Part A10x1 (No Choice) | 10 |
| Part B3x3 (Internal Choice) | 9 | Part B5x3 (Internal Choice) | 15 |
| Part C1x7 (Internal Choice) | 7 | Part C5x7 (Internal Choice) | 35 |
| **Total** | **20** | **Total** | **60** |

## Practical Papers

**Major – I & II years**

Internal : 20 marks
External : 30 marks
**Total : 50 marks**

**Internal : 20 marks**

| | |
|---|---|
| Performance of the experiments | : 2.5 |
| Regularity in attending practical and submission of records | : 2.5 |
| Model exam | : 10 |
| Record | : 5 |
| **Total** | **: 20 marks** |

**External : 30 marks (marks will be allotted as per the practical syllabus)**

## Practical Papers (Major - III year & Allied)

**Internal : 40 marks**

| | |
|---|---|
| Performance of the experiments | : 10 |
| Regularity in attending practical and submission of records | : 5 |
| Record | : 10 |
| Model exam | : 15 |
| **Total** | **: 40 marks** |

**External : 60 marks**

**(marks will be allotted as per the practical syllabus)**

**Evaluation Pattern**

**i) PART – III and ALLIED**

**Theory:**

**Internal : 25** (Test: 15 + Quiz: 5 + Assignment: 5)

**External : 75**

| Internal | External |
|---|---|
| Theory Papers (Core, Elective and Allied papers)<br>Part A: 4 x 1 = 4 marks. No choice.<br>Part B: 2 x 5 = 10 marks. With internal choice<br><br>Part C: 2 x 8 = 16 marks. With internal choice | Theory Papers (Core, Elective and Allied papers)<br>Part A: 10 x 1 = 10 marks. No choice.<br>Part B: 5 x 5 = 25 marks. With internal choice<br><br>Part C: 5 x 8 = 40 marks. With internal choice |

**Problems in Part C compulsory**
**Practical Papers (Major and Allied):**

**Internal – 40** (Model exam–15, Performance-10, Regularity–5, Submission of Records –10)

**External – 60**

Marks will be allotted as per the practical syllabus

**Practical examination and project viva will be conducted only in the even semesters.**

**ii) NMEC**

**Internal: 40**(Test: 20 + Quiz:10 + Assignment:10)

**External: 60**

| Internal | External |
|---|---|
| Part A: 4 x 1 = 4 marks. No choice.<br>Part B: 3 x 3 = 9 marks. With internal choice<br>Part C: 1 x 7 = 7 marks. With internal choice | Part A: 10 x 1 = 10 marks. No choice.<br>Part B: 5 x 3 = 15 marks. With internal choice<br>Part C: 5 x 7 = 35 marks. With internal choice |

**III) CERTIFICATE COURSE**

**Internal: 60**(Test: 20 + Album: 20 + Book exercise:20)

**External: 40**(4x 10 = 40, Open choice – 6 questions)

**iv) FOUNDATION COURSE**

**Internal: 60**(Test: 20 + Album: 20 + Book exercise:20)

**External: 40**(4x 10 = 40, Open choice – 6 questions)

**v) SLP – RUN (40 hours)**

# Semester - I

## Core – I : Inorganic Chemistry – I
## Course Code: CC1711

| Number of Hours Per week | Number of Credits | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 4 | 60 | 100 |

**Objectives**

- To study the atomic structure from wave mechanical concept, arrangement of elements in the periodic table and the variation of periodic properties.
- To understand the various types of chemical bond formation in molecules, metallurgy, properties and compounds of s and p block elements.

**Unit – I: Atomic Structure**

Atom models – Bohr's atom model – orbit and orbital, dual nature of matter – de Broglie equation, Heisenberg's uncertainty principle and its significance. Schrodinger wave equation (no derivation) and its applications – Eigen value and Eigen function – significance of $\Psi$ and $\Psi^2$.Quantum numbers and their significance – nodal planes. Sign of wave functions – shapes of s, p, d and f orbitals. Photo electric effect, Davisson & Germer experiment, derivation of radius & energy. Principles governing the occupancy of electrons around the nucleus – Pauli's exclusion principle, Hund's rule, Aufbau principle, stability of half filled and fully filled orbitals, electronic configuration of elements with atomic number upto 30.

**Unit – II : Periodic Table**

Modern periodic law – long form of periodic table - features of long form of periodic table – classification as s, p, d and f block elements based on electronic configuration. Periodicity in properties – effective nuclear charge, shielding or screening effect, Slatar rule. Variation of effective nuclear charge, atomic radii, ionic radii, covalent radii in periodic table (group & period).Variation of electron affinity and electro negativity along a group. Ionization enthalpy - successive ionization enthalpies and factors affecting ionization enthalpy, applications of ionization enthalpy. Electronegativity – Paulings, Mulliken and Alfred Rochow's scale of electronegativity, applications of electronegativity.

**Unit – III: Chemical Bonding**

Ionic bond: Properties of ionic compounds – lattice energy, Born – Haber cycle. Valence bond theory – postulates - hybridization of atomic orbitals and geometry of molecules – sp, $sp^2$, $sp^3$, $sp^3d$, $sp^3d^2$ and $sp^3d^3$ with examples. MO theory – LCAO approximation, bonding, antibonding and nonbonding orbitals. Filling of molecular orbitals. Differences beween bonding MO and antibonding MO. Applications of MOT to $H_2$, $N_2$, $O_2$, $F_2$, HF, CO and NO.

**Unit – IV: s-block elements**

**Group – I:** General characteristics of group 1 elements – comparison of lithium with other members of the family - diagonal relationship of lithium with magnesium. Extraction of lithium – uses of alkali metals.

Compounds: lithium carbonate, sodamide, sodium cyanide, potassium cyanide-preparation and uses.

**Group – II**: General characteristics – comparison of beryllium with other elements of group 2,diagonal relationship between beryllium and aluminium. Extraction of beryllium and properties.

Compounds: Basic beryllium acetate, calcium carbide, calcium cyanamide – preparation and uses.

**Unit – V: Hydrogen and Water**

**Hydrogen** :Position in the periodic table – resemblance with alkali metals – resemblance with halogens – types of hydrogen – nascent hydrogen – active hydrogen – atomic hydrogen–ortho and para hydrogen (brief study). Hydrogen as a future fuel. Hydrides – classification, preparation, properties and uses, occlusion of hydrogen. Isotopes of hydrogen- Dueterium and tritium–preparation, properties and uses. Heavy water - preparation, properties and uses.

**Water**: Hardness – temporary and permanent hardness - determination of hardness of water by EDTA method, DO –definition and determination, BOD, COD – definition and significance.

**Text Boos**


1. Puri, B.R., Sharma, L.R. and Kalia, K.C. (2010). Principles of Inorganic Chemistry, Milestone Publishers & Distributors.
2. Madan, R.D. (2005). Modern Inorganic Chemistry.(13$^{th}$ed.). Sultan Chand Publishers.


**Reference Books**


1. Lee, J.D. (2008).Concise Inorganic Chemistry.(5$^{th}$ed.). John Wiley and Sons Publications.
2. Douglas, B.E., McDaniel, D.H., and Alexander, J.J. (1994).Concepts & Models of Inorganic Chemistry.(3$^{rd}$ed.). John Wiley and sons Publications.

# Semester - I & III

# Allied Chemistry
# General Chemistry
# Course Code: CA1711/CA1731

| Number of Hours Per week | Number of Credits | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 4 | 60 | 100 |

**Objectives:**

1. To acquire knowledge about the atomic structure and bonding in molecules

2. To know about the fundamentals of organic chemistry.

**Unit – I: Atomic Structure**

Dual nature of electron – de-Broglie equation – Davisson and Germer experiment - Heisenberg's uncertainity principle and its significance. Schrodinger's wave equation and its significance (derivation not necessary) – eigen value and eigen functions, quantum numbers and their significance. Atomic orbitals – significance – shapes, difference between orbit and orbital. Rules for filling up of orbitals – Pauli's exclusion principle – Aufbau principle – Hund's rule – electronic configuration of elements with atomic number up to 20.

**Unit – II: Chemical Bonding**

**Ionic bonding**: Formation of ionic compound with examples – general characteristics of ionic compounds. Lattice energy – Born Haber cycle and its applications. Factors affecting dissolution of ionic compounds. Fajan's rules – ionic character in covalent compounds percentage of ionic character, bond moment. Dipole moment – applications of dipole moment – structure of $CO_2$, $H_2O$, $SO_2$, $BF_3$, $NH_3$, $CH_4$ and cis-trans isomerism.

**Unit – III: Covalent Bonding**

VB approach – postulates, formation of single, double and triple bond with examples, characteristics of covalent compounds. VSEPR theory – shapes of inorganic molecules – hybridisation with suitable examples of linear ($BeCl_2$), trigonal planar($BCl_3$) and tetrahedral molecules($CH_4$). Hydrogen bonding – types with examples and effects of hydrogen bonding.

**Unit – IV: Fundamentals of Organic Chemistry**

Cleavage of bonds – homolysis and heterolysis, nucleophiles and electrophiles with examples. Reaction intermediates - carbocations, carbanions and free radicals (preparation, structure and stability).Types of reactions – substitution, addition, elimination and polymerization.

Aromaticity : General characteristics of aromatic compounds, Huckel's rule – benzenoid compounds.

**Unit – V: Aliphatic Hydrocarbons**

**Alkanes** (upto five carbons) – preparation - catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis. Reactions - free radical substitution – halogenations.

**Alkenes** (upto five carbons) – preparation - dehydration of alcohols and dehydrogenation of alkyl halides (Saytzeff's rule), reactions - hydration, ozonolysis, and oxidation, Markowni Koff's and anti Markowni Koff's addition.

**Alkynes**: Preparation – acetylene from calcium carbide, dehalogenation of tetrahalides, reactions – formation of metal acetylides, addition of $Br_2$ and alkaline $KMnO_4$.

**Text Books**


1. Puri, B.R., Sharma, L.R.and Kalia, K.C. (2010). Principles of Inorganic Chemistry, Milestone Publishers& Distributors.

2. Madan, R.D. (2005). Modern Inorganic Chemistry.(13th ed.). Sultan Chand Publishers.


**Reference Books**


1. Lee, J.D. (2008). Concise Inorganic Chemistry. (5th ed.). John Wiley and sons publishers.
2. Douglas, B.E., McDaniel, D.H. and Alexander, J.J. (1994).Concepts & Models of Inorganic Chemistry. (3rd ed.). John Wiley and sons Publishers.

# Semester - I
# NMEC
# Molecules of Life
# Course Code: CNM171

| Number of Hours Per week | Number of Credits | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 2 | 60 | 100 |

## Objectives

1. To make the students understand the different types of nutrients like carbohydrates, vitamins and minerals essential for the growth of mankind.
2. To make the students understand the various aspects of fatty acids, lipids,aminoacids, proteins and nucleic acid.

**Unit – I: Carbohydrates**

**Carbohydrates:** Introduction – classification with examples. Manufacture of cane sugar – functions of carbohydrates in the body – energy source, maintenance of heart action and central nervous system. Digestion – absorption – metabolism of carbohydrates – bio-synthesis of sugar. Tests for carbohydrates – Molisch's, Benedict, Seliwanoff's, Iodine, Bial's, Fehlings and Barfoed's test. Regulation of blood sugar – diabetes mellitus – sources of carbohydrates in the diet.

**Unit - II: Amino acids , Proteins and Nucleic acids**

**Amino acids:** Definition**,** classification of amino acids on the basis of their chemical structure and nutritional requirement, isolation of amino acid from proteins, peptide linkage – polypeptides.

**Proteins:** Definition **-** classification based on biological functions – functions of proteins –deficiency diseases – Marasmus and Kwashiorkor, tests for proteins.

**Nucleic acids**: Functions of DNA & RNA – difference between DNA and RNA

**Unit – III: Lipids**

**Lipids:** Definition – classification – biological significance of lipids — metabolic and structural functions of lipids – digestion of lipids – absorption of lipids – lipid in blood – quantitative analysis of lipids and qualitative tests for lipids. Biological importance of cholesterol and bile acids – tests for cholesterol and normal level of cholesterol.

**Unit – IV: Enzymes**

**Enzymes:** Introduction, general properties – classification, factors influencing enzyme action, regulatory enzymes – allosteric enzymes and covalently modulated enzymes – isoenzymes. Industrial and medical applications of enzymes.

**Unit – V: Minerals, Vitamins and water**

**Minerals:** Introduction – source, function, deficiency and toxicity of calcium, phosphorous, sodium, potassium, iron and iodine. **Water**: Source and distribution of water in the body – functions of water – absorption, metabolism and storage of water.

**Vitamins**: Classification, source, biological function and deficiency diseases of Vitamin A,B,C,D,E and K.

**Text Books**


1. Alex V. Ramani.(2014). Food Chemistry. MJP Publishers.
2. Carroll Lutz and Karen Przytulski. (2001). Nutrition and Diet Therapy(3rded.). F.A. Davis Company (Philadelphia) publishers.


**Reference Books**


1. Morrison, R.T., & Boyd, R.N. (1991). Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I.L. (2001). Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I.L. (2001). Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D.L., & Cox, M.M. (1989). Lehninger's Principles of Biochemistry.(7thed.).W.H. Freeman publications.
5. Berg, J.M., Tymoczko, J.L. & Stryer, L. (2002). Biochemistry, W.H. Freeman Publishers.

## Semester - I

## Major Practical Paper I - Volumetric Analysis - I
## Course Code: CC17P1

| Number of Hours Per week | Number of Credits | Total Number of Hours | Marks |
|---|---|---|---|
| 2 | 2 | 30 | 50 |

**Objective:**

To develop skill in doing volumetric estimations

**Acidimetry- alkalimetry**

1. Estimation of $Na_2CO_3$ using std. $Na_2CO_3$ – Link HCl
2. Estimation of $H_2SO_4$ using std. oxalic acid – Link NaOH
3. Estimation of oxalic acid using std. oxalic acid – Link NaOH

**Permanganometry**

1. Estimation of oxalic acid using std. oxalic acid – Link $KMnO_4$
2. Estimation of ferrous ion using std. oxalic acid – Link $KMnO_4$
3. Estimation of ferrous ammonium sulphate using std. ferrous sulphate - Link $KMnO_4$

**Dichrometry**

1. Estimation of ferrous ion using std. ferrous sulphate - Link – $K_2Cr_2O_7$
2. Estimation of ferrous sulphate using std. ferrous sulphate - Link – $K_2Cr_2O_7$

**Text Books**


1. Thomas, A.O. (1999). Practical Chemistry for B.Sc Main students. Cannanore, Scientific book center.
2. Vogel, A.I. (1990). A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans.

# Semester - II

## Core – II :Physical Chemistry - I
## Course Code: CC1721

| Number of Hours Per week | Number of Credits | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 4 | 60 | 100 |

**Objectives**

1. To acquire knowledge about gaseous state, liquid state and solid state.
2. To learn about ionic equilibria and colloids.

**Unit - I: Gaseous State**

Kinetic molecular theory of gases – postulates and derivation of kinetic gas equation – Maxwell's law of distribution of molecular velocities. Types of molecular velocities – most probable velocity, average velocity and root mean square velocity. Collision diameter, collision number and mean free path. Kinetic theory and molar heat capacities of ideal gases – molar heat capacity at constant temperature and pressure. Viscosity of gases – calculation of mean free path, degrees of freedom of gaseous molecules – translational, rotational and vibrational. Principles of equipartition of energy – contributions to heat capacity of ideal gases. Deviation of real gases from ideal behavior, equations of state for real gases – Vanderwaal's equation of state(problems wherever necessary).

**Unit - II: Liquid State**

Liquid state – structure of liquids – physical properties of liquids – vapour pressure, heat of vapourisation – Trouton's rule. Surface tension - definition – surface energy, some effects of surface tension and surface active agents. Viscosity – definition – co-efficient of viscosity, effect of temperature and pressure. Refraction – refractive index – specific and molar refraction (definition only).Physical properties and chemical constitution – additive and constitutive properties – molar volume and chemical constitution, parachor and chemical constitution, viscosity and chemical constitution.

**Unit - III: Solid State**

Crystalline and amorphous solids – differences. Symmetry in crystal system - elements of symmetry, space lattice and unit cell – Bravais lattices – seven crystal systems – law of rational indices – Miller indices. X-ray diffraction – Bragg's equation – derivation, rotating crystal technique and powder technique, analysis of powder diffraction patterns of NaCl, CsCl and KCl. Types of crystals – molecular, metallic, covalent and ionic crystals (definition, examples and structure).

**Unit - IV: Ionic Equilibria**

Strong, weak and moderate electrolytes – ionic product of water, common ion effect. pH scale – buffer solutions – calculation of pH using Henderson Hasselbalch equation, hydrolysis of salts – hydrolysis constant and degree of hydrolysis of salts of strong acid and strong base, weak acid and strong base, strong acid and weak base, weak acid and weak base. Acid base indicators - solubility product –applications in qualitative analysis.

**Unit – V: Colloids**

Definition and classifications of colloids – lyophobic and lyophilic colloids – differences between them. True solutions, colloidal solutions and suspension – definition and characteristics. Preparation of colloidal solutions – dispersion methods and condensation methods. Purification of colloidal solutions, optical properties – Tyndall effect. Brownian movement. Electrical properties – electrical double layer. Protective colloids – coagulation of colloids, Hardy - Schulze Law, Hofmeister series – electro kinetic property – definitions of electrophoresis and electro osmosis.

**Surfactants** : Definition and examples.

**Emulsions** : Types and examples – emulsifiers. Gels – preparation, types and properties – imbibition, syneresis and thixotrophy. Applications of colloids.

## Text Books


1. Puri, B.R. and Sharma, L.R. (2013-2014).Elements of Physical Chemistry, Vishal Publishing Co., India.
2. Castellan, G.W. (2004). Physical Chemistry.(4th ed.), Narosa.


## Reference Books


1. Atkins, P.W.,& Paula, J. de Atkin's. (2014). Physical Chemistry.(10th ed.), Oxford University Press.
2. Ball, D.W. (2007). Physical Chemistry, Thomson Press, India.
3. Mortimer, R.G. (2009). Physical Chemistry.(3rded.).NOIDA(UP): Elsevier.
4. Engel, T.,& Reid, P. (2013). Physical Chemistry.(3rded.). Pearson Publishers.

# Semester - II & IV
# Allied Chemistry
# Inorganic and Physical Chemistry
# Course Code: CA1721/ CA1741

| Number of Hours Per week | Number of Credits | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 4 | 60 | 100 |

**Objectives**

1. To acquire knowledge about thermodynamics and electrochemistry
2. To know nuclear chemistry, hydrocarbons and metallurgy

**Unit – I: Hydrogen and Water**

Types of hydrogen – nascent hydrogen, active hydrogen, atomic hydrogen, ortho and para hydrogen. Hydrogen as a future fuel.Dueterium and tritium – preparation, properties and uses.Water: Hardness – types, determination of degree of hardness by EDTA method.

Heavy water: Preparation, properties and uses.DO, BOD and COD (definition only).

**Unit II: Metallurgy**

Minerals and ores – difference between them. Methods of dressing – roasting, calcinations, reduction by aluminothermic process, smelting, purification by electrolysis, zone refining, Kroll's process and Van Arkel de-Boer method.Extraction, properties and uses of titanium, molybdenum and tungsten. Preparation and uses - $TiO_2$ and $TiCl_4$, preparation and properties of $MoO_2$.

**Unit – III: Thermodynamics**

Exothermic and endothermic reactions with examples, change of enthalpy in a chemical reaction – sign of ΔH. Hess's law of constant heat summation, first law of thermodynamics – definition and mathematical statement. Enthalpy – heat capacity, relation between Cp and Cv in gaseous systems, Kirchoff's equation - derivation. Reversible and irreversible processes – difference between them. Isothermal and adiabatic processes – expression for q, w, ΔE &ΔH for reversible and irreversible isothermal expansion of an ideal gas.

**Unit – IV: Electrochemistry**

Strong and weak electrolytes with examples – degree of ionization – factors affecting degree of ionization – ionization constant – ionic product of water – pH scale – common ion effect and its applications. Salt hydrolysis – types of salts with examples, derivation of hydrolysis constant and degree of hydrolysis of a salt formed from weak acid and strong base, buffer solutions with examples. Solubility, solubility product and its applications.

**Unit – V: N u c l e a r  C h e m i s t r y**

Radioactivity – properties of α, β and γ rays. Soddy's group displacement law – radioactive decay, derivation of decay constant, half life period- derivation from decay constant. Average life, radioactive series. Nuclear reactions - nuclear fission and fusion – Stellar energy. Applications of radioactivity – in medicine, agriculture, industry and radio carbon dating.

**Text Books**


1. Puri. B.R., Sharma. L.R.and Kalia, K.C. (2010). Principles of Inorganic Chemistry, Milestone Publishers & Distributors.
2. Madan, R.D. (2005). Modern Inorganic Chemistry. (13th ed.), Sultan Chand Publishers.


**Reference Books**


1. Soni, P.L. and Chawla, H.M. (2014). A Text book of Organic Chemistry.(20th ed.). Sultan Chand Publishers.
2. Castellan, G.W. (2004). Physical Chemistry. (4thed.). Narosa Publishers.
3. Levine, I.N. (2010). Physical Chemistry.(6thed.). Tata Mc Graw Hill Publications.

# Semester - II
# NMEC
# Fuel Chemistry
# Course Code: CNM172

| Number of Hours Per week | Number of Credits | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 2 | 60 | 100 |

**Objectives**

1. To learn about the various energy sources and their applications.
2. To gain knowledge on different types of fuels, applications of fuels and petrochemicals.

**Unit – I: Energy sources**

Renewable energy sources – solar energy, wind energy, geothermal energy, bioenergy, hydropower and ocean energy - definition and examples.Non-renewable energy sources – fossil fuels and nuclear fuels – definition and examples.Fuel – definition – calorific value – determination of calorific value – classification of fuels– primary fuels, secondary fuels – criterion for selection of fuel – properties of fuel – ignition temperature, flame temperature, flash point, fire point.

**Unit – II: Solid fuels**

Natural, artificial and industrial solid fuels. Coal – formation of coal – properties of coal – classification of coal. Coking, non coking coals and pulverised coal. Role of Sulphur and ash in coal. Advantages and disadvantages of solid fuels. Carbonization – low temperature carbonization. Coal gas – preparation, composition and uses. Fractionation of coal tar – uses of coal tar based chemicals – coal gasification – liquefaction of coal.

**Unit – III: Liquid fuel**

Petroleum and petrochemicals – refining of petroleum – composition and uses of main petroleum fractions. Cracking – thermal and catalytic cracking - advantages of catalytic cracking – octane rating – anti knock agents – unleaded petrol – cetane rating – antidiesel knock agents – hydrocarbons from petroleum. Petrochemicals – direct and indirect petrochemicals – catalysts used in petroleum industry. Methods involved in manufacture of petrochemicals – alkylation, pyrolysis, halogenation, hydration, and polymerization.

**Unit – IV: Gaseous fuel**

Classification – natural and artificial. Natural gaseous fuels – examples and their importance .Natural gasoline – aviation gasoline – artificial gaseous fuels.Water gas and producer gas - manufacture, composition and uses.Semi water gas and LPG – composition and uses. Bio gas (Gobar gas) – biogas generator. Advantages and disadvantages of gaseous fuels.

**Unit – V: Rocket and Nuclear fuels**

Definition – solid and liquid propellants – homogeneous and heterogeneous propellants – propellants used in rocket and guided missiles.Nuclear propellants: definition, fertile materials, differences between nuclear and chemical fuels. Nuclear fuel cycle in India. Heavy water reactor and fast breeder reactors.

**Text Books**


1. Sharma, B.K. (2002). Industrial Chemistry.(13th ed.). Goel Publishing House.
2. Jain, P.C. & Jain. (2001). M. Engineering Chemistry. Delhi: Dhanpat Rai Publishers.


**References Books**


1. Stocchi, E. (1990). Industrial Chemistry, Vol. I, Ellis Horwood Publishers.
2. Murugesan, (2009). Environmental studies. (2nd ed.).Millennium Publishers.

## Semester - II

## Major Practical Paper II - Volumetric Analysis - II
## Course Code: CC17P1

| Number of Hours Per week | Number of Credits | Total Number of Hours | Marks |
|---|---|---|---|
| 2 | 2 | 30 | 50 |

**Objective:**

To develop skill in doing volumetric estimations

**Double Titrations involving preparation of standard solutions**

Iodometry – Estimation of Copper and $K_2Cr_2O_7$.Complexometric Titrations using EDTA-Estimation of Zinc(II), Calcium(II), Manganese(II), Lead(II), Cobalt(II), Copper (II) and Nickel(II).

**Text Books**


1. Thomas, A.O. (1999). Practical Chemistry for B.Sc Main students. Scientific book center, Cannanore.
2. Vogel, A.I. (1990). A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans.

## Semester – II & IV

## Allied Chemistry Practical - Volumetric and Organic Substance Analysis
## Course Code: CA17P1

| Number of Hours Per week | Number of Credits | Total Number of Hours | Marks |
|---|---|---|---|
| 2 | 2 | 30 | 100 |

**Objectives:**

1. To learn the principles of volumetric analysis.
2. To analyze an organic substance systematically.

**Volumetric analysis - 40 marks**
**Organic analysis - 20 marks**
**Acidimetry & Alkalimetry**

Estimation of sulphuric acid., Estimation of sodium carbonate.Permanganometry:Estimation of ferrous sulphate, Estimation of ferrous ammonium sulphate, Estimation of oxalic acid Iodometry:Estimation of copper sulphate Complexometry:Estimation of magnesium, Estimation of zinc sulphate, Organic Substance Analysis

- Systematic analysis of the organic compound with the view to find out the following.
- Detection of extra element
- Aliphatic or Aromatic
- Saturated or unsaturated
- Nature of the functional group (phenol, monocarboxylic acid, ester, aldehyde, reducing sugar and primary amine)

**Text Books**


1. Thomas, A.O. (1999). Practical Chemistry for B.Sc Main students.Cannanore: Scientific book center.
2. Vogel, A.I. (1990). A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans.

# Semester - III

## Core – III :Organic Chemistry - I
## Course Code: CC1731

| Number of Hours Per week | Number of Credit | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 4 | 60 | 100 |

**Objectives**:

1. To understand the basic concepts of Organic chemistry, hydrocarbons and stereochemistry.
2. To learn about the electronic displacements and polar effects in organic compounds

**Unit – I: Basic Concepts of Organic Chemistry**

**Organic Compounds**: Classification and IUPAC system of nomenclature - longest chain rule, lowest number rule, naming of hydro carbons, alcohols, aldehydes, ketones, amines, and compounds with additional functional groups. **Hybridization:** Definition, shapes of molecules, sp, $sp^2$ and $sp^3$ hybridisation with acetylene, ethylene and methane as examples - influence of hybridization on bond properties.Homolytic and heterolytic fission - examples.

Electrophiles and nucleophiles - examples.**Reaction intermediates:** Preparation, structure and stability of Carbanions, carbocations and free radicals.

**Unit – II: Electronic Displacements**

**Polar effects**: Inductive effect – definition – types – comparison of strength of substituted acids and bases. Electromeric effect – definition – types – examples – applications. Resonance effect – definition – relative strength of acids, conjugated system. Hyper conjugation effect – definition – stability of carbocations and free radicals.**Types of reactions:** Introduction to types of organic reactions – substitution, addition, elimination and polymerization reactions with examples.

**Unit – III: Chemistry of Aliphatic Hydrocarbons**

**Carbon-Carbon sigma bonds:** Chemistry of alkanes, general methods of preparation, Wurtz reaction, free radical substitutions - halogenation.**Carbon-Carbon pi bonds**: Formation of alkenes and alkynes by elimination reactions - Saytzeff and Hofmann rule - eliminations.**Reactions of alkenes**: Electrophilic addition of hydrogen halide - mechanisms of Markowni koff and Anti-Markownikoff addition, hydroboration, oxidation, ozonolysis, reduction (catalytic and chemical), cis and trans-hydroxylation. 1,2-and 1,4-addition reactions in conjugated dienes - Diels-Alder reaction.**Reactions of alkynes**: Acidity, electrophilic and nucleophilic additions, Birch reduction-mechanism.

**Unit – IV: Chemistry of halogenated hydrocarbons**

**Alkyl halides**:General methods of preparation, nucleophilic substitution reactions – $S_N1$, $S_N2$ and $S_Ni$ mechanisms with stereochemical aspects and effect of solvent, differences between $S_N1$&$S_N2$ reactions ; elimination – E1 and E2 mechanisms.**Alkenyl halides:** preparation, properties of vinyl chloride and allyl chloride. **Fluorocarbons:** – preparation of tetrafluoro ethylene and freon. Preparation and uses of westron and westrosol.**Poly - halogenated alkanes:** Preparation and properties of chloroform, iodoform and carbon tetrachloride.

**Unit –V: Functional groups containing Oxygen**

**Alcohols**: Preparation, properties and distinction among 1°, 2° & 3° alcohols - oxidation method, Victor Meyer method & Lucas method. **Dihydric alcohols**: Preparation and properties of glycols - Oxidation by periodic acid and lead tetraacetate, Pinacol- Pinacolone rearrangement.**Trihydric alcohols**:Glycerol -manufacture (hydrolysis of fats and oils), synthesis of glycerol from propene, reactions, preparation of nitroglycerine. Estimation of number of hydroxyl groups.**Ethers and Epoxides**: Preparation and reactions of ethers and epoxides, ethers with acids, reactions of epoxides with alcohols.

**Text Book**

Jain, M. K. &Sharma, S.C. (2016). Modern Organic Chemistry, (4$^{th}$ed.).Vishal Publishers.

**Reference Books**

1. Soni, P. L. & Chawla, H. M. (2014). A Text book of Organic chemistry(20$^{th}$ ed.). Sultan Chand & Sons.
2. Arun Bhal & Bhal B. S. (2013). A Text book of Organic chemistry (21$^{st}$ ed.). S. Chand & Company Pvt. Ltd.
3. Tewari (2016). Advanced Organic Chemistry, (1$^{st}$ed.). Books and Allied Pvt. Ltd.
4. Finar, I. L. (2014). Organic Chemistry Volume 1&II (18$^{th}$ed.). Pearson publishers.

# Semester – IV
# Practical Paper - IV
# Organic Analysis
# Course Code: CC17P4

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 2 | 2 | 30 | 50 |

**Objectives:**

1. To develop skill in doing Organic Substance Analysis.

**Organic Qualitative Analysis**

**Systematic analysis of the organic compound with the view to find out the following.:** Detection of extra element, Aliphatic or Aromatic Saturated or unsaturated, Nature of the functional group(Phenol, aromatic aldehyde, aromatic mono carboxylic acid, dicarboxylic acid, aromatic esters, carbohydrate (glucose), aromatic primary amine, urea, aromatic amide, aromatic nitro compound, anilide). F) Preparation of a solid derivative to confirm the functional group.

**Text Books**


1. Thomas, A. O. (1999). Practical Chemistry for B.Sc Main students,Scientific book center, Cannanore.
2. Vogel, I. (1990). A Text Book for Qualitative Inorganic Analysis, English Language Book Society and Longmans.

# Semester – V

## Core - V: Organic Chemistry - III
## Course Code :CC1751

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 5 | 5 | 75 | 100 |

**Objectives:**

1. To study about phenols and their derivatives
2. To learn poly nuclear, heterocyclic and organometallic compounds
3. To impart knowledge about alkaloids, drugs and pharmaceuticals

**Unit -1**

**Phenols**: Preparation from diazonium salts and sulphonic acid-Physical properties-Hydrogen bonding- Chemical properties; acidity and factors affecting it, ring substitution reactions, Reimer–Tiemann reaction, Kolbe's–Schmidt reaction, Fries and Claisen rearrangements with mechanisms.**Derivatives of monohydric phenols:** Preparation and properties of nitrophenol - picric acid and amino phenols.**Dihydric phenols:** Preparation, properties and uses of catechol, resorcinol and quinol.**Trihydric phenols:** Preparation, properties and uses of phloroglucinol.

**Unit – I1:**

**Polynuclear Hydrocarbons:** Isolated polynuclear compounds - preparation and properties of diphenyl, diphenyl methane, triphenyl methane and stilbene.

**Naphthalene**: Haworth synthesis, reactions and structural elucidation, derivatives of naphthalene. Naphthols, naphthylamine, naphthaquinone- preparation and uses.

**Anthracene**: Haworth synthesis , reactions, structural elucidation and uses- derivatives

– anthraquinone, alizarin- preparation and uses.

**Phenanthrene:** Synthesis, structure and reactions.

**Unit – II1: Heterocyclic Compounds**

Classification with examples, aromaticity in 5-membered and 6-membered rings containing one heteroatom.

**Furan**: Preparation, chemical properties- electrophilic substitution reactions, Diel's- Alder reaction and reduction reactions.

**Pyrrole**: Preparation from acetylene and Paal-Knorr synthesis, properties- basic nature, electrophilic substitution reactions, ring expansion, oxidation and reduction reactions.

**Pyridine**: Isolation from coal tar, synthesis, comparison of basic nature of pyridine and pyrrole with aliphatic and aromatic amine, electrophilic substitution, nucleophilic substitution – Chichibabin reaction.

**Quinoline**: Skraup synthesis, structural elucidation and reactions.

**Isoquinolin**e: Pictet – Spengler synthesis and reactions.

**Indole:** Preparation, properties and uses.

**Unit –IV : Carbohydrates**

Occurrence, classification and their biological importance.

**Monosaccharides**: Preparation and chemical reactions of glucose and fructose, differences between them. Structural elucidation and absolute configuration of glucose and fructose. Epimerization-epimers and anomers, mutarotation. Haworth projections and conformational structures.Conversion of an aldose to next higher aldose (Kiliani-Fischer synthesis) and aldose to next lower aldose (Wohl's method). Intercoversion between aldoses and ketoses.

**Disaccharides** : Structural elucidation of maltose and sucrose.

**Polysaccharides** : Structure of starch and cellulose

**Unit – V: Drugs & Pharmaceuticals**

Discovery, design and development, Procedures followed in drug design. Lead components and modification. Concept of pro-drugs. Physical and chemical factors of drug design. Pharmacological activities of drugs – receptors (definition only), metabolites and antimetabolites.Synthesis of drugs- chloramphenicol, benadryl and paracetamol, anti-inflammatory drugs, antiviral agent - Acyclovir. Central Nervous System (CNS) agents- Phenobarbital and diazepam, Cardiovascular drug- Glyceryltrinitrate. Antileprosy drug- Dapsone, HIV-AIDS related drug- Zidovudine.

**Text book**

Jain, M. K. &Sharma, S.C. (2016).*Modern Organic Chemistry* (4thed.).Vishal Publishers.

**Reference Books**

1. Soni, P. L. & Chawla, H. M. (2014). *A Text book of Organic chemistry* (20th ed.). Sultan Chand & Sons.
2. ArunBhal & BhalB. S.(2013). *A Text book of Organic chemistry* (21st ed.). Chand& Company Pvt. Ltd.
3. Tewari (2016). *Advanced Organic Chemistry* (1sted.). Books and Allied Pvt. Ltd.
4. Finar, I.L. (2014). *Organic Chemistry, Volume 1&II* (18thed.). Pearson publishers.

# Semester – V

## Core - VI: Inorganic Chemistry - II
## Course Code : CC1752

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 5 | 5 | 75 | 100 |

**Objectives**

1. To study the characteristics of p-block elements, noble gases and their compounds.
2. To understand the various metallurgical process.
3. To understand the principles of atom bomb, nuclear reactors and hydrogen bomb.

**Unit – I: Chemistry of p-block elements - I**

**Group – 13:** General characteristics of boron family with special reference to inert pair effect - extraction of boron – properties and uses.**Compounds:** Boron trifluoride and boron trichloride – aluminium trichloride-preparation, properties and structure. Hydrides of boron – preparation, properties and structure of diborane and carboranes. Preparation, properties and structure of boron nitride and borazine. **Group – 14:** General characteristics– comparison of carbon and silicon – structure of diamond and graphite – Fullerenes (definition and examples).**Compounds:** Metal carbides – classification with examples – their applications in industry. Preparation and uses of silica, silicic acid and silica gel. Silicones – preparation and uses. Silicon carbide – preparation, properties and uses.

**Unit – II: Chemistry of p-block elements - II**

**Group 15**: General characteristics– allotropes of phosphorous and arsenic. Structure of oxides of nitrogen, structure of oxy acids of phosphorous. Preparation, properties and uses of hydrazine, hydrazoic acid and hydroxyl amine.

**Group 16:** Anomalous behaviour of oxygen, allotropes of sulphur, oxyacids of sulphur- Caro's acid and Marshall's acid – preparation, properties and structure.

**Group 17:**General characteristics of halogens, peculiarities of fluorine, inter halogen compounds – definition, preparation, types and structure of XY, $XY_3$, $XY_5$ and $XY_7$.

Pseudohalogens - preparation and properties of cyanogens, thiocyanogen, selenium cyanogen and azidocarbondisulphide, interpseudohalogen compounds.

**Unit – III :**

**Noble gases:** Occurrence, electronic configuration and rationalization of inertness of noble gases. Isolation of noble gases from the atmosphere- Rayleigh's and Dewar's method. Hydrates of noble gases. Clathrates compounds – preparation, properties and uses. Preparation , properties and structure of $XeF_2$, $XeF_4$, $XeF_6$,$XeOF_2$,$XeOF_4$and$XeO_3$.

**Inorganic polymers:** Definition – properties, types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of siloxanes. Preparation and properties of silicates, phosphazenes and polysulphates.

**Unit – IV: Metallurgy and Alloys**

Minerals and ores – difference between minerals and ores, metallurgical processes – gravity separation, magnetic separation, froth floatation, roasting, calcination and smelting. Purification by electrolysis, oxidative refining, zone refining, Mond's process, Van - Arkel de-Boer process and Kroll's process. Extraction, properties and uses of V, W, Mo and Ti. Poly valency of vanadium.**Alloys**: Definition, purpose of making alloys. Types of alloys – ferrous alloys and non ferrous alloys with examples. Preparation of alloys-heat treatment of alloys – composition and uses– bronze, german silver, nichrome, monel metal, stainless steel, gun metal and bell metal.

**Unit – V:Nuclear Chemistry**

Nuclear forces- nuclear size- atomic mass unit and N/P ratio. Packing fraction - mass defect- binding energy. Nuclear models-shell and liquid drop. Radioactivity - α, β, γ radiations-their properties. Soddy's group displacement law. Natural radioactivity- detection and measurement of radioactivity by Geiger-Muller method. Rate of radioactive disintegration-decay constant-half life period- average life period. Radioactive equilibrium, artificial radioactivity-artificial transmutation of elements.

Nuclear reactions-nuclear fission – principle of atom bomb. Nuclear reactor – thermal and fast breeder reactor. Radioactive hazards- disposal of radioactive waste from nuclear reactors Nuclear fusion – principle of hydrogen bomb and stellar energy. Principle and working of cyclotron. Applications of radio activity - radioactive tracers in agriculture, medicine and industry. Radiocarbon dating.

**Text books**


1. Puri. B.R., Sharma, L.R. & Kalia, K.C. (2014). *Principles of Inorganic Chemistry*, Milestone Publishers.
2. Madan, R.D. (2005). *Modern Inorganic Chemistry*, (13$^{th}$ed.). S. Chand and Company.


**Reference Books**


1. Lee, J.D. (2008). *Concise Inorganic Chemistry*, (5$^{th}$ed.). John Wiley and Sons.
2. Greenwood, N.N. & Earnshaw,(1997). *Chemistry of the Elements*, (2$^{nd}$ ed.). Butterworth-Heinemann.
3. Cotton, F.A. & Wilkinson, G. (1999). *Advanced Inorganic Chemistry*, Wiley, (6$^{th}$ed.). VCH Publishers.
4. Miessler, G.L. & Donald, A. Tarr. (2010). *Inorganic Chemistry* (4$^{th}$ed.). Pearson.
5. Atkin, P. Shriver & Atkins. (2010). *Inorganic Chemistry*, (5$^{th}$ed.). Oxford University Press.

# Semester - V

## Core - VII: Physical Chemistry - II
## Course Code: CC1753

| Number of Hours Per week | Number of Credit | Total Number of Hours | Marks |
|---|---|---|---|
| 6 | 5 | 90 | 100 |

**Objectives**

1. To know and learn the principles of thermodynamics and colligative properties.
2. To understand the types of solutions and their behaviour.
3. To impart knowledge about the symmetry elements and symmetry operations.

**Unit – I: Solutions and Colligative Properties**

Solutions of non-electrolytes – solutions of liquids in liquids – vapour pressure of non-ideal solutions - type I, type II and type III. Vapour pressure - composition and boiling point - composition curves of completely miscible binary solutions - type I, type II and type III. Theory of fractional, azeotropic and steam distillations. Solubility of partially miscible liquids - phenol-water system, triethylamine – water system and nicotine water system.

Colligative properties – definition and examples – thermodynamic derivation of relation between concentration and elevation of boiling point. Osmosis – reverse osmosis - osmotic pressure (definition only) – determination of molar mass by depression of freezing point, Van't Hoff factor – degree of association and dissociation.

**Unit – II: Thermodynamics - I**

Chemical thermodynamics – importance of thermodynamics– basic terms – system, boundary and surroundings. Types of systems – open, closed and isolated. Types of processes - isothermal, adiabatic, isobaric and isochoric, reversible and irreversible process. Difference between reversible and irreversible process. First law of thermodynamics – different statements. Internal energy and first law – mathematical derivation of first law of thermodynamics. State and path functions. Heat capacity of a system – heat capacity at constant volume (Cv) and heat capacity at constant pressure (Cp) – relationship between Cp and Cv. Joule Thomson effect – Joule Thomson Coefficient of ideal, real gases and real gases obeying Vanderwaal's equation. Inversion temperature - definition – derivation. Zeroth law of thermodynamics – statement – calculation of $\Delta E$, q, $\Delta H$ and w for an ideal and real gas. Enthalpy of a system – enthalpy of combustion, enthalpy of neutralization and enthalpy of formation.Variation of enthalpy of a reaction with temperature (Kirchoff's equation).Hess's law of constant heat summation and its applications.

**Unit – III: Thermodynamics - II**

Limitation of first law and need for second law of thermodynamics – second law of thermodynamics - spontaneous process. Carnot's cycle – efficiency of heat engine – Carnot's theorem. Third law of thermodynamics - concept of entropy – entropy changes in reversible and irreversible processes – entropy changes of an ideal gas, isothermal, isobaric and Isochoric processes. Entropy of mixing – physical significance of entropy. Work function (A) and Gibb's Free Energy Function (G) and their significances. Gibb's Helmholtz equation – applications. Partial molar quantities – partial molar free energy - Gibb's Duhem equation –applications– Clapeyron equation– applications. Clausius – Clapeyron equation and applications

**Unit – IV: Thermodynamics – III**

Thermodynamic treatment of law of mass action – Van't Hoff reaction isotherm and its significance. Van't Hoff isochore and significance. Fugacity – concept – determination of fugacity of real gases – variation of fugacity with temperature and pressure. Physical significance of fugacity. Activity – activity coefficient. Nernst Heat theorem and its applications. Determination of absolute entropy of solids, liquids and gases, exceptions to the third law of thermodynamics. Thermodynamic interpretation of Le-chatelier principle – statement –effect of change of temperature and pressure on chemical equilibria.

**Unit – V: Group Theory**

Symmetry elements and symmetry operations – definition of identity (E), proper rotational axis (n) – mirror plane ($\sigma$) – inversion centre (i) and rotation reflection axis (Sn). Symmetry operations generated by symmetry elements- $H_2O$, $NH_3$, $BF_3$, $[PtCl_4]^{2-}$, $H_2O_2$ (Planar, cis and trans) and $CH_4$as examples. Group postulates –abelian and cyclic group – group multiplication table – molecular point groups – assignment of point groups to simple molecules like $H_2O$, $NH_3$ and $CO_2$. Determination of a point group.

## Text book

Puri,B.R., Sharma, L. R.& Pathania, M. S. (2013).*Elements of Physical Chemistry*, India : Vishal Publishing Co.

## Reference Books

1. Castellan, G. W. (2014).*Physical Chemistry*, ($4^{th}$ ed.). Narosa.
2. Engel, T. & Reid, P. (2012). *Physical Chemistry*, ($3^{rd}$ed.). Prentice-Hall
3. Levine, I .N. (2010). *Physical Chemistry*, ($6^{th}$ed.). Tata McGraw Hill
4. Metz, C.R. (2006).*Solved Problems in Chemistry*, Schaum Series.

# Semester – V
# Elective III - Green chemistry

## Course Code: CC1754

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives**

1. To know the principles of green chemistry.
2. To study the important techniques and green synthesis of compounds.
3. To study the concept of atom economy in chemical synthesis.

**Unit – I Introduction to green chemistry**

Definition – need for green chemistry – scope of green chemistry. Concept of atom economy – yield – mass intensity and atom economy. Calculation of atom economy, mass intensity, mass productivity and carbon efficiency.Different types of reactions and atom economy – addition, substitution, elimination and rearrangements.Concept of selectivity – enantioselectivity, chemoselectivity, regioselectivity and diastereoselectivity.

**Unit – II Green solvent**

Super critical fluids- Introduction – extraction of super critical fluids – solvents of super critical fluid – advantages and applications.

Carbondioxide as a super critical fluid – features of technique for using super critical carbondioxide – advantages and application.

Chemical reaction in supercritical water and near critical water region.

Extraction natural products, dry cleaning, supercritical polymerization, hydrogenation and hydroformylation.

Ionic liquid as green solvent: Introduction – synthesis of ionic liquids– acidic ionic liquid and neutral ionic liquids – applications in organic synthesis.

**Unit –III Green catalyst**

Catalysis over view: acid catalyst – basic catalyst- oxidation catalyst- polymer supported catalyst – photosensitized super acid catalyst and Tetra Amido Macrocylic Ligand (TAML) catalyst.

Biocatalyst: microbial oxidation, microbial reduction, enzyme catalyzed hydrolytic process, per fluorinated catalyst and modified biocatalyst.

Development of mesoporous supports by liquid crystal templating – neutral templating methods – heterogeneous catalyst – solid supported catalyst.

**Unit – IV Green synthesis**

Green synthesis of the following compounds – Adipic acid, Catechol, Benzoyl bromide, Acetaldehyde, Citral, Ibuprofen and Paracetamol. Microwave assisted reactions in water – Hoffmann Elimination, Hydrolysis of benzyl chloride and methyl benzoate – oxidation of toluene and alcohols.

Microwave assisted reactions in organic solvents – Esterification, Fries rearrangement, Clasien Rearrangement ,Diels - Alder Reaction and Decarboxylation. Ultra sound assisted reactions – esterification, saponification, alkylation, oxidation, reduction, coupling reactions and Cannizaro reactions.

**Unit – V Green reactions involving basic principle of green chemistry**

Twelve principles of green chemistry – choice of starting materials – biomimitic, multifunctional reagents – materials reagents.

Combinatorial green chemistry – Green Chemistry in sustainable developments.

Importance of Green chemistry in day to day life, versatile bleaching agents and analgesic drugs.

**Text Book**

Ahluwalia, V.K. & Kidwai, M.R. (2005).*New Trends in Green Chemistry*, Anamalaya Publishers.

**Reference Books**

1. Anastas, P.T. & Warner, J.K. (1998).*Green Chemistry Theory and Practical*, Oxford University Press
2. Matlack, A.S.(2001). *Introduction to Green Chemistry*, Marcel Dekker
3. Lancaster, M. (2010). *Green Chemistry*, (2nded.). *An Introductory Test* RSC Publishing.
4. Ahluwalia V.K &Rajender S. Varma (2009), *Green Solvents for Organic synthesis*, Narosa Publishing House Pvt. Ltd.

# Semester – V
# Elective IV – Applied Chemistry
# Course Code: CC1754

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives**

1. To understand the industrial applications of electro chemistry.
2. To gain knowledge of nanochemistry
3. To know the applications of computers in chemistry.

**Unit I: Applied Electrochemistry**

Industrial applications of electrolysis – principles and process in the manufacture of caustic soda and hydrogen peroxide. Organic electrochemistry – electrochemical oxidation- Kolbe's synthesis. Electro reduction of carbonyl compounds – adiponitrile synthesis. Electroplating – principle – process – electroplating of Cu, Ni and Cd. Power sources – primary cells – principle – selection of anode and cathode – alkaline $MnO_2$ cells. Secondary cells – characteristics – lithium battery and Ni-Cd battery. Fuel cells – principle – hydrogen – oxygen fuel cells – alkaline fuel cells. Corrosion – principle, stability of metals – active and noble metals – anode and cathode process – protective coating – types of coating – protection of structures and pipelines – protection of ships in sea.

**Unit II: Nano Chemistry**

Nanotechnology –introduction, fundamental principles. Nano particles – definition, size - nano particles of metals - semiconductors and oxides. Synthesis of nano sized compounds - reduction methods by sodium citrate and borohydride, sol–gel method and chemical vapour deposition method. Properties - optical and electrical. Nano clusters, carbon nano tubes – single walled nano tubes and multi-walled nanotubes. Properties of carbon nanotubes, applications. Application of nano chemistry in various fields.

**Unit III: Chemotherapy**

**Chemotherapy** : definition – classification of chemotherapeutic agents.

**Antibacterials**: Definition, preparation of sulphanilamide, sulphapyridine, sulphathiazole, sulphadiazine, sulphadimetine, sulphamethazine and their uses.

**Antimalarials**: Definition, examples and uses

**Antimonials and Arsenicals**: Preparation and uses of Tartar emetic, Salvarsan and Neosalvarsan.

**Antibiotics**: Definition, classification, chemotherapeutic uses of Penicillin, Streptomycin, Chloromycetin, Tetracycline, Aureomycin, neomycin, gentamycin and erythromycin.

**Antiprotozoals:** Definition and uses.

**Antiseptics**: Preparation of tincture of iodine, chloramine T, Salol, Thymol, Dettol and their uses.

**Antifungals**: Definition and examples.

**Antipyretics and Analgesics**: Definition and examples, preparation and structure of Aspirin, Paracetamol and Phenacetin.

**Unit IV: Petroleum**

Refining of petroleum – fractional distillation – cracking – types – octane rating – antiknocking agents – cetane rating – antidieselknock agents – flash point – petrochemicals – direct and indirect – synthetic petroleum – Bergius process – Fisher Tropsch process – catalysts used in petroleum industries.

Rocket fuels: Definition – solid and liquid propellants – homogeneous and heterogeneous propellants – propellants used in rockets and guided missiles.

**Unit V : Computers in Chemistry**

Programming in C++ - operators in C++ - library functions – square root, log etc. operator precedence and solving expressions –branching statement-looping statement. Simple programs for problems in chemistry - determination of RMS velocity, average velocity and most probable velocities of gases and calculation of half life of radioactive nuclei.MS Excel - drawing graphs and excel program

**Text Book**

Sharma, B.K. (2002). *Industrial Chemistry including chemical engineering* (13th ed.). Goel publishing House, Meerut.

**Reference Books**

1. Ederer, H. J. Klaus Heinrich Ebert & Thomas L. Isenhour, (1989). *Computer applications in Chemistry – An introduction for PC users with two Diskettes in basic and pascal* (1st ed.). VCH publishers.
2. Richard Selley, (1997). Barnes & Noble, *Elements of petroleum Geology* (2nd ed.). Elsevier Science publishers.
3. Geofrey A Ozin, (2008). *A Chemical approach to Nanomaterials* (2nd ed.). RSC publishers.
4. Balagurusamy, E. (2008). *Object Oriented Programming* (4th ed.). Tata McGraw Hill Publishing Company Ltd.

# Semester – V
# Elective III - Leather chemistry
# Course Code: CC1754

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives**

1. To know the principles involved in leather industry.
2. To understand the process of tanning, properties and uses of leather

**Unit I**

Hides, skins and leather -an elementary knowledge of the structure, composition and characteristics of hides and skin proteins. Anatomy and histology of protein constituents of leather (an elementary concept).Basic principles involved in pre – tanning such as soaking, liming, deliming, bating, pickling and depickling.

**Unit II**

Types of tanning – vegetable and mineral tanning. Different types of vegetable tanning – materials classification and chemistry of vegetable tanning. Factors and physico – chemical principles involved in vegetable tanning. Fixation of vegetable tanning- synthetic tannings – their classification, general methods of manufacture and use.

**Unit III**

The preparation and chemistry of chrome tanning liquids - olation, oxolation and hydrolysis of chrome liquids. Effect of adding tanning agents- role of pH in the reaction of chromium complexes with hide proteins. Factors governing chrome tanning – chemistry of neutralization process. A brief survey of chemistry of other tannings like Al, Zr and Te salts and their relative merits in contrast with chrome tanning. Chemistry of combination of tannages involving vegetable tanning aldehydes, chrome and other mineral tanning agents.

**Unit IV**

Chemical methods of curing and preservation of hides and skins in acid and alkaline solutions. Principles of analytical methods employed in curing, liming, deliming, bating, pickling. Analysis of vegetable tanning materials and extract. Process of dyeing leather, use of mordants, dyeing auxillaries such as leveling, wetting and dispersing agents – Dye fixations.

**Unit V**

Animal by products – their collection, handling and preservation methods (such as hair, blood, bones, glands, keratinous materials and their utilization). Tannary effluents and treatment -

Types of water pollution – physical, chemical, physiological and biological. Different types of tannary effluents and wastes- beam – house waste – liquors – tanning and finishing Yard waste liquors – solid waste- origin and disposal.

**Text book**

Anthony D. Covingtan, (2011). *The Science of Leather*, (3rd ed.). RSC publishers

**Reference Books**

1. Thomas C. Thorstensen, (1969).*Practical Leather Chemistry*, World press.com.
2. NIIR board of consultants and engineers, (2011).*Leather processing & Tanning technology, Hand book.* NIIR project consultancy services
3. Nelson D.L. & Cox M.M., (2000).*Hand Book of Leather Chemistry*.
4. B.K. Sharma, (2002). Industrial Chemistry (13th ed.). Goel Publishing Home.

# Semester - V
# SKILL BASED COURSE
# Chemistry for Competitive Examinations - I
# Course Code: CSK175

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 2 | 2 | 30 | 100 |

**Objective:**

1. To learn the basic principles in different branches of chemistry
2. To train students for competitive examinations to get jobs and admission for higher studies.

**Unit- 1 : Matter**

Definition- classification-physical classification, properties of solids, liquids and gases changes of physical state – chemical classifications-elements, compounds, mixtures – elements – definitions and their classifications viz metals, non –metal and metalloids with example – physical states of some important elements. Compounds- definition- classifications viz. inorganic and organic compounds with examples. Some important compounds and their common names and uses – characteristics of compounds. Mixtures – definitions- classifications – homogenous and heterogeneous – examples – properties of mixtures- differences between compounds and mixtures. Separation of mixtures – techniques, principles and examples - Handpicking, sieving, magnetic separation, sublimation, sedimentation, Decantation, filtration, evaporation, Distillation, Crystallization.

**Unit- II : Structure of Atoms**

Atoms- definition –Dalton's atomic theory – atom models - Rutherford, J.J. Thomson and Bohr .Sub-atomic particles – charges of sub- atomic particles discoveries of subatomic particles – atomic and mass number isotopes – symbols for elements – principles governing filling up of electrons in the orbitals – Electronic configurations of first twenty elements.

**Unit - III : Classification of Elements and Periodicity of Properties**

Classification of elements of Doberiner , Newlands, Mendeleev and modern Perioidc tables – Group and Periods – classification of elements into s,p,d and f block with examples – periodicity of properties –atomic – ionic radii - ionization potential energy, electron affinity and electronegativity.

**Unit -IV : Chemical Bonding and Non-Metals**

Need for the chemical bond formation- introduction to ionic bond, covalent bond, co-ordinate bond and metallic bond- ionic bond formation- lattice energy-formation with example as NaCl - covalent bond – definition and explanation using $H_2$, $O_2$, $N_2$ $CH_4$, Properties of ionic and covalent compounds Noble gases and their applications – Halogens and their applications preparation and uses of Hydrogen, phosphorus and sulphur- Allotropes of Carbon-graphite, diamond and fullerene.

**Unit -V : Air and Water**

Atmosphere- different layers of atmosphere and their compositions – composition of air – uses of various components of air – air pollution – sources, effects and control measures – water – abnormal properties of water and its explanation using H- bonding- Hard and soft water – temporary and permanent hardness – Removal of hardness – Boiling, Clarks process, Zeolite process and washing soda process - Reverse osmosis - preparation and uses of distilled water.

**Text Books**


1. Soni, P. L., Dharmara, O. P. &Dash U. N. (2001).Text book of Physical Chemistry (22nded.). New Delhi : Sultan Chand& Sons, Educational Publishers.
2. Soni, P.L. (1991). A text book of Inorganic Chemistry, New Delhi: Sultan Chand & Sons Publishers.
3. Bahl, B.S. & ArunBahl, (2004). A Text Book of Organic Chemistry, Sultan Chand & Sons.


**Reference Books**


1. Donald A. McQuarrie& John D. Simon, (1998). *Physical Chemistry – A molecular approach* (1sted.).
2. Negi, A.S. & Anand, S.C. (2007). *A text book of Physical Chemistry* by– New Age International Publishers.
3. Rakshit, (1980). *Physical Chemistry* (4thed.). SARAT book house.
4. James E.Huheey,(2013). *Inorganic Chemistry*(4thed.). Pearson Education.
5. Wahid V. Malik, Tuli G.D. & Madan,R.D. (2012). *Selected topics in Inorganic Chemistry*, S.Chand and Company Ltd.
6. Puri,B.R., Sharma,L.R. &KaliaK.C.(2012). *Principles of Inorganic Chemistry* (4thed.). Milestone Publishers.
7. Bahl, B.S.& ArunBahl, S. (2006). *A Text Book of Organic Chemistry*, Chand & Company (PVT.) Ltd.
8. Vogel, A. I. (1990). *Qualitative Inorganic Analysis*, The English Language Book Society and Longmans.
9. Vogel, A. I. (1994). Elementary *Practical Organic Chemistry*, The English Language Book Society and Longmans.
10. Mani,P. K. & Thomas, A.O. (1989). A *test book of Practical Chemistry* - Scientific book Centre.

# Semester - VI

## Core – VIII : Organic Chemistry - IV
## Course Code: CC1761

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 5 | 5 | 75 | 100 |

**Objectives:**

1. To understand the spectroscopic analysis of organic compounds
2. To learn about carboxylic acids and carbohydrates
3. To study about dyes and their synthesis

**Unit – I: Stereochemistry**

**Optical isomerism**: Optical activity-elements of symmetry, optical activity of compounds containing asymmetric carbon atoms-lactic and tartaric acids, Chirality-achiral carbon molecules, meaning of (+) and (-) and D and L notations. Projection formulae-Fischer, Flying Wedge, Sawhorse and projection formulae notation for optical isomers, Cahn Ingold and Prelog rules, R-S notation, enantiomers and diastereomers, racemic and meso forms. Racemisation-resolution of racemic mixtures. Walden inversion and asymmetric synthesis. Optical activity of compounds without asymmetric carbon atoms-biphenyl, allenes and spiranes.**Geometrical isomerism** : Maleic and fumaric acid- aldoximes and ketoximes. Methods of distinguishing geometrical isomers, determination of configuration ofketoximes, Beckmann rearrangement, E-Z notation.**Conformational Analysis**: Introduction of terms-configuration and conformation, dihedral angle, torsional strain, conformational analysis of ethane and n- butane and cyclohexane energy diagrams.

**Unit - II**

**Spectroscopy:** General principles, introduction to absorption and emission spectroscopy, electromagnetic region.

**UV Spectroscopy**: Types of electronic transitions -$\lambda_{max}$, chromophores and auxochromes. Bathochromic and hypsochromic shifts. Intensity of absorption - hyper chromic and hypo chromic shifts.

Application of Woodward Rules for calculation of $\lambda_{max}$ for α, β unsaturated aldehydes, ketones, carboxylic acids and esters.

Conjugated dienes - acyclic, homoannular and heteroannular, extended conjugated systems-aldehydes, ketones and dienes. Distinction between cis and trans isomers and applications.

**Photochemistry**: Photochemical reactions of ketones, Norrish type I and type II reactions - photo reactions of alkylnitrites (Barton reaction), photo induced reactions of α, β- unsaturated ketones and photochemical rearrangement of unsaturated ketones.

**Unit - III**

**IR Spectroscopy**: Molecular vibrations and origin of IR spectra - IR absorption positions of O, N and S containing functional groups , H-bonding- inter & intramolecular hydrogen bonding, conjugation . IR absorptions- fingerprint region and its significance. Application in functional group analysis. IR spectrum of alkane, alkene, alkyne, alkyl halide and carbonyl compounds**NMR Spectroscopy**: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it. Significance of number of peaks and peak area. Spin-spin coupling and coupling constant. Interpretation of NMR spectra of simple compounds- ethyl alcohol, benzene, methyl chloride, benzaldehyde and mesitylene.

**Unit - IV:**

**Alkaloids:** Natural occurrence, structural features, isolation and their physiological action, Hoffmann's exhaustive methylation. Structural elucidation and synthesis of conine, piperine and nicotine. Medicinal importance of nicotine, quinine and morphine.

**Terpenoids :** Occurrence, classification and isoprene rule. Elucidation of structure and synthesis of citral, geraniol, menthol and α-terpeniol.

**Unit – V: Dyes**

Classification based on application and chemical structure with examples. Colour and constitution of dyes. Chemistry of dyeing. Valence bond theory of colour.

One method of synthesis and applications of Azo dyes - methyl orange and congored.

Triphenyl methane dyes - malachite green, rosaniline and crystal violet.

Phthalein dyes - Phenolphthalein and fluorescein.

Anthraquinone dyes - Alizarin

Indigo dyes- Indigo.

**Text book**

Jain, M. K. & Sharma, S.C.(2016), *Modern Organic Chemistry* (4thed.). Vishal Publishers.

**Reference Books**

1. Soni, P. L. & Chawla, H. M.(2014). *A Text book of Organic chemistry* (20th ed.). Sultan Chand & Sons.
2. ArunBhal & Bhal B. S, (2013). *A Text book of Organic chemistry* (21st ed.). Chand & Company Pvt. Ltd.
3. Tewari (2016). *Advanced Organic Chemistry*(1stEdn.), Books and Allied Pvt. Ltd.
4. Finar, I.L. (2014). *Organic Chemistry*, Volume 1&II(18thed.). Pearson publishers.

# Semester – VI

## Core – IX : Inorganic Chemistry – III
## Course Code : CC1762

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 5 | 5 | 75 | 100 |

**Objectives**

1. To know the nomenclature, isomerism in co-ordination compounds, the theories, and stability of metal complexes.
2. To study the characteristics of transition and inner transition elements.
3. To learn the types of errors and principles of gravimetric analysis.

**Unit – I: Co-ordination chemistry I**

Double salts – co-ordination compounds – difference, definition and terminology – co-ordination complexes and complex ions – central ion and ligands – co-ordination number – co-ordination sphere – charge on a complex ion - types of ligands with examples. Nomenclature of co-ordination compounds, isomerism in co-ordination compounds, structural isomerism – ionization, hydrate, co-ordination, linkage and co-ordination position isomerism. Stereoisomerism – geometrical isomerism in tetrahedral and octahedral complexes - optical isomerism in octahedral complexes.

**Unit – II: Co- ordination Chemistry II**

Theories of co-ordination compounds- Werner's theory- postulates – verification of Werner's theory- cobalt ammine complexes. EAN rule – calculation of EAN with reference to metal complexes and carbonyls. Pauling's theory (VBT) – postulates - application of VBT to square planar and tetrahedral complexes, inner and outer complexes – merits and demerits of VBT.Shapes of d-orbitals. Crystal field theory – Crystal field splitting of tetrahedral, square planar and octahedral systems. Factors affecting the value of CFSE–crystal field splitting energy values and its application in the stability of complexes. Distortion from perfect symmetry – Jahn-Tellar theorem and its effect.

**Unit -III: Co-ordination chemistry III**

Molecular Orbital Theory (MOT)– MO diagrams of $ML_6$ type complexes – weak and strong field ligands – spectrochemical series.

Stability of metal complexes – relation between stability constant and dissociation constant – factors affecting the stability of metal complexes from thermodynamic data. Irving William series – stabilization of unstable oxidation state. Substitution reactions of square planar complexes – trans effect .Metal carbonyls - classification – examples – structure and nature of M-L bond in metal carbonyls – structures of mono, di and polynuclear carbonyls of Ni, Cr, Fe, Co and Mn. Applications of complexes in qualitative and quantitative analysis.

**Unit - IV: Transition Elements**

Group discussion with special reference to electronic configuration, oxidation state,spectral and magnetic properties, colour, variable valency - polyvalency of Vanadium-magnetic and catalytic properties, ability to form complexes. Difference between the first, second and third transition series. Extraction, properties and uses of Cu, Co and Ni. Preparation and uses of titanium(II)oxide,vanadium(V)oxide,potassiumdichromate,potassiumpermanganate,potassiumferrocyanide,potassium ferricyanide, Vaska's complex, platinum (IV) chloride, chloroplatinic acid and purple of Cassius. **Inner transition Elements-**Electronic configuration, oxidation states, colour, spectral and magnetic properties. Causes and consequences of lanthanide contraction – extraction of lanthanides from monazite sand - separation of lanthanides by ion-exchange method - uses of lanthanides. Comparison between lanthanides and actinides. Extraction, properties and uses of thorium and uranium - zinc uranyl acetate, Uraniumhexafluroide.

**Unit - V: Analytical Chemistry**

**Errors:** Types of errors- determinate and indeterminate errors- minimization of errors. Precision and accuracy- Comparison of precision and accuracy with example-Standard deviation- mean deviation – relative mean deviation and coefficient of variance. Accuracy-absolute error- relative error- confidence limit- Rejection of a doubtful value – Q Test and student T test.

Principles and requirements of gravimetric analysis, gravimetric steps-digestion, filtration, washing, drying and ignition.

Mechanism of precipitation – factors affecting solubility of precipitate - co-precipitation-different types – prevention- post precipitation – prevention and difference between co-precipitation and post precipitation, precipitation from homogenous solution with examples.

**Text books**


1. Puri. B.R., Sharma, L.R. & Kalia, K.C. (2014). *Principles of Inorganic Chemistry*, Milestone Publishers.
2. Madan, R.D. (2005). *Modern Inorganic Chemistry*, (13$^{th}$ed.). S. Chand and Company.


**Reference Books**


1. Lee, J.D. (2008). *Concise Inorganic Chemistry*, (5$^{th}$ed.). John Wiley and Sons.
2. Soni, P.L. &Katyal, M., (2006). *A text book of Inorganic Chemistry*, (12$^{th}$ed.). S. Chand and Co.
3. Asim K. Das,(2007). *Bio-inorganic Chemistry*, Books and Allied (P) Ltd.
4. Mendham, J., Denney, R.C., Barnes, J.D., Thomas, M.J.K. (1968).*Test Book of Quantitative Inorganic Analysis* (6$^{th}$ed.). English Language Book Society.
5. Satake. M., (2011), *Coordination Chemistry*, (1$^{st}$ed.). Discovery Publishing House.

# Semester - VI
# Core – X : Physical Chemistry - III
# Course Code :CC1763

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 6 | 5 | 90 | 100 |

**Objectives**

1. To acquire the knowledge of phase diagram and chemical kinetics.
2. To have an idea about electrochemistry and photochemistry.
3. To impart knowledge about spectroscopy.

**Unit – I: Phase Equilibria**

Concept of phase – components and degrees of freedom (definitions and examples), derivation of Gibb's phase rule. Phase diagram for one component system – water and sulphur system. Two component system – reduced phase rule – simple eutectic system – lead-silver system – Pattinson's process of de-silverisation of lead-freezing mixtures-KI-$H_2O$ system .Formation of compounds with congruent melting point – zinc-magnesium system and $FeCl_3$-$H_2O$ system. Formation of compounds with incongruent melting points – $Na_2SO_4$-$H_2O$ system. Solid-gas equilibria – $CuSO_4$-$H_2O$ system. Efflorescence, deliquescence and hygroscopy.

**Unit – II: Chemical Kinetics**

Rate of reaction – expression of rate – factors influencing rate of reaction – order and molecularity of a reaction- definition and examples – differences between order and molecularity of a reaction – various orders of reaction and their derivation – zero, first and second order reaction – definition, examples and derivation of rate constant and half life period. Methods of determining order of reaction – use of differential, integral, half-life method and Ostwald's isolation methods. –Concept of activation energy – effect of catalyst – calculation of energy of activation (Arrhenius equation) – theories of reaction rates – collision theory of bimolecular gaseous reactions, activated complex theory – comparison of collision theory and activated complex theory. Lindeman's theory of unimolecular reactions(Problems wherever necessary).

**Unit III : Electrochemistry - I**

Definition – conductance, specific conductance, equivalent conductance and molar conductance – factors affecting conductance of a solution. Transport number – determination of transport number by Hittorf's method and moving boundary method- Strong and weak electrolytes – variation of equivalent conductance with dilution. Debye-Huckel theory of strong electrolytes – Debye-Huckel Onsagar equation. Kohlrausch's law and its applications-Applications of conductance measurements –Determination of $\lambda$ infinity of weak acid and weak base-degree of dissociation of weak electrolytes- solubility and solubility products of sparingly soluble salts and conductometric titrations. (Problems wherever necessary).

**Unit - IV: Electrochemistry – II**

Electrochemical cells –chemical cells – reversible and irreversible cells -EMF of cells – determination. Cell representation. Single electrode potential – types of electrodes – metal- metal ion electrodes, amalgam electrodes, gas electrodes, metal –insoluble metal salt electrodes and oxidation – reduction electrodes. Standard electrode – hydrogen electrode (SHE) and calomel electrode. Nernst equation for electrode potential – Nernst equation for emf of cells – standard electrode potential – electro chemical series – thermodynamics of galvanic cells –$\Delta G$,$\Delta H$ and$\Delta S$ and equilibrium constant (K). Concentration cells – with transference and without transference – liquid junction potential and its elimination. Applications of EMF measurements –determination of transport number, valency of an ion, pH of a solution using hydrogen, quinhydrone and glass electrode. Potentiometric titrations - acid-base, oxidation – reduction and precipitation titrations. Decomposition potential and overvoltage (Problems wherever necessary).

**Unit - V: Spectroscopy**

Different regions of EMR spectrum and general spectroscopic methods – Born-Oppenheimer approximation – types of molecular spectra – microwave (rotational) spectra – theoretical principle, intensity, selection rule and applications in the determination of bond distance in diatomic molecules. Vibrational (IR) spectra – principle, harmonic oscillator and unharmonicity – selection rule, intensity, modes of vibrations and types – force constant – applications of IR– hydrogen bonding –Inter and Intramolecular hydrogen bonding- Fermi resonance – overtones and combination bands. Electronic spectra - selection rules, Frank Condon Principle - types of transitions – applications. Raman spectra - principle – stokes, antistokes lines - comparison of IR & Raman Spectroscopy using $CO_2$ and $H_2O$.ESR spectra –principle – hyperfine splitting - ESR spectra of methyl radical .

## Text book

Puri, Sharma & Pathania, (2013). Elements of Physical Chemistry, India : Vishal Publishing Co.

## Reference Books

1. Peter Atkins & Julio De Paula (2014).*Physical Chemistry* (10th ed.). Oxford University Press.
2. Castellan, G. W. (2004).*Physical Chemistry*, (4th ed.). Narosa.
3. McQuarrie, D. A. and Simon, J. D., (2004).*Molecular Thermodynamics*, Viva Books Pvt. Ltd. New Delhi.
4. Engel, T.& Reid, P. (2012).*Physical Chemistry* (3rd ed.). Prentice-Hall.
5. Mortimer, R. G. (2009).*Physical Chemistry* (3rd ed.). Elsevier: NOIDA, UP.
6. Levine, I. N. (2011).*Physical Chemistry* (6th ed.). Tata McGraw-Hill.
7. Metz, C. R. (2009).*Physical Chemistry* (2nd ed.). Tata McGraw-Hill.

# Semester – VI
# Elective IV – Bio Chemistry

## Course Code: CC1764

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives**

1. To know the biological action of carbohydrates
2. To know the functions of lipids, proteins and amino acids.
3. To impart knowledge about nucleic acids.

**Unit I : Carbohydrate**

Definition and classification of carbohydrates. Glycosides – their physiological significance. Amino sugars – importance. Chemistry of polysaccharides – starch, glycogen, cellulose, inulin, hemi-celluloses, chitin, pectin and lignin. Glycosaminoglycans- hyaluronic acid, chondroitin sulphate, keratansulphate, heparin and dermatan sulphate. Blood group substances. Carbohydrate metabolism – Embden – Meyerhof pathway- TCA cycle.

**Unit II : Lipids**

Definition and classification of lipids. Types of fatty acids – saturated, unsaturated, unusual and essential fatty acids. Triacylglycerols – chemistry. Characterization - saponification number, iodine number, acid number, RM value and acetyl value. Chemistry and functions of phospholipids – lecithin and cephalin. Sphingolipids – sphingomycin. Glycolipids - cerebroside, ganglioside (structure and function only). Cholesterol – spot tests and structure (structural elucidation not required).Biochemical functions of cholesterol.

**Unit III : Amino acids and proteins**

Classification of amino acids and proteins – structure, classification and biochemical importance – one method each to identify C-terminal and N- terminal amino acids, secondary, tertiary and quaternary structures. Abbreviated names - structure and importance of simple peptide - glutathione, carnosine, anserine, vasopressin and oxytoxin. Peptide antibiotics - Geramicidin, bacitracin and actinomycin. Transamination – deamination- urea cycle.

**Unit IV**: **Nucleic Acids**

Purines, pyrimidines, deoxyribose, ribose, nucelosides, nucleotides,cyclic nucleotides. Structure and functions of DNA and different types of RNAs (m-RNA, t-RNA and r- RNA) - Nucleoprotiens.

**Unit V** : **Enzymes**

Enzymes – classification - specificity. Factors affecting enzyme reaction – Michaelis – Menten equation - derivation- inhibition of enzyme action – competitive, non - competitive and

uncompetitive coenzymes and their mechanism of $NAD^+$ and PLP. Immobilisation of enzymes - industrial and medical application of enzymes.

**Text Books**

Satyanarayana, U.&Chakrapani, U. (2008).*Essentials of Biochemistry*, (2nded.).ArunabhaSen publishers.

**Reference Books**

1. Eric E.Conn, Roy H &Doi, John,(1987). *Outlines of Bio Chemistry*, Wiley publishers.
2. Abraham white and Philip Handler, (2008).*Principles of Bio Chemistry*, McGraw Hill publishers.
3. Weil, J. H. &Wilfy, (1987).*General Bio Chemistry*, (6thed.). Eastern publishers.
4. Lehninger, Nelson & Cox, (2006). *Principles of Bio Chemistry*, (2nded.). CBS publishers.

# Semester – VI

## Elective IV – Instrumental methods
## Course Code: CC1764

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives**

1. To understand the instrumental methods to analyze chemical compound.
2. To gain knowledge on working of instrumentation.
3. To know the applications of spectroscopy.

**Unit I Chromatography**

Chromatography- Definition, plate and rate theory. Classification-Paper chromatography-Principle-types-ascending, descending and radial - applications. Thin layer chromatography - experimental technique and applications. Coloumn chromatography –principle, experimental technique and applications. Ion exchange chromatography- principle, experimental techniques, applications, separation of zinc and magnesium, chloride and bromide.

**Unit II: Thermo Analytical and Electroanalytical Methods**

Thermogravimetric analysis (TGA) - principle, automatic thermogravimetric analysis, factors affecting TGA, applications. Thermometric titrations. Differential thermal analysis (DTA), simultaneous DTA, TGA curves. Electrogravimetric analysis - theory, instrumentation, applications.Coulometric analysis – coulometric titrations, applications. Potentiostatic coulometry. Polarography – principle, dropping mercury electrode, experimental assembly, polarographic curves, applications to qualitative and quantitative analysis, concept of pulse polarography. Amperometric titrations – principles and applications.

**Unit III: Colorimetric and Spectrophotometric Analysis**

Colorimetry: Instrumentation for visual colorimetry, photoelectric colorimetry. Spectrophotometry: Instrumentation. Fluorometry - principle, instrumentation, applications.Flame photometry- principle, instrumentation and application.Nephelometry and turbidimetry – theory and instrumentation, turbidimetric titrations and applications.

**Unit IV:Spectroscopy – 1**

Introduction – types – UV Spectroscopy instrumentation – Theory – Adsorption laws – types of electronic transition, chromophore concept – solvent effect –woodward – Fieser rule for calculating

λ max for benzene and its simple derivatives (alcohol, aldehyde, Ketone) – applications of ultraviolet spectroscopy.

IR spectroscopy – principle and instrumentation – sampling Techniques – vibrational frequencies and factors affecting IR spectra – Finger print region – Applications.

**Unit: V:Spectroscopy II**

Raman spectroscopy instrumentation – Rayleigh and Raman Scattering, stokes and antistokes lines - Raman effect and molecular structure – Raman Spectra of $CO_2$, $H_2O$.Advantages and limitations of Raman Spectroscopy.

NMR spectroscopy–principle relaxation effect, chemical shift, factors influencing chemical shift, solvent used–instrumentation, spin– spin coupling and coupling constant, NMR spectrum of simple organic molecules of 1- Propanol, 1, 1, 2 – Tribromoethane, ethyl acetate, benzaldehyde – applications of NMR spectroscopy,2D NMR and nuclear Overhauser effect.

Constitutional Problems wherever necessary.

**Text Book**

Sharma, B.K. (2004). *Instrumental methods of analysis* (23rd ed.). GOEL Publishing House, Meerut.

**Reference Books**

1. Higson, S. (2003). *Analytical Chemistry* (1st ed.). USA: Oxford University Press.
2. Christian, G.D. (2007). *Analytical Chemistry* (6th ed.). John Wiley &Sons.
3. Kemp, W. (1994). *Organic Spectroscopy* (3rd ed.). Macmillam.

# Semester – VI
# Paper XIV - Elective IV – Forensic Chemistry
# Course Code: CC1764

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives**

1. To understand the applications of Forensic chemistry.
2. To gain knowledge on detective materials.
3. To know the applications of forensic laboratories.

**Unit I**

History and development of forensic science the beginning of forensic toxicology – principles, governing the practice of Forensic science – history of forensic science laboratory in Tamil Nadu. FSD's services – anthasapology – Ballistin – Biology – Chemistry – Document – Excise – explosives – Narcotives – Photo-physics prohibition – Research and Development – serology – Toxicology – Mobile forensic Science laboraties – role of forensic scientist injustice – administration system – Legal recognition to forensic science in India.

**Unit II**

Physical evidence – Common types– Information – Classification – crime material -general nature – Physical state– interaction – striations – tears – break and cuts – sources of trace evidence – foot wear – body- trace metal detection – other sources – fibres – buttons –cordage and rope metallic fragments – soil – paint flakes / smear – glass particles – purntpaner of glass – Glass splinters – dust and airborne particles.

**Unit III**

DNA profiling – background – nuclear DNA – mitochondrial DNA – Technique Blood – Blood groups and their significance – blood strains field test precipitin test – location of stains – semen – identification – micro crystalline test – acid phosphatase – test – Saliva – identifications – characteristics. Sweat – hair significance – human hair – distinguishing features.

**Unit IV**

Foot prints – methods used for collection – propellant – Gum powder – smoke less powder – semi smokeless powder – Arson – Chemistry of fire. Explosives – low explosives – high explosives.

**Unit V**

Alcohol poisoning – stage of excitement – symptoms and signs – in coordination – stage of narcosin – cause of death – medical aspects – dreamlessness – instrumental methods of analysis – atomic absorption spectrophotometry.

**Text book**

David. E. Newton. (2014). *Forensic Chemistry* (6th ed.). Viva books private Ltd.

**Reference Books**

1. Chatterjea. M.N. &Chawla. R., (2010), *Clinical Chemistry* (2nd ed.). Jaypee Brothers Medical Publishers Pvt. Ltd.
2. Nanda Maheswari (2008), *Clinical Biochemistry* (1st ed.). Jaypee Brothers Medical Publishers Pvt. Ltd

# Semester - III
# Elective I - Dairy Chemistry
# Course Code: CC1732

| Number of Hours Per week | Number of Credit | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives**

1. To learn about the dairy products.
2. To make the students to understand the various aspects of health and hygiene and to practicelab to land.

**Unit I**: **Properties of milk**

Milk – definition - composition - physico chemical properties – colour, odour, acidity, specific gravity, conductivity of milk. Indian standards of milk .Factors affecting composition of milk - food and nutritive value. Physico-chemical properties of milk constituents – water, fat, proteins, lactose and mineral matter. Action of milk on metals. Flavour defects in milk - their causes and prevention - uses of milk. Estimation of fat, acidity and total solids in milk. Adulterants in milk – definition, common adulterants and their detection. Preservatives in milk – definition, common preservatives and their detection. Neutralizers in milk – definition, the different types of neutralizers and their detection.

**Unit II** :**Microbiology of milk**

Introduction, growth of micro-organisms, destruction of micro-organisms – heat treatment, use of ionizing radiation, electricity, high frequency sound waves and application of pressure. Pasteurization – definition, objectives and requirements of pasteurization. Methods of pasteurization – in-the-bottle pasteurization, batch / holding pasteurization or Low-Temperature – Long Time pasteurization (LTLT), High Temperature – Short Time pasteurization (HTST), Ultra-High Temperature pasteurization (UHT), Uperization (Ultra-pasteurization), vacuum pasteurization (vacreation) and stassanization. Dairy detergents – definition – desirable properties, different types, cleaning and sanitizing procedure, cleaning-in-place (CIP). Sterilizers – definition – desirable properties – cleaning and sterilization of dairy utensils – Chloramine – T and hypo chlorite solution.

**Unit III : Special Milks**

Sterilized milk – definition, requirements, advantages and disadvantages and method of manufacture.Homogenized milk – definition, merits and demerits, methods of manufacture.Flavoured milks – definition, purpose, types of flavoured milks, method of manufacture. Chocolate flavoured milk and Fruit flavoured milk. Vitaminized milk – definition, purpose Standardized milk – definition, merits, method of manufacture. Toned milk (single and double toned milk) – manufacture. Humanised milk.

**Dried milk** : Definition**,** composition, objectives of productions - principle involved in manufacture, food and nutritive value, role of milk constituents, keeping quality.
**Condensed Milk:** Definition**,** composition, objectives of production -principle involved in manufacture of condensed milk (flow chart and explanation) - uses of condensed and evaporated milk. Types of condensed milk – plane condensed milk, super heated condensed milk & frozen condensed milk.

**Unit: IV**: **Cream, Butter, Ghee, Ice cream and Cheese**
**Cream:** Definition – composition - gravitational and centrifugal methods of separation of cream - estimation of fat in cream.
**Butter:** Definition - percentage composition - manufacture of butter, estimation of fat in butter - determination of acidity and moisture content - desibutter.
**Ghee**: Major constituents of ghee - common adulterants added to ghee - detection of the adulterants. Rancidity of ghee – definition, different types – hydrolytic, oxidative and ketonic rancidity - prevention of rancidity - antioxidants
**Ice cream:** Introduction – definition – classification – composition – food and nutritive value – defects in ice cream, their causes and prevention.
**Cheese:** Introduction – definition – classification – composition – food and nutritive value – cottaged cheese - processed cheese – defects in cheese - their causes and prevention.

**Unit V : Proteins, Carbohydrates, Vitamins in milk and dairy sweets**

**Milk Proteins:** Physical properties of milk proteins - electrical properties - hydration of proteins, solubility - effect of heat on milk proteins, milk enzyme and functions.
**Milk carbohydrate:** Lactose - structure of lactose (both α- and β–forms), reactions of lactose – hydrolysis, oxidation and reduction. Estimation of lactose in milk – picric acid method and chloramine – T method.
**Milk vitamins:** Water soluble vitamins and fat soluble vitamins in milk - form of occurrence in milk - importance of the vitamins with respect to physiological activity - effect of heat treatments and exposure to light radiation.
**Dairy Sweet:** Preparation of peda, gulabjamun, rossogolla and kheer paneer.
Kheer – Khoa/ Mawa – Khurchan – Rabri-Kulfi/Malai –Ka- baraf- Dahi – Panir- Chhana – Makkhan – Lassi - Ghee Residue.

**Text Books**

Sukumar De.(1991). Outlines of Dairy Technology, (1st ed.). Oxford University Press.

**Reference Books**

1. Webb Johnson & Alfond, Fundamentals of Dairy Chemistry. Delhi: C.B.S. Publishers and Distributers.
2. Rangappa, K.S & Achaya, K.T. (1974). Indian Dairy products, Bombay: Asia Publishing House.
3. Webb, B.H. & Whittier, E.O. (1970). By-products from Milks, Westport, Connecticut: A.V.I. Publ. Co. Inc.,
4. Srinivasan, M. R. & Anantakrishnan, C.P.: (1957). Milk Products of India, ICAR Animal Husbandry Series No. 4, New Delhi.
5. Murray, R.K.,Granner, D.K., Mayes, P.A. & Rodwell (1990). V.W.Harper's Biochemisry, (21sted.). McGraw-Hill.

## Semester - III

## Elective I - Nutritional Chemistry
## Course Code: CC1732

| Number of Hours Per week | Number of Credit | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives:**

1. To make the students understand the different types of nutrients essential for the growth.
2. To have an idea about the dairy products and various aspects of health and hygiene and to practice what they learn to cherish a healthy life.

**Unit I:**

**Nutrients:** Discovery of nutrients-total energy need for the human body, energy and nutrient-calorific value of food.

**Carbohydrates:** Definition – classification - sources and energy released from sucrose, lactose and maltose, tests for carbohydrates, manufacture of sucrose, function of carbohydrates-digestion and absorption - Regulation of blood sugar-important sources-carbohydrate in the diet.

**Unit II**

**Proteins:** Definition - amino acids - classification and function. Classification-sources and function of common proteins viz egg albumin, insulin, casein, collagen, keratin and haemoglobin -tests for proteins - nucleic acids-RNA, DNA (Structure not necessary).

**Lipids:** Definition-biological significance-tests for lipids-preservation of egg, milk, meat, fish, fruits and vegetables by physical (temperature control refrigeration) and chemical methods (preservative).

**Unit III**

**Minerals:** Calcium – sources – deficiency, phosphorus - food sources – functions, iron – sources – deficiency and potassium - functions, deficiency.

**Vitamins:** Classification - sources - deficiency diseases.

**Adulteration of food:** Simple methods to find adulteration of milk, food, oils (edible and mineral) and honey. Food poisoning and its prevention. Antibodies, food preservation, colouring, flavouring and sweeting agents in catering technology. Carcinogens in food materials.

**Unit IV: Enzymes**

Introduction, properties, nomenclature and classifications of enzymes. Oxido-reducatases, transferases, hydrolases, lyases, isomeases, ligases.Cofactors and coenzymes. Mechansim of enzyme catalysis, factors affecting enzyme activity, regulation of enzyme activity. Reversible/ competitive inhibitors and irreversible / noncompetitive inhibitors.

**Unit V: Hot and Cold beverages**

**Hot beverages** – Tea, coffee and soups.

**Tea** - Quality of the ingredients, time of extraction

**Coffee**: Methods of preparation-filtration-percolation-instant coffee powder.

**Soup**:Clear soup,cream soup, chowder soup and vegetable soup.

**Cold beverages**-Lassi-definition-composition-nutritive value. Fresh juices - orange, mosuombi and mango. Synthetic fruit flavoured drinks-carbonated drinks-alcoholic beverages.

**Text Book**

Swaminathan, M. (1977). Handbook of Food and Nutrition, (1st ed.). Chennai: Ganesh & Co.

**Reference Books**

1. Sukumar De., (2002). Outlines of Dairy Technology (17th ed.). New Delhi: Oxford University press.
2. Clarence Henry, Eckles, Willes Barnes Combs and Harold Macy (2002). Milk and Milk products (3rd ed.). Tata McGrow Hill publishing company.
3. Byron H. Webb, Arnold H. Johnson and John A.Alford, (1987). Fundamentals of Dairy Chemistry (2nd ed.). New Delhi: CBS Publishers.
4. A Manual (2005). Analysis of milk and milk products, Milk Industry Foundation.

## Semester - III

## Elective I - Applied Electro Chemistry
## Course Code: CC1732

| Number of Hours Per week | Number of Credit | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

Objectives

1. To learn about industrial electro chemistry, hydrometallurgy, electro metallurgy and pyrometallurgy
2. To gain knowledge about electro plating and electro chemical power sources.

Unit I

Industrial electrochemistry – electrochemical processes in industry - components of electrochemical reactors. Types of electrolytes, cathodes and anodes in electrochemical reactor – separators. Inorganic electrochemicals - caustic soda and chlorine productions. Mercury cells, diaphragm cells, membrane cells, advantages of membrane cells.Other inorganic electrochemicals – chlorates, perchlorates, hydrogen peroxide. Organic electrochemicals . Special features of electro-organic synthesis – electrochemical oxidation – Kolbe synthesis, Electro reduction of carbonyl compounds, adiponitrile synthesis.

**Unit II**

**Electrometallurgy:** Electrodeposition of metals – principles – nucleation and growth of crystals .Nature of electro deposits.

**Hydrometallurgy:** Recovery of metals from aqueous electrolytes – recovery of silver from photographic emulsion. Electrorefining – production of high purity copper – process description.

**Pyrometallurgy:** Necessity for using molten electrolytes – reactors for molten salt electrolysis production of aluminum – electrodes and electrode reactions in cryolite melt–electrochemical purification of aluminum, other metals through molten salt electrolysis – Mg and Na – brief outline.

**Unit III**

**Electroplating:** Fundamental principles, Nature of deposits for electroplating – Hull cell experiments – operating conditions and nature of deposits – throwing power, preparation of samples for electroplating – chemical and electrochemical cleaning –electroplating of copper, nickel and cadmium. **Electrodes plating:** Importance – plating on non-metals, bath composition, electroless plating of copper and nickel.

**Unit IV**

**Electrochemical power sources:** Basic principles – chemical and electrical energies – interconversion charging and discharging. Requirements for a good power source. Types of power sources. Primary Batteries - description of primary cells – alkaline – manganese cells, Button cells, silveroxide - zinc cells, Lithium primary cells – applications. Secondary Batteries - important applications – charge discharge efficiency – cycle life – energy density lead acid batteries – Nickel, metal hydride batteries – Lithium, secondary batteries – Batteries for electric vehicles. Fuel cells - basic principles – $H_2$, $0_2$ fuel cells – gas diffusion electrodes for fuel cells – alkaline fuel cells only.

**Unit V**

**Corrosion:** Principles – stability of metals – EMF series active and noble metals – $P^H$ effect on stability, Pourbaix diagram – Kinetics of corrosion – Mixed potential process – cathodic reaction – anodic reaction – corrosion current – Active dissolution – passivation - breakdown of passivity – Evans diagram.

**Methods of corrosion protection:** Principle –inhibition of anodic, cathodic processes – inhibitive additives for corrosion protection – protective coatings – types of coatings – protection of structures and pipelines- cathodic protection – examples, sacrificial anodes – protection of ships in sea water.

**Text book:**

Hamann, C.H. A. Hamnett & W. Vielstich, W. (2007).Electrochemistry, (2nded.). Wiley – VCH.

**Reference books**

1. Pletcher, D. & Walsh, F. C. (1990). Industrial Electrochemistry (2nded.). London: Chapman Hall.
2. Hibbert, D. B. (1993). Introduction to Electrochemistry (18thed.). Mac Millan Publication.

# Semester - III
# Practical Paper III
# Organic Preparation and Determination of Physical Constants
# Course Code: CC17P3

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 2 | 2 | 30 | 50 |

**Objectives:**

1. To develop skill in preparing Organic compounds.

2. To find out the exact melting and boiling point of Organic Substances.

**Preparation of organic compounds**

Acetylation : a) Preparation of acetanilide from aniline b) Preparation of aspirin from salicylic acid.Benzoylation: a) Preparation of benzanilide from aniline b) Preparation of beta naphthyl benzoate from beta naphthol. Nitration: a) Preparation of m - dinitro benzene from nitrobenzene

b) Preparation of p-nitro acetanilide from acetanilide

c) Preparation of picric acid from phenol.

Halogenation: a) Preparation of p- bromoacetanilide from acetanilide

Hydrolysis: a) Preparation of salicylic acid from methyl salicylate

b) Preparation of benzoic acid from benzamide

Oxidation: a) Preparation of benzoic acid from benzaldehyde

Condensation: a) Preparation of osazone from glucose

**Determination of exact melting and boiling point of some organic substances.**

**Text Books**


1. Thomas, A. O. (1999). Practical Chemistry for B.Sc Main students,Scientific book center, Cannanore.
2. Vogel, I. (1990). A Text Book for Qualitative Inorganic Analysis, English Language Book Society and Longmans.

# Semester - IV

## Core – IV : Organic Chemistry - II
## Course Code: CC1741

| Number of Hours Per week | Number of Credit | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 4 | 60 | 100 |

**Objectives:**

1. To study the chemistry of halogenated hydrocarbons
2. To learn about aromaticity of organic compounds
3. To understand oxygen derivatives and carbonyl derivatives

**Unit – I: Carbonyl Compounds**

Structure, reactivity and general methods of preparation of aldehydes and ketones.

Nucleophilic addition and condensation reactions.Mechanisms of Aldol condensation, Benzoin condensation, Knoevenagel condensation, Perkin & Cannizzaro reaction and Benzil-Benzilic acid rearrangement.**Addition reactions of unsaturated carbonyl compounds**: Michael addition., Oxidations– Baeyer- Villiger - oxidation, Reductions- Clemmensen,Wolff-Kishner, $LiAlH_4$and $NaBH_4$ reductions.

**Unit - II: Carboxylic Acids and their Derivatives**

Preparation and reactions of monocarboxylic acids.Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids - succinic, phthalic, malic, tartaric, maleic and fumaric acids.

Preparation and reactions of acid chlorides, anhydrides, esters and amides. Mechanism of Claisen condensation and Hofmann rearrangement.

**Unit – III: Functional Groups Containing Nitrogen**

Preparation and important reactions of nitro compounds, nitriles and isonitriles

**Amines**: Preparation - Gabriel phthalimide synthesis, properties- carbylamine reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; distinction among 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.**Diazonium Salts**: Preparation and synthetic applications, Curtius rearrangement.

**Unit – IV**

**Active methylene compounds**

Reactivity of active methylene group.

**Acetoacetic ester**: Preparation, properties-acid hydrolysis and ketonic hydrolysis, synthetic applications-synthesis of mono alkyl acetone, butanoic acid, 2 - pentanone, acetonyl acetone, succinic acid, α,β unsaturated acid, 2,5-diketone, 1,3 – diol, γ-keto acid and 4-methyl uracil.

**Malonic ester**: Preparation, synthetic applications-synthesis of pentanoic acid, succinic acid, pentanedioic acid, adipic acid, β- keto acid, α,β - unsaturated acid, cyclo alkane carboxylic acid and barbituric acid.

**Cyano acetic ester**: Preparation, synthetic applications-synthesis of malonic acid, propionic acid,α,β unsaturated acid, succinic acid and β-amino ester.

**Cycloalkanes :**Preparation and properties of cycloalkanes. Relative stability - Baeyer's strain theory and modification.

**Unit V: Aromatic hydrocarbons**

**Aromaticity:**Concept of Aromaticity and characteristics of aromatic compounds, Huckel's rule,aromatic character of cyclic hydrocarbons, arenes, cyclic carbocations, carbanions and heterocyclic compounds.Benzene- isolation, preparation and structure.

**Aromatic Substitution reactions**: Electrophilic aromatic substitution-halogenation, nitration, sulphonation, Friedel-Craft's alkylation and acylation with their mechanisms. Directing effects of the groups.

**Text book**

Jain, M. K.,& Sharma, S.C.(2016). Modern Organic Chemistry (4$^{th}$ed.). Vishal Publishers.

**Reference Books**

1. Soni, P. L. &Chawla, H. M.(2014). A Text book of Organic chemistry (20$^{th}$ ed.). Sultan Chand & Sons.
2. Arun Bhal & Bhal B. S, (2013). A Text book of Organic chemistry (21$^{st}$ ed.). Chand & Company pvt. Ltd.
3. Tewari (2016). Advanced Organic Chemistry(1$^{st}$ed.). Books and Allied Pvt. Ltd.
4. Finar, I.L. (2014). Organic Chemistry, Volume 1&II (18$^{th}$ed.). Pearsonpublishers.

# Semester – IV

## Elective II - Industrial Chemistry - II
## Course Code: CC1742

| Number of Hours Per week | Number of Credit | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives**

1. To understand the applications of chemical industries.
2. To gain knowledge on working of industries.
3. To know the impact of industry on environment.

**Unit I: Petroleum Industry**

Petroleum and petrochemicals – refining of petroleum – composition and uses of main petroleum fractions. Cracking – thermal and catalytic cracking - advantages of catalytic cracking – Octane number, cetane number, ignition and flash points– anti knock agents – unleaded petrol — antidiesel knock agents – hydrocarbons from petroleum. Petrochemicals – direct and indirect petrochemicals – catalysts used in petroleum industry. Methods involved in manufacture of petrochemicals – alkylation, pyrolysis, halogenation, hydration and polymerization.

Classification of petrochemicals – examples. Manufacture of synthetic petrol – Bergius process – Fischer – Tropsh process. Manufacture and uses of petrochemicals - Methanol , Ethanol , Isopropyl alcohol , formaldehyde , Ethylene glycol, Glycerol, Phenol and Acetone .Petrochemical Industries in India.

**Unit: II: Fertilizers and agro chemicals**

Plant nutrients – Macronutrients – Micronutrients. Need for fertilizers -characteristics of a good fertilizer. Role of N, P and K in plant growth – Classification of fertilizers – Natural fertilizers – artificial fertilizers. Classification, manufacture and uses of artificial fertilizers – Urea – Calcium cyanamide – calcium ammonium nitrate – superphosphate of lime-Triple superphosphate – Potassium chloride – DAP. NPK fertilizers – Biofertilizers and its advantages.

Agro chemicals – Classification – Insecticides – Preparation and Uses of Lead arsenate , Calcium arsenate , DDT , Methoxychlor , BHC , Chlordane , Parathion, Malathion , Baygon . Fungicides – Preparation and Uses of Lime , Sulphur , Boreaux mixture , Sodium sulphate , Thallium Sulphate. Weedicides – Preparation and uses of Butachor , Eptam (EPTC) , DNOC. Rodenticides - Preparation and uses of Zinc phosphide , Aluminium phosphide, Coumachlor and Warfarin.

**Unit III: Rubber**

Importance of rubber – Latex - Coagulation of rubber – Refining of Crude rubber – Drawbacks of raw rubber – Rubber fabrication – Vulcanisation - Techniques of vulcanisation - Properties of vulcanised rubber – Physical and chemical properties of rubber –Solvents for natural rubber-Classification.

Synthetic rubber – classification. Manufacture, Properties and uses of Buna-S –Neoprene-Buna-S – Thiokol- Silicon rubber - Polyurethane – Spandex - Reclaimed – Spong-foam – laminates - rubber cement and thermocole - Applications of rubber.

**Unit IV: Matches and explosives**

Safety matches – classification – composition – Manufacture of Safety matches. Pyrotechny – composition of fireworks. Explosives – Characteristics - Low explosives – Gun powder – Smokeless powder. Primary explosives – Preparation and usesof Lead azide – Mercury fulminate – Diazodinitrophenol- Tetryl – Ethylene dinitramine. High explosives – Trinitrotoluene – Picric acid – Ammonium picrate – Glyceryltrinitrate – Dynamite – PETN – Cyclonite – HMX.

Toxic chemicals-Preparation and properties – Mustard, Phosgene, Nerve gases, Adamsite, Chloroacetophenone, Chloropicrin. Screening of smokes – Incendiaries - Explosives in India.

**Unit V: Protective coatings and silicates**

Paints-Definition - Classification- Composition-Manufacture-Process of setting of paint-Requirements of a good paint-Importance of pigment volume concentration- Applications. Emulsion paints – Constituents – advantages - methods of manufacture - chemical action - paint removers. Varnishes – Definition – Classification – manufacture - raw materials - composition. Lacquers – Definition, Composition and importance .

Cement – Definition, Raw materials used in the Manufacture of cement, Setting of cement. Properties- Quality test –Uses. Glass –Manufacture –Physical and Chemical properties-Preparation and uses of Special glasses-fused silica glass, Vycor glass, optical glass, lead glass, coloured glass, opal glass, safety glass, fibre glass laminates, glass wool, flint glass. Pyrex and jena glasses. Refractories – definition and classification. Abrasives – definition, uses, classification. Natural abrasives – Synthetic abrasives.

**Text Book**

Sharma, B.K., (2003). Industrial chemistry (47$^{th}$ed.). Meerut: Goel publishing House.

**Reference books**

1. Dryden, C.E., (1973). Outline of chemical Technology (2$^{nd}$ed.). New Delhi: East - west press.
2. Steiner, H., (1961). Introduction to Petrochemicals (2$^{nd}$ed.). Pergaman press Newyork.
3. Sharma, B. K. &Kaur, H., (1997). Environmental Chemistry. Meerut: Goel Publishing House.

## Semester - IV

## Elective II – Polymer Chemistry
## Course Code: CC1742

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives**

1. To know about the different types of polymerization reactions.
2. To understand the importance and the biomedical application of polymers.

**Unit – I:Polymer types and types of polymerization:**

Distinction among plastics, elastomers and fibres – nomenclature of polymers – homo and hetero polymers – copolymer – tacticity – isotactic, atactic, syndiotactic polymers. General characteristics of polymers in comparison with common organic compounds. Plastics – thermosetting and thermoplastics – differences. Functionality – cross linking – linear, branched and cross linked polymers. Types of polymerization – addition, condensation and copolymerization. Mechanism of addition polymerization –initiation, propagation and termination processes. Initiators and inhibitors. Methods of polymerization – bulk, suspension, emulsion and solution polymerization. Block and graft copolymers.

**Unit – II: Synthetic polymers**

Synthesis, properties and applications of phenol-formaldehyde resin, melamine – formaldehyde resin, polyurethanes and epoxy resins. Grades, Curing processes and its importance with mechanisms. Polycarbonates, natural rubber - vulcanization. Synthetic rubber – styrene rubber, nitrile rubber, butyl rubber, polysulphide rubber and neoprene. Synthetic polymers – polyolefins – polyethylene – HDPE, LDPE, LLDPE – polypropylene – polyvinylchloride – grades of PVC – teflon, polymethylmethacrylate (Plexiglass) – polystyrene. Homopolymers, copolymers (SBR, ABS, SAN) – polyester, polyamide – nylon 66, natural polymers – cellulose, starch, silk, wool – cellulose acetate and cellulose nitrate.

**Unit – III: Properties of polymers**

Molecular mass – number average, weight average, viscosity average. Practical significance of molecular mass distribution – size of polymers. Kinetics of polymerization and Carother's equation. Viscosity, solubility, optical, electrical, thermal and mechanical properties of polymers. Degradation of polymers by thermal, oxidative, mechanical, chemical ultrasonic waves, high energy radiation and photodegradation methods.

**Unit – IV: Glass transition Temperature**

Glass transition temperature and crystallinity – factors influencing glass transition temperature – glass transition temperature and molecular weight – glass transition temperature and plasticizers – glass transition temperature of copolymers – glass transition temperature and melting point. Heat distortion temperature, e-determination of glass transition temperature – significance of glass transition temperature.

Crystalline solids and their behavior towards X-rays – polymers of X-ray diffraction – degree of crystallinity – crystallisability – polymer crystallization – crystallites – factors affecting crystallinity – Helix structures – spherulites – polymers single crystals – folding of chains during formation – effect of crystallinity on properties of polymers.

**Unit – V:Polymer dissolution and Advances in polymers**

Process of polymer dissolution – thermodynamics of polymer dissolution – general principles – effect of molecular weight on solubility – solubility of crystalline and amorphous polymers.Flory-Huggins theory of polymer solution. Heat of dissolution and solubility parameters. Biomedical applications of polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells. High temperature and fire resistant polymers.

Silicones & conducting polymers - poly sulphur nitrite, poly phenylene, poly pyrrole and poly acetylene.

**Text Book**

Bhatnagar, M.S. (2004), A text book of Polymers,(1st ed.).New Delhi:S. Chand and Company Ltd.

**Reference Books**

1. Billmeyer, F.W. (1984).Text book of Polymer Science.(3rd ed.). John Wiley and Sons.
2. Raymond B. Seymour, (1981). Introduction to Polymer Chemistry, (1st ed.).
3. Gowarikar, Viswanathan,N.V & Sreedhar, J. (2015). Polymer Science.(2nd ed.). New Age International Publishers.
4. P.K Palanisamy, (2015). Material Science (2nd ed.). Chennai :Scitech Publication India, Pvt. Ltd..

# Semester - IV

## Elective II – Pharmaceutical Chemistry - I
## Course Code: CC1742

| Number of Hours Per week | Number of Credit | Total Number of Hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives:**

1) To impart knowledge about various diseases and their treatment.
2) To study about common drugs and their action and to compare natural and synthetic drugs.

**Unit I Introduction:**

Pharmacology–pharmacophore, metabolites, anti metabolites, classification of drugs, nomenclature of drugs – non proprietary names, sources, assay (biological, chemical and immunological) testing of potential of drugs and their side effects.

**Unit II Action of drugs:**

Mechanism of drug action in absorption, drug delivery, drug extraction. Indian medical plants and trees -tulsi, neem, keezhanelli and thoothuvalai. Biological role of salts of Na, K, and Ca, Cu, Zn and Iodine. Source, deficiency and uses of$MgSO_4 7H_2O$, milk of magnesia, magnesium trisilicate and aluminum hydroxide gel.

**Unit III Common drugs:**

Analgesics- salicylates, Narcotics-Opiates, Pethadine and morphine. Anaesthetics - local andgeneral anaesthetics -chloroform, ether and barbiturate , antipyretics, antiseptics and disinfectants–distinction, phenols and chloramines. Antibiotics- therapeutical values of pencillin and streptomycin. Hypoglycaemic drugs–Insulin, oral hypoglycaemic agents. Hypnotics, drug addition- sedatives and tranquillizers.

**Unit IV Common diseases and treatment-I:**

Common diseases – causes and treatment, insect born diseases - malaria and filariasis. Air born diseases- Diphtheria, Influenza and TB. Water born diseases-Cholera and Typhoid. Jaundice and Leprosy, Health care medicines. Biological role of sodium, Potassium, Calcium ,iodine and their compounds.

**Unit V Common diseases and treatment-II:**

Blood grouping, Rh factor, test for urea and sugar. Clotting mechanism of blood, blood pressure – causes and control. Causes of anaemia, antianaemic drugs,

cardiovascular drugs, antianginal drugs, causes for cancer, antineoplastic agents – cobalt therapy, Aids – causes, HIV virus, prevention and treatment.

**Text Book**

Jayashree Ghosh.S. (2010). A text book of pharmaceutical chemistry (1st ed.). New Delhi: Chand and company.

**Reference Books**

1. Lakshmi, S. (2012).Pharmaceutical chemistry (2nd ed.). Sultan Chand publishers.

2. Ashutoshkar,(2010).Medical Chemistry (1st ed.). New age international pvt. Ltd.

3. Satoskar,R.S.&Bhandarkar,S.D.(2015).Pharmacology and Pharmatherapeutics(24th ed.). Elsevier publishers.

4. Gurdeep R. Chatwal. (2009). Synthetic Drugs (3rd ed.). Goel Publishing Company.

## Semester - VI

## Skill Based Course / Project
## Course Code: CSK176

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 2 | 2 | 30 | 100 |

Project and Viva-voce

# Semester - V
# Practical Paper V & VI
# Organic Estimation and Inorganic Semi-micro Analysis
# Course Code: CC17P5

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 3 | 4 | 45 | 100 |

**Objectives**

1. To train the students in organic estimation
2. To study the principles of qualitative Analysis.
3. To make the students know about the interfering ions.

**I Organic Estimation**

1. Estimation of Phenol
2. Estimation of Aniline
3. Estimation of Ethyl methyl ketone – course work
4. Estimation of the number of hydroxyl groups in a given compound- course work

**II Analysis of an Inorganic mixture containing two anions and two cations.**

Two anions and two cations may be selected from the following:

**Anions**

1. Carbonate 2. Sulphate 3.Nitrate 4.Chloride 5. Bromide

6. Oxalate 7. Borate 8.Fluoride 9. Phosphate

**Cations**

1. Lead 2. Copper 3.Bismuth 4.Cadmium 5. Manganese

6. Nickel 7. Cobalt 8.Zinc 9.Barium 10. Strontium

11. Calcium 12. Magnesium 13. Ammonium

**Text Books**


5. Thomas, A. O. (1999). *Practical Chemistry for B.Sc Main students*,Scientific book center, Cannanore.
6. Vogel, I. (1990). *A Text Book for Qualitative Inorganic Analysis,* English Language Book Society and Longmans.

# Semester – VI

## Practical Paper VI
## Gravimetric Analysis, Inorganic Complex Preparation
## Course Code: CC17P6

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 3 | 3 | 45 | 100 |

### Objective

1. To develop skills in gravimetric analysis
2. To enhance the skill in complex preparation

### Gravimetric Analysis

1. Estimation of Lead as Lead Chromate
2. Estimation of Barium as Barium Chromate
3. Estimation of Calcium as Calcium oxalate monohydrate
4. Estimation of Copper as Cuprous thiocyanate - course work
5. Estimation of Zinc as Zinc Oxinate -course work
6. Estimation of Nickel as Nickel Dimethyl Glyoximate - course work

### Inorganic Complex preparation

1. Preparation of Prussian blue
2. Preparation of potash alum
3. Preparation of chloropentamminecobalt III chloride
4. Preparation of tetrammine copper II sulphate
5. Preparation of chrome alum

### Reference books


1. Vogel, A. I. (1994). *Elementary Practical Organic Chemistry*, The English Language Book Society and Longmans.
2. Thomas, A. O. (1989). *Practical Chemistry for B.Sc Main students*,Scientific book center, Cannanore.
3. Vogel, I. (1990). *A Text Book for Qualitative Inorganic Analysis*, English Language Book Society and Longmans.

# Semester – VI

## Practical Paper VII
## Physical Chemistry
## Course Code: CC17P7

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 2 | 3 | 30 | 100 |

### Objective

1. To develop skill in doing conductivity and potentiometric titrations.
2. To improve the skill in plotting graph and calculations.
3. To enhance problem solving ability.

**List of Experiments**

- Determination of molecular weight by Rast macro method.
- Determination of molecular weight of a solute by transition temperature method
- Construction of the phase diagram of a simple eutectic system and interpretation of the diagram
- Determination of CST of Phenol – water system Determination of the unknown concentration of NaCl solution by CST. Using Phenol–water system
- Determination of Heat of solution by solubility method (benzoic acid, ammonium oxalate)
- Comparison of strengths of acids by acid hydrolysis of ester (methyl acetate)

**Conductometric titrations**

a) Comparison of strengths of given hydrochloric acids using NaOH

b) Estimation of strength of hydrochloric acid using Std. oxalic acid and NaOH

**Potentiometric titrations**

a) Determination of strength of Std $K_2Cr_2 0_7$ Vs $FeSO_4$and $KMnO_4$
b) Determination of strength of Std $FeSO_4$Vs $KMnO_4$ and FAS

### Demonstration Experiments

1. Demonstration of Fluoride ions by Flourimeter.
2. Estimation of Na and K ions by Flame Photometric method.
3. Estimation of Nitrate and Sulphate ions by Photocolourimetric method.

**Reference books**


1. Vogel, A. I. (1994). *Elementary Practical Organic Chemistry*, The English Language Book Society and Longmans.
2. Thomas, A. O. (1989). *Practical Chemistry for B.Sc Main students*, Scientific book center, Cannanore.
3. Vogel, I. (1990). *A Text Book for Qualitative Inorganic Analysis*, English Language Book Society and Longmans.


| | |
|---|---|
| | Content addressed with Local Needs |
| | Content addressed with National Needs |
| | Content addressed with Regional Needs |
| | Content addressed withGlobal Needs |

# DEPARTMENT OF CHEMISTRY

**With effect from the academic year 2017 – 2020**

## Aim

The course aims at providing knowledge about the basic concepts concerning various areas associated with the field of Chemistry with specialization in important applied areas.

## Objectives

1. To provide a firm foundation in chemical concepts, laws and theories.
2. To relate chemistry with medicine, food, environment and polymer science.
3. To instill in students the vital part which chemistry plays in day to day life.
4. To develop and sharpen the scientific knowledge.
5. To impart theoretical knowledge about practical.

## Eligibility Norms for Admission

A pass in the B.Sc. Chemistry or equivalent examination with Chemistry as Major, with a minimum of 50% in major and major related papers. For SC/ST candidates, a pass in B.Sc. Chemistry is sufficient.

**Duration of the Course:** 2 years.

**Medium of Instruction:** English

**Passing Minimum**

A minimum of 50 % in the external examination and an aggregate of minimum 50% is required.

There is no minimum pass mark for the continuous internal assessment.

**Components of the M. Sc. Chemistry Programme**

| Paper | No. of Papers | Max. Marks / Paper | Total Marks |
|---|---|---|---|
| Theory Papers (Core) | 11 | 100 | 1100 |
| Core Practical's | 4 | 100 | 400 |
| Electives (Theory Papers) | 4 | 100 | 400 |
| Project Dissertation | 1 | 100 | 100 |
| **Total** | **20** | **20 x 100** | **2000** |

## Course Structure
## Distribution of Hours and Credit

| Course | Sem. I | Sem. II | Summer vacation | Sem. III | Sem. IV | Total | |
|---|---|---|---|---|---|---|---|
| | | | | | | Hours | Credit |
| Core - Theory | 6 (4) + 6 (5) + 6 (4) | 6 (4) + 6 (5) + 6 (4) | - | 6 (5) + 6 (4) | 6 (4) + 6 (5) + 6 (4) | 66 | 48 |
| Core - Practical | 6 | 6 (5+5) | - | 4 | 6 (4+5) | 22 | 19 |
| Elective | 6 (4) | 6 (4) | - | 6 (4) | 6 (4) | 24 | 16 |
| Project | - | - | - | 8 (4) | - | 8 | 4 |
| *Life Skill Training - I | - | (1) | - | - | - | - | 1 |
| *Life Skill Training - II | - | - | - | - | (1) | - | 1 |
| *Summer Training Programme | - | - | (1) | | - | - | 1 |
| **TOTAL** | **30 (17)** | **30 (28)** | **(1)** | **30 (17)** | **30 (27)** | **120** | **90** |

**Practical examinations will be conducted only at the end of even semester**

*** Courses / Programmes conducted outside the regular working hours**

## Courses offered

| Semester | Subject code | Title of the paper | Hours/week | Credit |
|---|---|---|---|---|
| I | PG1711 | Core I Organic Chemistry –I | 6 | 4 |
| | PG1712 | Core II Inorganic Chemistry – I | 6 | 5 |
| | PG1713 | Core III Physical Chemistry – I | 6 | 4 |
| | PG1714<br>PG1715 | Elective I (a) Instrumental Methodsof Analysis<br>(b) Electrochemistry | 6 | 4 |
| | PG17P1 | Practical I Organic Chemistry | 6 | - |
| | PG1721 | Core IV Organic Chemistry – II | 6 | 4 |
| | PG1722 | Core V Inorganic Chemistry – II | 6 | 5 |
| | PG1723 | Core VI Physical Chemistry – II | 6 | 4 |

| | | | | |
|---|---|---|---|---|
| **II** | PG1724<br>PG1725 | Elective II (a) Research Methodology<br>(b) Nuclear Chemistry | 6 | 4 |
| | PG17P1 | Practical I Organic Chemistry | - | 5 |
| | PG17P2 | Practical II Inorganic Chemistry | 6 | 5 |
| | LST172 | Life Skill Training (LST) – I | - | 1 |
| **III** | PG1731 | Core VII Organic Chemistry – III | 6 | 5 |
| | PG1732 | Core VIII Physical Chemistry –III | 6 | 4 |
| | PG1733<br>PG1734 | Elective III (a) Advanced Topics in Chemistry<br>(b) Medicinal Chemistry | 6 | 4 |
| | PG17P3 | Practical III Gravimetric analysis and Inorganic preparations | 4 | - |
| | PG17PR | Project and Viva | 8 | 4 |
| **IV** | PG1741 | Core IX Organic Chemistry – IV | 6 | 4 |
| | PG1742 | Core X Inorganic Chemistry – III | 6 | 5 |
| | PG1743 | Core XI Physical Chemistry –IV | 6 | 4 |
| | PG1744<br>PG1745 | Elective IV (a) Energy for the Future<br>(b) Nanochemistry | 6 | 4 |
| | PG17P3 | Practical III Gravimetric analysis and Inorganic preparations | - | 4 |
| | PG17P4 | Practical IV Physical Chemistry | 6 | 5 |
| | LST174 | Life Skill Training (LST) – II | - | 1 |
| | STP171 | Summer Training Programme | - | 1 |
| | | **TOTAL** | **120** | **90** |

**Self-Learning Course (Extra Credit Course)**

| Semester | Subject code | Title of the paper | Hours/week | Credit |
|---|---|---|---|---|
| **III** | PC17S1 | Chemistry for Lecturership exam - I | - | 2 |
| **IV** | PC17S2 | Chemistry for Lecturership exam - II | - | 2 |

The objective of the project is to motivate the students for doing research and to inculcate in them self confidence, team spirit and creativity. The project will be done by a group of two students and if needed 3 students in case of odd number.

**Project:**

Report : 80 (Internal - 40 marks & External - 40 marks)
Viva voce : 20 (External only)

**Internal : 40 Marks**
Evaluation : 30 Marks
Viva-voce : 10 Marks
**External : 60 Marks**
Dissertation : 40 Marks
Viva-voce : 20 Marks

**Summer Training Programme:** 60 hours programme with one credit for I P.G students.

## Instruction for Course Transaction
## Theory (Major Core / Elective) paper hours

| Components | Sem. I | Sem. II | Sem. III | Sem. IV |
|---|---|---|---|---|
| Lecture hours | 75 | 75 | 75 | 75 |
| Group Discussion / Tutorial | 5 | 5 | 5 | 5 |
| CIA (Test, Quiz) | 5 | 5 | 5 | 5 |
| Seminar | 5 | 5 | 5 | 5 |
| Total hours / semester | **90** | **90** | **90** | **90** |

## Examination Pattern

**Ratio of Internal & External –** 30 : 70

**Internal Components and distribution of marks**

Test - 20 marks

Seminar - 5 marks

Assignment - 2.5 marks

Quiz - 2.5 marks

**Question Pattern**

| Internal Test | Marks | External Exam | Marks |
|---|---|---|---|
| Part A 6x1 (No Choice)<br>Part B 2x4 (Internal Choice)<br>Part C 2x8 (Internal Choice) | 6<br><br>8<br><br>16 | Part A 10x1 (No Choice)<br>Part B 5x4 (Internal Choice)<br>Part C 5x8 (Internal Choice) | 10<br><br>20<br><br>40 |
| **Total** | **30** | **Total** | **70** |

## Value Added Course

| Name of the course | Total hours | Credit |
|---|---|---|
| Food Analysis | 30 | - |

**1. Value added course:** The classes will be handled by the staff members of Department of Chemistry in the month of June during the semester vacation**.**

## (b) Practical Papers

Internal : 40 marks

External : 60 marks

**Total : 100 marks**

**Internal : 40 marks**

Performance of the experiments : 10

Regularity in attending practicals and Submission of records : 10

Record : 5

Model exam : 15

**Total : 40 marks**

**External : 60 marks** Major practicals : 25

Minor practicals : 20

Spotters (4 x 2½) : 10

Record : 5

**Total : 60 marks**

**Semester I**
**Organic Chemistry I**
**Sub. Code: PG1711**

| No. of hours per week | Credit | Total no. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives:**

1. To gain knowledge on polarization effects and hyper conjugations
2. To understand the stereochemistry and conformations of organic compounds.
3. To enable the students know the methods of addition in alkenes and their mechanisms

**Unit I: Electron Displacement and Reactive Intermediates**

Polarization effects: Inductive effect, mesomeric effect, types and impact on the physico-chemical characteristics of molecules and dissociation constants of acids and bases. Tautomerism. Comparision of mesomerism and tautomerism. Hyperconjugation. Steric effects in molecules and their impact. Preparation and stability of carbocations, carbanions and free radicals. Preparation, structure, stability and reactions of carbenes and nitrenes. Electron donor acceptor complexes - types, nature and applications.

**Unit II: Stereochemistry**

Concept of chirality. Newman, Sawhorse and Fischer projections and their conversions. Enantiotopic, diastereotopic hydrogens and prochiral centres. Axial and planar chirality - ansa compounds and cyclophanes. Stereochemistry of compounds containing two dissimilar asymmetric carbons.

Optical activity of biphenyls, allenes and spiranes. Optical isomerism of nitrogen and sulphur compounds.

Stereospecific and stereoselective synthesis. Asymmetric synthesis. Cram's rule - open chain, cyclic and dipolar model. Prelog's rule.

**Unit III: Conformational Analysis**

Conformation: Definition, differences between configuration and conformation. Conformation of simple acyclic systems. Effects of conformation on reactivity of acyclic system - electrophilic addition, nucleophilic addition, cis- and trans- addition, $E_2$ elimination and cis-elimination.

Conformation of cyclic systems up to 6 membered rings, Conformational analysis of mono and di-substituted cyclohexanes. Effects of conformation on reactivity of cyclic systems involving saponification, esterification, $S_N^1$ and$S_N^2$ reactions.

Conformation equilibrium. Curtin-Hammet principle. Conformation of decalin, perhydrophenanthrene and perhydroanthracene.

**Unit IV: Addition to multiple bonds**

Mechanism and stereochemical factors in reactions like addition of hydrogen halides, hypohalous acids, hydroboration, hydroxylation and epoxidation.

Mechanism and applications of Michael addition, Diels' Alder reaction, Knoevenagal reaction, Mannich reaction, Stork-enamine reaction, Grignard reaction, Darzen's reaction, Reformatsky reaction and Wittig reaction.

**Unit V: Organic Reaction Mechanism and Methods**

Reaction mechanism: Energy diagram of simple organic reactions, transition state and intermediate. Kinetic and Thermodynamic requirements of reactions. Baldwin rules for ring closure, Hammond postulate, microscopic reversibility and control of product formation.

Primary and secondary isotope effect. Testing and Trapping of intermediates, isotopic labeling, cross–over experiment and stereo chemical evidence.

Linear Free Energy Relationship: Hammett equation, physical significance of σ and ρ, applications and limitations. Taft equation.

**Text Books:**


1. Morrison, R.T. & Boyd, R.N. (1997). Organic Chemistry. (6th ed.). New Jersey: Prentice Hall.
2. Nasipuri, D. (2011). Stereochemistry of Organic Compounds - Principles and Applications. (3rd ed.). India: New Age International, Ltd.
3. Kalsi, P.S. (2015). Stereo chemistry Conformation and Mechanism. (8th ed.). India: New Age International, Ltd.
4. Ahluwalia, V.K. & Parshar, R.K. (2010). Organic Reaction Mechanism. (4th ed.). India: Narosa publishing House.
5. Sykes, P. (2003). A Guidebook to Mechanism in Organic Chemistry. (6th ed.). Pearson.


**Reference Books:**


1. March, J. (2006). Advanced Organic Chemistry. (4th ed.). New York: John Wiley and Sons.
2. Eliel, E.L. & Wilen, S.H. (2003). Stereochemistry of organic compounds. India: Wiley.
3. Carey, F.A. (2007). Organic Chemistry. (5th ed.). New York: Tata McGraw Hill.
4. Norman, R.O.C. (1993). Principles of Organic Synthesis. London: Chapman Hall.
5. Finar, I.L. (2002). Organic Chemistry Volume I. (6th ed.).India: Pearson Education.
6. Finar, I.L. (2002). Organic Chemistry Volume II. (5th ed.). India: Pearson Education.
7. Bansal, R.K. (2005). Reaction Mechanism in Organic Chemistry. (3rd ed.). India: Tata McGraw Hill.

**Semester I**
**Inorganic Chemistry I**
**Sub. Code: PG1712**

| No. of hours per week | Credit | Total no. of hours | Marks |
|---|---|---|---|
| 6 | 5 | 90 | 100 |

**Objectives:**

1. To gain knowledge on transition elements, co-ordination complexes and organometallic compounds.
2. To understand the properties and theories related to solids.
3. To learn the preparation, properties and structures of some Inorganic compounds.

**Unit I: Chemistry of transition elements**

Second and third series: Zirconium and Hafnium - Occurrence, isolation and oxidation states. Aqueous Chemistry - $Zr^{4+}$ and $Hf^{4+}$ halides, $ZrO_2$ and mixed oxides, Zr clusters. Niobium and Tantalum - Occurrence, isolation, oxidation states, oxygen compounds and pentafluoride.

Rhenium- Occurrence, isolation and oxidation states. Preparation and properties of Rhenium heptafluoride, $ReCl_5$, $ReCl_4$ and $ReCl_3$.

General characteristics of Ruthenium and Osmium: Nitrogen-ligand complexes of Ru. Creutz-Taube and related complexes - Rh and Ir - Wilkinson's catalyst. Pt complexes in the treatment of cancer. Preparation and properties of $PtCl_4$, $H_2PtCl_6$ and Cis-$PtCl_2(NH_3)_2$

**Unit II: Co-ordination Chemistry**

Stability constant, determination of stability constant by Jobs and spectrophotometric methods. Magnetic and spectral properties of $[Ti(H_2O)_6]^{3+}$and $[Cu(H_2O)_6]^{2+}$ complexes. Chelate compounds. Nephelauxetic effect.

Substitution in octahedral complexes - Acid hydrolysis and base hydrolysis. Electron transfer reactions - Outer sphere and inner sphere mechanism. Applications of electron transfer reactions in synthesis of coordination complexes. Mechanism of ascorbic acid oxidation by free and chelate Cu(II) Complexes.

**Unit III: Organometallic Chemistry**

Introduction, EAN and its correlation to stability. Synthesis and structures of metal carbonyls. Carbonylate anions. Carbonyl hydride complexes and metal nitrosyls. Isolobal analogy. IR study of metal carbonyls.

Synthesis, properties and structural features of metal complexes with carbene, alkene, alkyne and arene. Hapticity. Metallocenes - Synthesis, properties and bonding in ferrocene. Covalent versus ionic bonding in beryllocene.

**Unit IV: Solid State**

Electronic structure of solids: Free electron theory and band theory. Type of solids -conductors, insulators, intrinsic and extrinsic semiconductors.

Optical and electrical properties of semiconductors. Photovoltaic effect. Hall effect. Metal-metal and metal-semiconductor junction. Superconductivity - high temperature super conductors, properties and applications. BCS theory, Cooper electrons, Meissener effect and levitation.

Crystal defects in solids - line and plane defects. Colour centres. Solid electrolytes and their applications.

**Unit V: Inorganic chains, Rings, Cages and Clusters**

Silicates: classification - soluble and insoluble, based on $(SiO_4)^{4-}$ linkage - ortho, pyro, cyclic, chain, sheet, three-dimensional silicates. Intercalation chemistry of silica and graphite. Polyacids - structure of isopoly and heteropoly anions. Polythiazyl - preparation and properties. Borazines - preparation, similarity with benzene and applications. Phosphazenes - preparation and structure – Craig-Paddock model and Dewar's model. Preparation of carboranes, Diborane- preparation, structure and chemical properties. Preparation and structure of tetraborane, structures of pentaborane-9, pentaborane-11, hexaborane-10 and decaborane-14.

Metal clusters: Carbonyl type clusters - structure of four, five and six atom clusters - Anionic and hydrido clusters. Non carbonyl type - Octahedral and triangular clusters.

**Text Books:**


1. Malik, W.U., Tuli, G.D. & Madan, R.D. (2012). Selected topics Inorganic Chemistry. ($5^{th}$ ed.). New Delhi: S. Chand Company Ltd.
2. Cotton, F.A. & Wilkinson, G. (1970). Advance Inorganic Chemistry. ($2^{nd}$ ed.). India: Wiley Eastern Private Ltd.
3. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. (2011). Inorganic Chemistry: Principles of Structure and Reactivity. ($4^{th}$ ed.). India: Pearson Education.
4. Kittle, C. (2012). Introduction to Solid State Physics. ($8^{th}$ ed.). New York: Wiley Eastern Ltd.
5. Puri B.R., Sharma, L.R. & Kalia, K.C. (2012). Principles of Inorganic Chemistry. ($4^{th}$ ed.). India: Milestone publishers.


**Reference Books:**


1. Soni, P.L. (1991). A text book of Inorganic Chemistry. India: Sultan Chand Sons Publishers.
2. Bannerje, D. (1993). Coordination Chemistry. New York: Tata McGraw Hill.
3. West, A.R. (1998). Solid State Chemistry and its Application, Asia: John Wiley & Sons.
4. Dougles, B.E., McDaniel, D.H.& Alexander, J.J. (1983). Concepts and Models of Inorganic Chemistry. ($2^{nd}$ ed.). New York: John Wiley and Sons Ltd.
5. Azaroff, L.V. (1989). Introduction to Solids.India: Tata McGraw Hill Publishing Ltd.
6. Miessler, G.L. (2004). Inorganic Chemistry. ($3^{rd}$ ed.).India: Pearson Education.

**Semester I**
**Physical Chemistry I**
**Sub. Code: PG1713**

| No. of hours per week | Credit | Total no. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives:**

1. To learn the various concepts of thermodynamics, statistical thermodynamics and phase rule.
2. To gain more knowledge about kinetics of reactions and quantum mechanics.
3. To acquire knowledge about surfaces and surface active agents.

**Unit I: Thermodynamics and phase rule**

Thermodynamics: Partial molar properties - Significance and determination by intercept and density methods. Partial molar free energy - Gibb's-Duhem equation. Definitions for chemical potential, partial molar volume and partial molar heat content. Variation of chemical potential with temperature and pressure. Choice of standard states - components in gases and solution. Determination of activity and activity coefficients for non-electrolytes.

Phase rule: Definitions of phase and components, three liquid components forming one, two or three pairs of partially miscible liquids.

Two solids and water systems involving (i) no chemical combination (ii) forming of a double salts - decomposed and not decomposed by water (iii) formation of a hydrate - dehydrated and not dehydrated by second salt.

**Unit II: Statistical thermodynamics**

Aim, permutation and combinations. Thermodynamic probability and entropy. Ensemble - canonical and microcanonical and grand canonical. Maxwell-Boltzmann statistics, Bose-Einstein statistics and Fermi-Dirac statistics. Population inversion. Negative Kelvin temperature. Comparison of MB, BE and FD.

Derivation of distribution laws - Partition function - translation, rotational, vibrational and electronic partition function. Thermodynamic functions in terms of partition function-internal energy and entropy. Relationships between partition function and work, pressure, enthalpy, Gibbs free energy and internal energy. Sacker-Tetrode equation.

**Unit III: Chemical kinetics - I**

Arrhenius equation. Simple collision theory. ARRT theory - statistical and thermodynamic treatments. Ionic reactions - primary and secondary salt effects. Derivation and significance of volume of activation.

Kinetic isotopic effect. Kinetics of unimolecular reaction - Lindemann, Hinshelwood and Rice-Ramsperger-Kassel Marcus.

Fast reactions - general features - flow techniques - relaxation theory and relaxation techniques (T-jump and p jump) - crossed molecular beam technique.

**Unit IV: Quantum mechanics - I**

Quantum mechanical operators: Addition, subtraction and multiplication of operators, position operator, linear operators, linear momentum operator, angular momentum operator, kinetic energy operator and Hamiltonian operator, Hermitian operator-commutation relationship among Lx, Ly, Lz and $L^2$ operators.

Wave functions, Eigen functions and eigen values. Orthogonality and normalization. Schrodinger time independent wave equation, De-Broglie equation, Heisenberg's uncertanity principle, postulates of quantum mechanics, setting up of schrodinger equation, solution and interpretation with regard of particle in 1 D box, particles in a 3D box, simple harmonic oscillator.

**Unit V: Surface chemistry**

Electrical aspects of surface chemistry, electrical double layer, Zeta potential. BET and Gibbs adsorption isotherms - Derivation and application. Determination of surface area (BET equation) surface films and liquids. Membrane equilibria and dialysis.

Surface active reagents: Classification of surface agents - micellization, hydrophilic interactions - critical micellar concentration - factors affecting the CMC of surfaces. Adsorption on semiconductor surfaces. Transition state theory of surface reactions - rates of chemisorptions - Hertz-Knudson equation.

**Text Books:**


1. Kuriacose, J.C. & Rajaram, J. (1986). Thermodynamics. Delhi: Shohanlal and Company.
2. Atkins, P. & Atkins, J.P. (2002). Physical Chemistry. (7th ed.). USA: Oxford university press.
3. Laidler, K.J. (1987). Chemical Kinetics. (3rd ed.). New York: Harper and Row.
4. Chandra. A.K. (2001). Introductory Quantum Chemistry. (4th ed.). India: Tata McGraw-Hill.
5. Puri, B.R., Sharma, L.R. & Pathania, M.S. (2016). Principles of Physical Chemistry (47th ed.). India: Vishal Publications.


**Reference Books:**


1. Glasstone, S. (1969). Thermodynamics for chemistry. New York: Van Nostrand Company
2. Glasstone, S.A. (1969). Text Book of Physical Chemistry. (2nd ed.). London: Macmillan and Co Ltd.
3. Kapoor, K.L. (1986). Text Book of Physical Chemistry. Delhi: MacMillan India Ltd.
4. Mcquarrie, D.A. (2008). Quantum Chemistry. Sausalito: University Science Books.
5. Prasad, R.K. (2014). Quantum Chemistry. (4th ed.). New Delhi: New Age International Publishers.

**Semester I**

**Instrumental Methods of Analysis (Elective I)**

**Sub. Code: PG1714**

| No. of hours per week | Credit | Total no. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives:**

1. To gain knowledge about different chromatographic techniques and its applications
2. To learn the principles, instrumentation and applications of various analytical techniques.
3. To understand the principles and instrumentations of spectroscopy techniques.

**Unit I: Chromatography I**

Chromatography: Definition, classification, plate and rate theories. Paper chromatography - Principle, types - ascending, descending and radial paper chromatography, applications.

Thin layer chromatography – Principle, experimental technique and applications. Column chromatography - principle, experimental technique and applications.

**Unit II: Chromatography II**

Ion exchange chromatography - Principle, experimental techniques, applications, separation of zinc and magnesium, chloride and bromide.

High performance liquid chromatography - Principle, experimental technique and applications. Gas chromatography - Principle, experimental technique and applications.

**Unit III: Thermo Analytical and Electroanalytical Methods**

Thermogravimetric analysis (TGA) - principle, automatic thermogravimetric analysis, factors affecting TGA, applications. Thermometric titrations. Differential thermal analysis (DTA), simultaneous DTA, TGA curves.

Electrogravimetric analysis - theory, instrumentation and applications. Coulometric analysis - coulometric titrations and applications. Potentiostatic coulometry.

Polarography - Principle, dropping mercury electrode, experimental assembly, polarographic curves, applications to qualitative and quantitative analysis, concept of pulse polarography. Amperometric titrations - principles and applications.

**Unit IV: Colorimetric and Spectrophotometric Analysis**

Colorimetry - Instrumentation for visual colorimetry and photoelectric colorimetry. Spectrophotometry - Instrumentation. Fluorometry - principle, instrumentation and applications. Flame

photometry - principle, instrumentation and applications. Nephelometry and turbidimetry - theory and instrumentation. Turbidimetric titrations and applications.

**Unit V: Spectroscopy**

Principles and Instrumentation techniques of UV, IR, Raman, $^{1}$HNMR, Mass, Mossbauer and AAS.

**Text Books:**


1. Kaur, H. (2007). An Introduction to Chromatography. (2nd ed.). India: PragatiPrakashan Publishing Ltd
2. Higson, S. (2003). Analytical Chemistry. (1st ed.).USA: Oxford University Press.
3. Kaur, H. (2014). Instrumental Methods of Chemical Analysis. India: Pragati Prakashan Publishing Ltd.
4. Day, R.A. & Underwood, A.L. (1998). Quantitative Analysis. (6th ed.). India: Prentice Hall.
5. Mohan, J. (2001). Organic Spectroscopy Principles and Applications. India: Narosa publishing house.


**Reference Books:**


1. Christian, G.D. (2007). Analytical Chemistry. (6th ed.). New York: John Wiley & Sons.
2. Chatwal, G.R. & Anand, S.K. (2002). Instrumental Methods of Chemical Analysis. (5th ed.). India: Himalaya Publishing House.
3. Kemp, W. (2011). Organic Spectroscopy. (3rd ed.).New York: Macmillam.
4. Silverstein, S.M., Bassler, G.V. & Morril, T.C. (2004). Spectrometric Identification of Organic Compounds. (6th ed.), New York: Wiley.

**Semester I**
**Electrochemistry (Elective I)**
**Sub. Code: PG1714**

| No. of hours per week | Credit | Total no. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives:**

1. To acquire knowledge about industrial electrochemistry and their applications.
2. To know the types of batteries and cells.
3. To understand the types of corrosion and methods of prevention of corrosion.
4.

**Unit I: Industrial Electrochemistry**

Electrochemical processes in industry - components of electrochemical reactors - Types of electrolytes - Cathodes and anodes in electrochemical reactor - Separators.

Electro Inorganic Chemicals - Caustic soda and chlorine production, mercury cells, diaphragm cells, membrane cells, Advantages of membrane cells - Other inorganic electrochemicals - Chlorates, perchlorates, hydrogen peroxide.

Organic Electrochemicals - Special features of electro - organic synthesis - electrochemical oxidation - Kolbe synthesis - Electroreduction of carbonyl compounds -Adiponitrile synthesis.

**Unit II: Electrometallurgy**

Electrodeposition of metals - principles - Nucleation and growth of crystals - Nature of electrodeposits.

Hydrometallurgy - Recovery of metals from aqueous electrolytes - Recovery of silver from photographic emulsion - Electrorefining- Production of high purity copper - Process description.

Pyrometallurgy - Necessity for using molten electrolytes - Reactors for molten salt electrolysis - Production of Aluminium - Electrodes and electrode reactions in cryolite melt - electrochemical purification of Aluminium - Other metals through molten salt electrolysis - Mg and Na - Brief outline.

**Unit III: Electroplating**

Fundamental principles - Nature of deposits for electroplating - Hull cell experiments - operating conditions and nature of deposits - throwing power - preparation of samples for electroplating - chemical and electrochemical cleaning - electroplating of copper, nickel and cadmium.

Electroless plating - Importance - plating on nonmetals - Bath composition - Electroless plating of copper and nickel.

**Unit IV: Electrochemical power sources**

Basic principles - chemical and electrical energies - Interconversion - charging and discharging - requirements for a good power source - types of power sources.

Primary batteries - Description of primary cells - Alkaline - Manganese cells - Button cells - Silver oxide - Zinc cells - Lithium primary cells - Applications.

Secondary batteries - Important applications - Charge discharge efficiency - Cycle life - Energy density - Lead acid batteries - Nickel - metal hydride batteries - Lithium - secondary batteries - Batteries for electrical vehicles.

Fuel cells:Basic principles - $H_2$, $O_2$ fuel cells - gas diffusion electrodes for fuel cells - Alkaline fuel cells only.

**Unit V: Corrosion**

Principles - stability of metals - EMF series - Active and noble metals - pH effect on stability - Pourbaix diagram - Kinetics of corrosion - Mixed potential process - Cathodic reaction - Anodic reaction - corrosion current - Active dissolution - passivation - Breakdown of passivity - Evans diagram.

Methods of corrosion protection - Principles - Inhibition of anodic, cathodic processes - Inhibitive additives for corrosion protection - Protective coatings - Types of coatings - Protection of structures and pipelines - Cathodic Protection - Examples - Sacrificial anodes - protection of ships in sea water.

**Text Books:**


1. Hamann, C.H., Hamnett, A. & Vielstich, W. (2001). Electrochemistry. (4th ed.). New York: John Wiley and Sons.
2. Holze, R. (2009). Experimental Electrochemistry. New York: John Wiley and Sons.
3. Pletcher, D. & Walsh. F.C. (1993). Industrial Chemistry. (3rd ed.). London: Blackie Academic and Professional.
4. Perez, N. (2016). Electrochemistry and Corrosion Science. New York: Springer.


**Reference Books:**


1. Bard, A.J. (2006). Electrochemical Methods: Fundamentals and Applications. New York: John Wiley and Sons.
2. Hibbert, D.B. (1981). Introduction to Electrochemistry. London: Macmillan.
3. Oldham, K., Myland, J. & Bond, A. (2011). Electrochemical Science and Technology: Fundamentals and Applications. New York: John Wiley and Sons.

**Semester II**
**Organic Chemistry II**
**Sub. Code: PG1721**

| No. of hours per week | Credit | Total no. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives:**

1. To study the nucleophilic substitution and elimination reactions
2. To know about aromaticity and organic reactions.
3. To gain knowledge on bio-active molecules and natural products.

**Unit I: Substitution and Elimination Reactions**

Aliphatic nucleophilic substitution - $S_N1$, $S_N2$, $S_Ni$ mechanism. Effect of substrate, nucleophile, leaving group and solvent on aliphatic nucleophilic substitution. $S_N1'$, $S_N2'$ and $S_Ni'$ mechanism for allylic system. Aromatic nucleophilic substitution - $S_NAr$, $S_N1$ and $S_N2$. Effect of substrate, structure, nucleophile, leaving group and solvent on aromatic nucleophilic substitution. Ortho-, para- and meta-directing groups in aromatic nucleophilic substitution. Neighbouring group participation of alkyl and aryl groups, halogens, carboxylate anion, oxygen, sulphur, C=C bond and C-C bond. Elimination - $E_1$, $E_2$ and $E_{1CB}$ mechanisms. Effect of substrate, base, solvent and the leaving group on elimination reaction. Hofmann, Saytzeff and Bredt's rule.

**Unit II: Aromaticity and Novel Ring System**

Aromaticity: Huckel's rule - five, six, seven, eight membered rings and fused six membered aromatic rings. Aromaticity of fulvene, fulvalene, azulene, tropolones, ferrocene and fullerenes. Non-benzenoid aromatics – annulenes and heterocyclic compounds. Craig's rule of aromaticity. Concept of antiaromaticity and homoaromaticity. Calculation of energy of aromatic and anti-aromatic systems. Alternant and non-alternant hydrocarbons.

Novel ring system: Nomenclature of bicyclic and tricyclic systems - structure and synthesis of adamantane, congressane, cubane and catanene.

**Unit III: Organic name reactions**

Mechanism and applications: Sharpless asymmetric epoxidation, Stobbe condensation, Dieckman condensation, Robinson annulations, Oppenauer oxidation, Meerwein-Ponndorf Verley reduction, Wolf-Kishner reduction, Clemmensen reduction and Birch reduction, Simmon-Smith, Bischler-Napieralski, Chichibabin, Ziegler alkylation and Vilsmeier-Heck reactions.

**Unit IV: Chemistry of bio-active molecules**

Proteins: primary structure of proteins, terminal group analysis, Edman degradation and DNP method. Secondary structure of protein principles leading to $\alpha$ –helix and $\beta$ sheet structure. Tertiary and quaternary structures. Structural elucidation of oxytocin - Tuppy's method (Synthesis not required) and insulin (Biosynthesis). Polynucleotides and polynucleosides, role and function of RNA's in protein synthesis, DNA replication, transcription and translation.

Lipoproteins: LDL, HDL and their characteristics.

Antibiotics: Structural activity relationship of penicillins, cephalosphorin, streptomycin and chloramphenicol.

**Unit V: Natural Products**

Steroids: Structural elucidation of cholesterol (Synthesis not required), bile acids -Lithocholic acid. Sex-harmones: Synthesis of progestrone, oestrone, oestriol, oesterodiol, testosterone and androsterone. Conversion of cholesterol into androsterone, progestrone and testosterone. Conversion of oestrone into oestriol and oesterodiol.

**Text Books:**


1. March, J. (2006). Advanced organic chemistry. (4th ed.).New York: John Wiley and Sons.
2. Morrison, R.T. & Boyd, R.N. (1997). Organic Chemistry. (6th ed.). New Jersey: Prentice Hall.
3. Ahluwalia, V.K. & Parshar, R.K. (2005). Organic Reaction Mechanism. (2nd ed.). India: Narosa, publishing House.
4. Finar, I.L. (2002). Organic Chemistry Volume II. (5th ed.). India: Pearson Education.
5. Agarwal, O.P. (1984). Chemistry of Natural Products. Vol. I. Meerut: Goel publishing House.


**Reference Books:**


1. Clayden, J., Greeves, N. & Warren. S. (2012). Organic Chemistry. USA: Oxford University Press.
2. Finar, I.L. (2002). Organic Chemistry Volume I. (6th ed.). India: Pearson Education.
3. Ghosh, J. (2014). A Textbook of Pharmaceutical Chemistry. India: S. Chand and Company Ltd.
4. Kar, A. (2006). Medicinal Chemistry. (4th ed.).India: New Age international Ltd.
5. Chatwal, G. (1992). Organic Chemistry of Natural Products. Vol. I and II. Bombay: Himalaya Publishing House.
6. Agarwal, O.P. (1984). Chemistry of Natural Products. Vol. II. Meerut: Goel publishing House.

**Semester II**
**Inorganic Chemistry II**
**Sub. Code: PG1722**

| No. of hours per week | Credit | Total no. of hours | Marks |
|---|---|---|---|
| 6 | 5 | 90 | 100 |

**Objectives:**

1. To provide an in-depth knowledge about lanthanides and actinides.
2. To understand the photochemistry of some Inorganic compounds.
3. To get clear information about I.R and Raman spectroscopy.

**Unit I: Lanthanides and Actinides**

Lanthanides and actinides: Correlation of electronic structures, occurrence and properties of the elements. Chemistry of separation of Np, Pu and Am from U fission products. Common and uncommon oxidation states. Lanthanide and actinide contractions. Spectral and magnetic properties of lanthanides and actinides, similarities between actinides and lanthanides. Preparation and properties of $UF_4$, $UO_2(NO_3)_2.9H_2O$, $ThO_2$, $Th(NO_3)_2$.

**Unit II: Inorganic Photochemistry**

Importance of photochemistry. Photochemistry of Co(III) complexes - photosubstitution reactions, photooxidation-reduction reactions and photoanation reactions.

Photochemistry of Cr(III) complexes - Photoaquation - octahedral complexes, mixed-ligand complexes, photoisomerization, photoracemization, photoanation, photosubstitution in non-aqueous solvents and photoredox reactions.

Photochemistry of Ruthenium polypyridyls - Preparation of $[Ru(bpy)_3]^{2+}$ and important characteristics of $[Ru(bpy)_3]^{2+}$. Properties of $[Ru(bpy)_3]^{2+}$- absorption spectroscopy, ground state properties, redox properties and emission spectroscopy, photosubstitution, photoredox and reductive quenching reactions.

**Unit III: Bio Inorganic Chemistry - I**

Metalloporphyrins - porphyrin ring in chlorophyll. Photosynthetic electron transport sequence. Biological electron transfer. Electron transfer agents - cytochromes, iron-sulphur proteins. Blue Copper proteins - stellacyanin, plastocyanin, azurin and non-blue copper protiens. Synthetic oxygen carriers. Vitamin $B_1$, $B_2$, $B_6$ and Vitamin $B_{12}$ coenzymes. Nitrogen fixation - invitro and invivo nitrogen fixation. Chelate therapy - therapeutic chelating agents and their uses. Anticancer platinum complexes and their interaction with DNA.

**Unit IV: Application of spectroscopy to the study of inorganic compounds - I**

IR and Raman Spectroscopy: Application of IR and Raman spectra in the study of coordination compounds. Application to metal carbonyls and nitrosyls. Geometrical and linkage isomerism. Detection of inter and intramolecular hydrogen bonding. Stretching mode analysis of metal carbonyls.

Photoelectron Spectroscopy: Basic principles, Koopmans's theorem.UPS, XPEs of $N_2$, $O_2$ and $NH_3$. Chemical shifts in XPES. Application of ESCA to inorganic systems. Auger electron spectroscopy.

**Unit V: Applications of spectroscopy to the study of inorganic compounds - II**

Electronic spectra: Term, states and microstates, term symbols, selection rules. Hund's rule, LS coupling, J - J coupling schemes, Racah parameters B and C. Orgel and Tanabe-Sugano diagrams. Evaluation of 10 Dq and $\beta$ for octahedral $Ni^{2+}$ system and tetrahedral $Co^{2+}$ complexes. Applications of charge transfer spectra. Electronic spectra of lanthanide and actinide complexes.

**Text Books:**


1. Malik, W.U., Tuli, G.D. & Madan, R.D. (2012). Selected topics Inorganic Chemistry.
2. ($5^{th}$ ed.). New Delhi: S. Chand Company Ltd.
3. Roundhill, D.M. (1994). ($1^{st}$ ed.). Photochemistry and Photophysics of Metal Complexes. New York: Plenum Press
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. (2011). Inorganic Chemistry: Principles of Structure and Reactivity. ($4^{th}$ ed.).India: Pearson Education.
5. Puri B.R., Sharma, L.R. & Kalia, K.C. (2012). Principles of Inorganic Chemistry.
6. ($4^{th}$ ed.). India: Milestone publishers.
7. Lee, J.D. (2008). Concise Inorganic Chemistry. ($5^{th}$ ed.). India: Wiley India.


**Reference Books:**


1. Cotton, F.A. & Wilkinson, G. (1970). Advance Inorganic Chemistry. ($2^{nd}$ ed.). India: Wiley Eastern Private Ltd.
2. Rohatgi, K.K. & Mukherjee, K.K. (2014). Fundamentals of Photochemistry. ($3^{rd}$ ed.). India: New Age International.
3. Chatwal, G.R. & Bhagi, A.K. (2005). Bio-inorganic Chemistry. ($2^{nd}$ ed.). India: Himalaya Publishing House.
4. Cotton, F.A., Wilkinson, G., Marilo, C.A. & Bochman, M. (1999). Advanced Inorganic Chemistry. ($6^{th}$ ed.). New York: Wiley Interscience Publication.
5. Manku, G.S. (2004). Theoretical Principles of Inorganic Chemistry. New York: Tata McGraw Hill.
6. Douglas, B.E., Mc Daniel D.H., & Alexander, J.J. (1983). Concepts and Models of Inorganic Chemistry. ($2^{nd}$ ed.). New York: John Wiley and Sons Ltd.
7. Shriver, D.F., & Atkins, P.W. (1994). Inorganic Chemistry. USA: Oxford University Press.

**Semester II**
**Physical Chemistry II**

**Subject code: PG1723**

| No. of hours per week | Credit | Total no. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives:**

1. To understand the concepts of electrochemistry and photochemical reactions.
2. To learn about homogenous and heterogeneous catalysis.
3. To understand quantum mechanics and apply to various molecules**.**

**Unit I: Electrochemistry - I**

Debye Huckel limiting law, determination of activity coefficient by electrical method, Debye-Huckel limiting law at appreciable concentration of electrolytes, Huckel equation, Debye Huckel-Bronsted equation - qualitative and quantitative verification. Electrode - electrolyte interface, electrolytic interface, adsorption at electrified interface - alloy deposition, electrical double layer, electro capillary phenomenon - Lippmann equation.

**Unit II: Electrochemistry - II**

Electrode potential, mechanism of electrode reaction polarization and over potential -theory and applications of over potential, Butler-Volmer equation, electron transfer reaction. Significance of electron exchange current density and symmetry factor. Transfer coefficient and its significance. Mechanism of hydrogen and oxygen evolution reactions.

Corrosion- corrosion of common metals, atmospheric and immersed types of corrosion, acid, colloidal, oxide-film, electrochemical and differential aeration theories. Passivation of metals - Pourbaix diagram, Evan's diagram. Fuel cells, acid and alkaline storage batteries. Electrode deposition - principle and applications.

**Unit III: Photochemistry**

Introduction to photochemistry - laws of photochemistry, quantum yield calculation. Physical properties of electronically excited molecules - excited state dipolemoment, acidity constant and redoxpotential. Photophysical processes in electronically excited molecules - Jablonski diagram, intersystem crossing, internal conversion, fluorescence, phosphorescence and other deactivation processes. Delayed fluorescence. Stern-Volmer equation and its application. Photosensitation and chemiluminescence. Chemical lasers - photoexplosion and dissociation laser - experimental techniques. Chemical actinometry and flash photolysis.

**Unit IV: Catalysis**

Homogenous Catalysis: General catalytic mechanism - equilibrium treatment and steady state treatment, general acid - base catalysis and determination of catalytic co-efficient. Discussion of

protolytic and prototropic mechanisms of acid catalysis. Bronsted relationships as linear free energy relationships. Acidity functions and correlation of mechanisms.

Heterogeneous Catalysis: Physisorption and chemisorption - Langmuir adsorption isotherm, mechanism of surface reactions. Langmuir - Hinshelwood and EleyRideal mechanism. Absolute rate of surface reactions.

**Unit V: Quantum mechanics - II**

Approximation methods - Variation Theorem - Application of variation principle to Helium atom. Perturbation theory - application of perturbation theory to Helium atom. Pauli's exclusion principle, Slater determinant, Secular determinant and secular equation.

Chemical bonding in diatomic molecules - Born Oppenheimer approximation. M.O. theory. LCAO approximation - application to hydrogen molecule ion $H_2^+$- Hydrogen molecule $H_2$, Valence bond theory - application to $H_2$ molecule.

**Text Books:**


1. Bard, A.J. (2006). Electrochemical Methods: Fundamentals and Applications. New York: John Wiley and Sons.
2. Hamann, C.H., Hamnett, A. & Vielstich, W. (2001). Electrochemistry. (4th ed.). New York: John Wiley and Sons.
3. Rohatgi-Mukhergee, K.K. (1997). Fundamentals of Photochemistry. India: New Age International Ltd.
4. Atkins, P. & Atkins, J.P. (2002). Physical Chemistry. (7th ed.). USA: Oxford university press.
5. Chandra. A.K. (2001). Introductory Quantum Chemistry. (4th ed.). India: Tata McGraw-Hill.


**Reference Books:**


1. Holze, R. (2009). Experimental Electrochemistry. New York: John Wiley and Sons.
2. Puri, B.R., Sharma, L.R. & Pathania, M.S. (2016). Principles of Physical Chemistry (47th ed.). India: Vishal Publications.
3. Glastone, S.A. (1969). Text Book of Physical Chemistry. (2nd ed.). London: Macmillan and Co Ltd.
4. Kapoor, K.L. (1986). Text Book of Physical Chemistry. Delhi: MacMillan India Ltd.

**Semester II**

**Research Methodology (Elective II) Sub. Code: PG1724**

| No. of hours per week | Credit | Total no. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives:**

1. To motivate the students for research based studies.
2. To gain knowledge about statistical analysis and instrumentational analysis.
3. To gain basic knowledge on computer and cheminformatics.

**Unit I: Literature Searching and Preparation of Project Report**

Sources of information: primary, secondary and tertiary sources - Libraries, databases, abstracts, journals, books, newspapers, Government documents, conference proceedings, dissertations and thesis. Internet - Inflib net. Presentation of seminar - OHP and power point. Project report writing - International conventions.

**Unit II: Statistical Analysis**

Classification of errors. Expression and calculation of errors in different forms. Precision and accuracy with respect to random errors. Confidence limits. Tests of significance - F-test, t-test, chi square test and annova. Regression analysis - correlation analysis.

**Unit III: Instrumental Analysis**

Applications of UV, IR, NMR, and Mass spectra in structural elucidations. ESR. Study of morphology - Principle of XRD and SEM, STM and AFM and applications.

**Unit IV: Computer in Research**

Basic features common to Word, Excel, Access, Powerpoint. Toolbars and dialog box. Internet: introduction, history, types of internet connections, HTML, HTTP, web design, hyperlinks, URLS, domain server, static and dynamic ID, protocols and internet security.

**Unit V: Cheminformatics**

Cheminformatics: History, Representing molecules: older systems - connection tables, line notation - Inchi, SMILES, WLN canonicalization. Line notation versus connection tables. Query languages - SMARTS. Nomenclature: IUPAC names, trade names, common names. Molecular similarity: Ways to measure similarity - 2D topology, 3D configuration, Physical properties, clustering. Chemical registration system. Chemistry softwares.

**Text Books:**


1. Berg, B.L. (2009). Qualitative Research Methods for the Social Sciences. (7th ed.). USA: Pearson Education Inc.
2. Patton, M.Q. (2002). Qualitative research and evaluation methods. (3rd ed.). India: Sage Publications.
3. Mohan, J. (2001). Organic Spectroscopy Principles and Applications. India: Narosa publishing house.
4. Maidasane, D. (2005). Learning Computer Fundamentals, MS Office and Internet and Web Technology. New Delhi: Firewall media.
5. Polanski, J. (2009). Chemoinformatics. Poland: Elsevier Publications.


**Reference Books:**


1. Silverman, D. (2011). Qualitative Research: Issues of Theory, Method and Practice. (3rd ed.). India: Sage Publications.
2. Marczyk, G., Dematteo, D. & Festinger, D. (2005). Essential of Research Design and Methodology. New York: John Wiley andSons.
3. Vogel, A.I. (1978). A Text Book of Quantitative Inorganic Analysis. (4th ed.). New York: Longman.
4. Gasteiger, J. & Engel, T. (2003). Chemoinformatics. New York: Wiley.

**Semester II**

**Nuclear Chemistry (Elective II)**
**Sub. Code: PG1724**

| No. of hours per week | Credit | Total no. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives:**

1. To provide knowledge about the radioactivity and nuclear reactions.
2. To understand the interaction between radiation and matter.
3. To gain knowledge on applications of radio isotopes in industries and daily life.

**Unit I Radioactivity and its Measurement** **(12 Hours)**

Discovery - types of decay - decay kinetics - half-life period - mean life - parent-daughter decay - growth relationship - secular and transient equilibrium. Units of radioactivity. Alpha - beta and gamma decay. Theory of decay - energies and properties. Artificial radioactivity. Detectors - ionization chamber - electron pulse counter - scintillation detectors - semiconductor detectors - thermoluminescence detectors and neutron detectors.

**Unit II Nuclear Reactions** **(12 Hours)**

Bathe's notation - types of nuclear reactions - transmutation reactions - elastic and inelastic scattering - spallation - fragmentation, stripping and pick-up - fission - fusion - photonuclear and thermonuclear reactions. The compound nucleus theory and reaction cross section

**Unit III Nuclear Reactors** **(12 Hours)**

Fission energy - reproduction factor. Classification of reactors based on moderators - coolants - phase of fuel and generation. Principle of thermal nuclear reactors - four factor formula - reactor power - critical size of a thermal reactor - excess reactivity and control. Breeder reactor. India's nuclear energy programmes. Reprocessing of spent fuels - nuclear waste management - safety culture - active and passive safety. Containment building - nuclear criticality safety - ionizing radiation protection - enforcement agencies.

**Unit IV Radiation and Matter** **(12 Hours)**

Radiation chemistry - passage of radiation through matter - units for measuring radiation absorption. Radiation dosimetry - radiolysis of water - free radicals in water radiolysis - chemical dosimetry. Radiolysis of Fricke Dosimeter solution. Radiation induced colour centres in crystals.

Effects of radiation with matter. Radiolysis of inorganic gases - organic gases - organic compounds - solids and polymers. Annealing of radiation damage.

**Unit V Applications of Radioactivity (12 Hours)**

Application of radioisotopes - probing by isotopes - reactions involved in the preparation of radioisotopes. Szilard-Chalmers' reaction. Radiochemical principles in the use of tracers - applications of radioisotopes as tracers. Chemical investigations - analytical applications - agricultural and industrial applications. Neutron activation analysis. Carbon and rock dating. Use of nuclear reactions. Radioisotopes as source of electricity. Nuclear medicines.

**Text Books:**


1. Arniker, H.J. (2009). Essentials of Nuclear Chemistry. India: New age International.
2. Puri B.R., Sharma, L.R. & Kalia, K.C. (2012). Principles of Inorganic Chemistry. (4th ed.). India: Milestone publishers.
3. Arora M.G. & Singh, M. (1994). Nuclear Chemistry. India: Anmol Publications.


**Reference Books:**


1. Glasstone, S. (1967). Source Book on Atomic Energy. (3rd ed.). London: East West press.
2. Friedlander, M.G., Kennedy, J.M., Macian, E.S. & J.M. Miller. (1981). Nuclear and Radiochemistry. (3rd ed.). New York: John Wiley and Sons.
3. Gilreath, E.S. (1982). Fundamental Concepts of Inorganic Chemistry. New York: McGraw Hill

**Semester I**
**Practical I**
**Organic Chemistry**
**Sub. Code: PG17P1**

| No. of hours per week | Credit | Total no. of hours | Marks |
|---|---|---|---|
| 6 | 5 | 90 | 100 |

**Objectives:**

1. To provide knowledge about the separation and analysis of binary mixtures.
2. To estimate various organic substances.
3. To prepare organic compounds.

1. Separation of a Binary mixture (Minimum six binary mixtures)

Quantitative chemical separation of a binary mixture following a systematic procedure. The two components should not interact at room temperature. They should be sufficiently soluble in ether. Two neutral components should be avoided. A few possible combinations are:

a. Any acidic component and a neutral substance
b. Any basic component and a neutral substance
c. A carboxylic acid and a phenol
d. A phenol and a basic component

The two components must be exhibited along with weight, in the normal physical state of the substance.

2. A quantitative estimation of any one of the following in an organic substance. (Minimum five estimations)

a. Glucose- Lane and Eynon method
b. Glucose- Bertrand's method
c. Estimation of phenol
d. Estimation of aniline
e. Iodine value of an oil
f. Number of hydroxyl groups in a given compound.
g. Estimation of Ethyl methyl ketone

3. Preparation of a solid compound involving a familiar name reaction – rearrangement in two stages. (Minimum five preparations)

a. P-Bromoaniline from Acetanilide
b. P-Nitroaniline from acetanilide

c. Benzpinacolone to Benzophenone
d. Benzaniilide from Benzophenone
e. S-Benzylisothiuroniumbenzoate from Thiourea
f. S-Tribromobenzene from Aniline.
g. Phthalimide from phthalic acid.

Students are expected to submit five recrystallised samples of the final products at the time of practical examination for evolution by the examiners.

**Note:** Record of experiments may be evaluated by internal assessment only.

**Reference Books:**


1. Dey, B.B., Sitaraman M.V. & T.R. Govindachari. (1992). Laboratory Manual of Organic Chemistry. (2nd ed.). New Delhi: Allied Publishers.
2. Vogel, A.I. (1987). Quantitative Organic Analysis Part III. (2nd ed.). New Delhi: CBS Publishers.
3. Bansal, R.K. (1990). Laboratory Manual of Organic Chemistry. (2nd ed.). New York: Wiley Eastern Ltd.

**Semester II**
**Practical II**
**Inorganic Chemistry**
**Sub. Code: PG17P2**

| No. of hours per week | Credit | Total no. of hours | Marks |
|---|---|---|---|
| 6 | 5 | 90 | 100 |

**Objectives:**

1. To gain knowledge in semi micro qualitative analysis of inorganic mixture.
2. To impart skill in estimating the presence of various elements.
3. To estimate the elements by photocolorimetric method.

1. Semi-micro qualitative analysis of inorganic mixture containing two familiar and two less familiar cations.

   Pb, Cu, Bi, Cd, Sb, Zn, Co, Ni, Mn, Ca, Ba, Sr, W, Ti, Se, Te, Mo, Ce, Th, Zr, V, U, Ti and Li.

2. Complexometric titration - Estimation of Cu, Zn and Mg by EDTA titration in presence of either Pb or Ba.
3. Photocolorimetric estimation of Fe, Ni, Cr, Mn, Cu and $NH_4^+$
4. Separation and identification of a binary mixture of inorganic cations by paper chromatography.

**Reference Books:**


1. Davies D.G. & Kelly, T.V.G. (1969). Inorganic Reactions at Advanced Level, Mills and Boom publications.
2. Ramanujan, V. (1990). Inorganic Semi-micro Qualitative Analysis. (3rd ed.).Chennai: National Publishing Company.
3. Svehla, G. (2008). Vogel's qualitative inorganic analysis. (7th ed.).India: Pearson Education.

**Semester III**
**Organic Chemistry III**
**Sub. Code: PG1731**

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 6 | 5 | 90 | 100 |

**Objectives:**

1. To acquire knowledge on principles involved in UV, NMR and Mass spectroscopy.
2. To gain knowledge about the synthesis, properties and structure of heterocyclic compounds.
3. To learn the uses of the reagents in organic synthesis.

**Unit I: UV- Visible spectroscopy and IR spectroscopy**

UV-Visible spectroscopy: Basic principles of electronic transition. Absorption spectra of conjugated dienes, α,β- unsaturated carbonyl compounds and aromatic compounds. Woodward-Fieser rule and Fieser-Khun rule. Effect of solvent polarity on $\lambda_{max}$. Applications of UV-Visible spectroscopy.

IR spectroscopy: Principle, instrumentation and sampling techniques, Hooke's law, types of stretching and bending vibrations. Factors influencing the vibrational frequency. Vibrational frequencies of alkane, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenol, amines, acids, esters and amides. Overtones and combination bands. Fermi resonance. Applications of IR spectroscopy.

**Unit II: NMR Spectroscopy**

$^{1}$H NMR Spectroscopy: Instrumentation, principle of NMR spectroscopy, Chemical shift and factors affecting chemical shift. Spin-spin splitting. Types of coupling - geminal, vicinal, long range and through space coupling. Coupling constant - AB, $AB_2$ and $A_2B_3$. Simplification of complex spectra - chemical exchange, double resonance and NMR shift reagents.

$^{13}$C NMR Spectroscopy: Principle, chemical shift, factors affecting chemical shift, broad band decoupling and OFF - resonance decoupling. 2D-NMR - COSY-HOMCOR, HETCOR and DEPT Technique. Comparison of $^{13}$ C NMR and $^{1}$H NMR.

**Unit III: Mass Spectroscopy**

Basic principle, instrumentation and production of ions - EI, CI and FAB. Molecular ion peak, base peak, meta stable peak and isotopic peaks. Nitrogen rule. McLafferty rearrangement. Retro Diels Alder reaction. Fragmentation pattern of simple organic compounds - alkenes, halogens, alkylbenzene, benzene, aliphatic and aromatic alcohols, acids, ketones and aldehydes. Application of mass spectroscopy. Problems related to structural determination using UV, IR, $^{1}$HNMR and Mass spectroscopy.

Circular birefringence (CB), Circular dichroism (CD), Cotton effect, ORD, Kronig-Kramers relation, applications of axial haloketone rule and octant rule.

**Unit IV: Heterocyclic Compounds**

Synthesis, reactions and structure of indole, carbazole, oxazole, imidazole, thiazole, pyrones, coumarins, chromone. Structural elucidation of flavones, isoflavone, anthocyanins, caffeine, theobromine and theopylline.

**Unit V: Reagents in organic synthesis**

Oxidation reactions involving $SeO_2$, DDQ, DCC, 1,3-dithiane, NBS, m-CPBA and Aluminium isopropoxide. Reduction involving complex metal hydrides - $LiAlH_4$, $NaBH_4$, DIBAL, Gilman's reagent, Tri-n-butyl tin hydride, 9-BBN, Wilkinson's catalyst, Vaska's catalyst and Baker yeast, Phase transfer catalysts, crown ether, LDA, $Me_3SiI$, Fetizon's reagent, Lemieux-Von Rudloff reagent and Lemieux-Johnson reagent.

**Text Books:**


1. Kemp, W. (1994). Organic Spectroscopy. (3rd ed.). New York: Macmillan.
2. Mohan, J. (2001). Organic Spectroscopy Principles and applications. India: Narosa publishing house.
3. Silverstein, S.M., Bassler, G.V. & Morril, T.C. (2004). Spectrometric identification of organic compounds. (6th ed.). New York: Wiley.
4. Gilchrist, T.L. (2007). Heterocyclic Chemistry. (3rd ed.). India: Pearson Education.
5. Chatwal, G.R. (2016). Reaction Mechanism and Reagents in Organic Chemistry. (5th ed.). India: Himalaya Publishing House.


**Reference Books:**


1. Dyer, J.R. (1987). Applications of Absorption spectroscopy of Organic Compounds. New York: Prientice Hall.
2. Dani, V.R. (1995). Organic spectroscopy, India: Tata McGraw Hill.
3. Acheson, R.M. (1977). An Introduction to the Chemistry of Heterocyclic Compounds. (2nd ed.). New York: Wiley-Interscience.
4. Ahluwalia, V.K. & Parashar,R.K. (2011). Organic reaction mechanisms. (4th ed.). India: Narosa publishing house.
5. Tewari, K.S., Vishnol, N.K. & Mehrotra, S.N. (2002). A text book of organic chemistry. India: Vikas publishing House Ltd.
6. Robert, M.T., Boyd, R.N. & Bhattacharjee, S.K. (2011). Organic Chemistry. (7th ed.). India:Pearson Education.
7. Kalsi, P.S. (1996). Organic Reactions and Mechanism. (1st ed.). India: New Age International Ltd.

**Semester III**
**Physical Chemistry III**
**Sub. Code: PG1732**

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives:**

1. To apply group theory to molecules.
2. To understand the principle and applications of microwave and photoelectron spectroscopy.
3. To understand the chemistry of polymers and role of radiations in chemistry.

**Unit I: Group Theory - I**

Molecular symmetry elements and symmetry operations, molecular symmetry and point groups. Group multiplication tables, abelian, non-abelian, cyclic and sub groups, conjugacy relation and classes. Representation of symmetry operations by matrices - representation for the $C_{2v}$, $C_{3v}$, $C_{2h}$. Reducible and irreducible representations, the great orthogonality theorem and its consequences without proof. Construction of the character tables $C_{2v}$, $C_{3v}$ and $C_{4v}$.

**Unit II: Group Theory - II**

Standard reduction formula, Symmetry of normal modes of vibration in $H_2O$, $NH_3$, and $CO_2$. Application of group theory to normal mode analysis of $H_2O$ and $NH_3$. Symmetry properties of integrals and symmetry based selection rule for vibrational spectra. Identification of IR and Raman active fundamentals, symmetry of molecular orbitals and symmetry based selection rule for electronic transition, prediction of electronic transitions in ethylene and formaldehyde. Group theory applied to determine π- electron energy in ethylene. HMO theory - HMO calculations and delocalization energy in trans-1,3-butadiene and benzene. Group theory applied to determine hybridization scheme in $CH_4$ and $BF_3$.

**Unit III: Molecular Spectroscopy - I**

Microwave spectroscopy: Rotation of molecules, rotational spectra of diatomic molecules, intensity of spectral lines, effects of isotopic substitution, non-rigid rotator. Rotational spectra of polyatomic molecules, chemical analysis by microwave spectroscopy.

Photoelectron spectroscopy: Principle, photoelectric effect, Ionization process. Applications of photoelectron spectroscopy to simple molecules - $O_2$ molecule, $N_2$ molecule, CO molecule, $NaN_3$, Ethyl trifluoro acetate.

**Unit IV: Polymer Chemistry**

General introduction. Determination of molecular mass - osmometry, viscosity, diffusion, light scattering, and sedimentation methods. Visco-elasticity, Rubber elasticity. Kinetics and mechanism of linear stepwise polymerization - addition, free radical, cationic and anionic polymerization. Kinetics of

co-polymerization. Polymerization in homogeneous and heterogeneous systems. Conducting Polymers. Factors affecting the conductivity of conducting polymers. Dopping of conducting polymers. Polymers processing - compression moulding, injection moulding, transfer moulding and extrusion moulding. Casting extrusion of fibres, spinning.

**Unit V: Radiation Chemistry**

Radioactivity, rate of radioactive disintegration. Sources of high energy radiation. Comparison of radiation chemistry with photochemistry, interaction of high energy radiation with matter. Nature of radiations from radioactive elements. Detection and measurement of radioactivity - Geiger-Muller counter and Wilson Cloud Chamber. G-value, Curie, radiolysis of water, hydrated electron. Radiolysis of some aqueous solutions - Fricke Dosimeter solution and redox reactions using energy transfer from irradiated alkali halides. Radiation dosimetry - Rad, Gray, dose rate and Rontgen. Chemical dosimeters - Fricke and Ceric sulphate dosimeters Applications of radiation chemistry in biology and industry.

**Text Books:**


1. Bhattacharya,P.K. (1986). Group Theory and its Chemical Applications. India: Himalaya Publishing house.
2. Cotton, F.A. (2008). Chemical Applications of Group Theory. (3rd ed.). New York: Wiley.
3. BanWell, C.N. & Mccash, E.M. (1997). Fundamentals of Molecular Spectroscopy. New Delhi: Tata Mc Grow Hill.
4. Ghosh, P. (1990). Polymer Science and Technology of Plastics and Rubbers. India: Tata McGraw-Hill Publishing Company.
5. Arnikar, H.J. (2010). Essentials of Nuclear Chemistry.(4th ed.). India: New Age International Pvt. Ltd.


**Reference Books:**


1. Ramakrishnan, V. & Gopinathan, M.S. (1998). Group Theory in Chemistry. India: Vishal Publications.
2. Raman, K.V. (1990). Group Theory and its Applications to Chemistry. India: Tata Mcgraw Hill Publishing Co.
3. Gowariker, V.R., Viswanathan. N.V. & Sreedhar, J. (1986). Polymer chemistry. India: New Age International Ltd.
4. Billmeyer, F.W. (1984). Textbook of Polymer science. New York: Wiley Interscience publication.
5. Glasstone, S. (1967). Source Book on Atomic Energy. (3rd ed.). London: East West press.
6. Atkins, P.W. (2009). Physical Chemistry. (9th ed.). USA: Oxford University Press.

**Semester III**

**Advanced Topics in Chemistry (Elective III)**
**Sub. Code: PG1733**

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives:**

1. To acquire knowledge about nanoparticles and green chemistry.
2. To gain idea about supramolecular chemistry.
3. To study the applications of medicinal and biophysical chemistry.

**Unit I** **(12 Hours)**

**Nanochemistry:** General principles of nanotechnology. Nanoparticles - definition - size relationship - nanoparticles of metals - semiconductors and oxides. Synthesis of nanosized compounds - reduction methods and solgel methods. Optical and electrical properties of nanoparticles. Nanosystems - introduction - synthesis and purification of fullerenes. Carbonnanotubes - types - preparation - Arc and chemical vapour deposition methods. Nanoshells - gold and silver nanoshells and its applications. Nanosensors - introduction - nanoscale organization - characterization and optical properties. Nanomedicines - introduction - approach to developing nanomedicines - protocol for nanodrug administration - diagnostic and therapeutic applications.

**Unit II** **(12 Hours)**

**Green Chemistry:** Green chemistry and sustainable development - principles and applications of green chemistry. Atom economy - atom economy vs. yield. Prevention of waste/byproducts. Prevention or minimization of hazardous products. Designing safer chemicals through Sommelet-Hauser - Cope - Wolff - Witting and Bamberger reactions. Energy requirement for synthesis. CFC alternatives - green chemistry in organic synthesis. Selection of appropriate solvent and starting material. Use of protecting groups and catalyst. Methods of greening organic reactions - solvent free reactions and reactions at ambient temperature. Microwave assisted reactions. Sonication assisted reactions - Reformatsky - Ullmann coupling - Wurtz and Bouveault reaction. Reactions in ionic solvents and super critical fluids. Tandem reactions.

**Unit III** **(12 Hours)**

**Supramolecular Chemistry:** Supramolecular interactions - discussion of host-guest systems - cation and anion binding host. Crown ethers - synthesis - properties and applications. Lariat ethers. Podants - properties and 3-dimensional podants. Cryptands - synthesis - properties and applications. Spherands - synthesis - structure and uses. Supramolecular chemistry of fullerenes and cyclodextrins. Molecular devices - non-linear optical switches and electrophotoswitching, Liquid crystal display. Supramolecular photochemistry.

**Unit IV** **(12 Hours)**

**Medicinal Chemistry:** Modern drugs for diseases. Anticancer drugs - classification - synthesis and assay of cyclophoshamide - chlorambucil - cisplatin - vinblastine and vincristine. Antimalarial drugs - classification - synthesis and assay of chloroquine and primaquine. Diuretics - classification - synthesis and assay of Frusemide and benzthiazide. Anti-inflammatory drug - synthesis and therapeutic action of phenylbutazone and ibuprofen. Antipyretics and non-narcotic analgesics - synthesis and therapeutic action of paracetamol and aspirin

**Unit V** **(12 Hours)**

**Biophysical Chemistry:** Thermodynamics in biology and limitations of equilibrium thermodynamics. Irreversible thermodynamics - postulates and methodologies. Irreversible thermodynamics and biological systems. Biochemical standard state - ATP. Currency of energy - oxidative phosphorylation. Role of singlet oxygen in biology. Reactions in biomolecules - membrate potential and ion pumps. Photoacoustic effect and its application in biology. Biophysical applications of Moss-bauer effect. NMR imaging - applications of spin labeling in membrane research.

**Text Books**


1. Klabunde, K.J. & Richards, R.M. (2009). (2nd ed.). Nanoscale Materials in Chemistry. New York: Wiley.
2. Ozin, G. & Arsenault, A. (2005). Nanochemistry: A Chemical Approach to Nanomaterials. USA: Elsevier.
3. Rao, C.N.R. (2001). Nanochemistry. New York: Wiley.
4. Ahluwalia, V.K. (2006). Green chemistry-Environmentally benign reactions. India: Ane Books Publications.
5. Kar, A. (2007). Medicinal Chemistry. (4th ed.), New Age International Publishers.


**Reference Books**


1. Brechignac, C., Houdy, P. & Lahmani, M. (2006). Nanomaterials and Nano chemistry. New York: Springer.
2. Nalwa, H. (1998). Nanostructured Materials and Nanotechnology. New York: Academic Press.
3. Ahluwalia, V. K. (2012). Strategies for Green Organic Synthesis. New York: Taylor and Francis group, CRC Press.
4. Matlack, A. (2010). Introduction to Green Chemistry. (2nd ed.). New York: Taylor and Francis group, CRC Press.
5. Ilango, K. & Valentina, P. (2009). Text Book of Medicinal chemistry. (4th ed.). India: Keerthi Publishers.

**Semester III**

**Medicinal Chemistry (Elective III (b))**
**Subject Code: PG2034**

| Hours per week | Credits | Total Hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives:**

- To understand the pharmacology and nomenclature of drugs.
- To gain knowledge on mechanism of drugs action and its function.
- To acquire knowledge on blood grouping and Indian medicinal plants.

**Course Outcome (COs)**

| CO | *Upon completion of this course, the students will be able to*: | PSO Addressed | CL |
|---|---|---|---|
| CO-1 | understand the classification, nomenclature and therapeutic action of drugs | PSO-1 | U |
| CO-2 | apply the therapeutic values of drugs | PSO-2 | A |
| CO-3 | analyze the chemical constituents and its therapeutic values of drugs | PSO-2 | Y |
| CO-4 | evaluate the role of metals in drugs | PSO-2 | E |

**Unit I** **(12 Hours)**

**Classification and Nomenclature of Drugs:** Important terminologies - molecular pharmacology - pharmacophore - mutation - metabolites - antimetabolites - virus - bacteria - fungi and actinomycetes. Drugs - classification - nomenclature - non-proprietary names - source - assay - biological - chemical and immunological. Testing of potential of drugs and their side effects.

**Unit II** **(12 Hours)**

**Role of Metals in Drugs:** Mechanism of drug action - absorption - drug delivery and drug excretion. Physiological effects of different functional groups in drugs. Indian medicinal plants and trees - Tulsi - Neem - Keezhanelli - Adathode and Thoothuvalai. Biological role of salts - source and deficiency - Na - K - Ca - Cu - Zn and iodine. Disinfectants - Uses of $MgSO_4.7H_2O$ - milk of magnesia - magnesium trisilicate - aluminium hydroxide gel - $HgCl_2$ - $HgI_2$ and $Hg(CN)_2$.

**Unit III** **(12 Hours)**

**Common Drugs and their Therapeutic Values:** morphine andpethidine. Anaesthetics - local anaesthetics - procaine and related compounds. General anaesthetics-chloroform - ether and barbiturates. Antipyretics - paracetamol and other p-aminophenol derivatives. Antiseptics and disinfectants - distinction - phenols - chloramines - cyclohexadiene and organomercurals. Antibiotics - therapeutical values of penicillin - streptomycin - chloromphenicol and tetracyclines. Hypoglycemic drugs - insulin - oral hypoglycaemic agents - sulphonylureas. Hypnotics - tranquilizers and sedatives. Drugs addiction.

**Unit IV** **(12 Hours)**

**Common Diseases and First Aid:** Common diseases - causes and treatment - insect borne diseases - malaria and filariasis. Airborne diseases - diphtheria - whooping cough - influenza and TB. Waterborne diseases - cholera - typhoid and dysentery. Jaundice and leprosy. First aid for accidents - cuts - bleeding - fractures - burns - fainting - poisonous bites and poisoning.

**Unit V** **(12 Hours)**

**Blood Grouping and Therapeutic Drugs:** Blood grouping - Rh factor. Tests for urea and cholesterol. Role of blood as oxygen carrier and clotting mechanism. Blood pressure - causes and control. causes of anaemia, Antianaemic drugs - cardiovascular drugs - cardiglycosides - antianginal agents and vascodilators(one example for each). Causes of cancer. Antineoplastic agents - cobalt therapy. AIDS - causes - HIV virus - propagation - prevention and treatment.

**Text Books**


1. Kar, A. (2007). Medicinal Chemistry. (4th ed.). India: New Age International Publishers.
2. Cairns, D. (2012). Essentials of Pharmaceutical Chemistry. (4th ed.). India: Pharmaceutical Press.
3. Barber, J., & Rostron, C. (2013). Pharmaceutical Chemistry. (1st ed.). USA: Oxford University Press.
4. Ghosh, J. (2014). A Textbook of Pharmaceutical Chemistry. India: S. Chand and Company Ltd.


**Reference Books**


1. Chatwal, G.R., & Arora, M. (2010). Pharmaceutical Chemistry-Inorganic. India: Himalaya Publication House.
2. Chatwal, G.R., & Arora, M. (2008). Pharmaceutical Chemistry Organic. India: Himalaya Publication.
3. Ilango, K. & Valentina, P. (2009). Text Book of Medicinal chemistry. (4th ed.). India: Keerthi Publishers.

**Semester IV**
**Organic Chemistry IV**
**Sub. Code: PG1741**

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives**

1. To impart idea about retrosynthetic analysis.
2. To study the nature of alkaloids and molecular rearrangements.
3. To learn photochemical and pericyclic reactions.

**Unit I: Retrosynthetic Analysis**

Planning – relay, linear and convergent approach, protecting groups and activating groups. Target molecule containing one functional group requiring a single disconnection. Synthons and synthetic equivalents. Latent polarity. Target molecules with two functional groups - 1,3-, 1,5- and 1,4-dicarbonyl compounds. Functional group interconversions. Umploung synthesis. Retrosynthetic analysis of bisabolene, cis-Jasmone and longifolene.

**Unit II: Alkaloids**

Alkaloids, Extraction, general properties, classification, general methods for determining structure. Structural elucidation - morphine, atropine, cocaine, quinine, papaverine.

**Unit III: Molecular rearrangements**

Classification - electrophilic, nucleophilic and free radical rearrangements. Mechanisms of the following rearrangements – Wagner Meerwin, Tiffenev- Demyanov, Dienone- Phenol, Favorskii, Fries, Baeyer-Villager, Stevens, Neber, Sommelet-Hauser, Baker-Venkatraman, von-Richter, Ullmann and Di- π- methane rearrangements.

**Unit IV: Organic Photochemistry**

General introduction. Thermal versus photochemical reactions. Jablonski diagram. Photochemical reactions of ketones – photosensitization, Norrish type - I and Norrish type - II reactions and mechanisms, Paterno–Buchi reaction, photooxidation and photoreduction of ketones, photochemistry of arenes. Photodimerisation, photoisomerisation. Reactions involving free radicals – Barton, Huns-diecker, Pschorr and Gomberg-Bauchman reactions.

**Unit V:Pericyclic Reactions**

Characteristics and classifications of pericyclic reactions - electrocyclic, cycloaddition and sigmatropic reactions -Woodward Hofmann rule. 2+2, 2+4 – reactions, Retro-Diels Alder reaction, Diels Alder reaction, Cope rearrangements, Claisen rearrangements.Conservation of orbital symmetry. Prediction of reaction conditions using FMO, correlation diagrams and Zimmerman (Mobius-Huckel analysis) approaches.

**Text Books:**


1. Tewari, K. S., Vishnol, N. K. & Mehrotra, S.N. (2002). A Text Book of Organic Chemistry. India: Vikas publishing House Ltd.
2. March, J. (2006). Advanced Organic Chemistry. (4th ed.). New York: John Wiley and Sons.
3. Finar, I.L. (2002). Organic Chemistry Volume II. (5th ed.). India: Pearson Education
4. Depuy, C.H., & Chapman, O.S. (1988). Molecular Reactions and Photochemistry. Prentice Hall of India Pvt. Ltd.
5. Gill, G.B., &Wills, M.R. (1974). Pericyclic Reactions. Chapman and Hall, London.


**Reference Books:**


1. Jain, M.K. & Sharma, S.C. (2014). Modern Principles of Organic Chemistry. India: Vishal publication.
2. Morrison, R.T. & Boyd, R.N. (1997). Organic Chemistry. (6th ed.). New York: Prientice Hall.
3. Finar, I.L. (2002). Organic Chemistry Volume I. (6th ed.).India: Pearson Education.
4. Agarwal, O.P. (1947). Chemistry of Organic Natural Product Vol. I. India: Goel Publishing House.
5. Agarwal, O.P. (1947). Chemistry of Organic Natural Product Vol. II. India: Goel Publishing House.
6. Ahluwalia, V.K. & Parashar, R.K. (2011). Organic Reaction Mechanisms. (4th ed.). India: Narosa publishing house.

**Semester IV**
**Inorganic Chemistry III**
**Sub. Code: PG1742**

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 6 | 5 | 90 | 100 |

**Objectives:**

1. To gain knowledge about various spectroscopic techniques and nuclear reactions.
2. To acquire knowledge in different properties of solids.
3. To know the concepts of bio-inorganic chemistry.

**Unit I: Application of spectroscopy to the study of inorganic compounds - III**

NMR Spectroscopy: Principle, $^{31}P$, $^{19}F$, $^{15}N$, applications in structural problems. Monitoring the course of reaction. NMR of fluxional molecules. NMR of paramagnetic molecules - contact shift and shift reagents.

NQR Spectroscopy: Principle, comparison with NMR, electricfield gradient, quadrupolar splitting of energy levels in symmetric and asymmetric fields, quadrupolar coupling in atoms and molecules, asymmetry parameter. Application - hydrogen bonding, phase transition, substituent effect and structural information.

**Unit II: Applications of spectroscopy to the study of inorganic compounds - IV**

ESR spectroscopy: Principles, presentation of the spectrum, hyperfine splitting, factors affecting the magnitude of g values, zero-field splitting and Kramer's degeneracy, anisotropy in the hyperfine coupling constant. Covalency of M-L bonding by ESR. Jahn- Teller distortion in Cu (II) complexes from ESR studies.

Mossbauer Spectroscopy: Principle, Doppler Effect, recoil energy, minimizing recoil energy, Doppler broadening. Isomer shift in Fe and Sn compounds. Electro negativity and chemical shift. Quadrupole interaction - quadrupole splitting in the MB spectra of Fe complexes. Applications of MB spectroscopy.

**Unit III: Non- aqueous solvents**

General properties and classification of solvents. Self-ionization and leveling effect. Reactions in non-aqueous solvents. Solute-solvent interaction. Solution of metals in liquid ammonia. Reaction in liquid HF, liquid halogens, interhalogens and liquid $H_2SO_4$. Molten salts as non-aqueous solvents. Titration in non-aqueous solvents. HSAB theory. Acid base concepts - Arrhenius, Lux flood, Usanovich, Lowry-Bronsted and Lewis concept. Solvent system definitions.

**Unit IV: Electrical and magnetic properties of solids**

Conductivity of pure metals - Electrical conductivity, photoconductivity, photoconductive device. Solar cell and solar energy conversion. Dielectric properties - permittivity, dielectric constant, electric susceptibility, electronic polarization, ionic polarization, orientation, dielectric loss and

dielectric break down, ferro electricity. Applications of magnetic properties of solids - dia, para, ferro, antiferro and ferrimagnetism. Effect of temperature on magnetism - Curie and Weiss law. Calculation of magnetic moments.

**Unit V: Bio Inorganic Chemistry - II**

Photosynthesis, photosystem I and II, photosynthetic reaction center. Metallo enzymes - enzymes in di-oxygen management. Super oxide dismutase, superoxide toxicity, structure of Cu, Zn-SOD, enzymatic activity and mechanism. Peroxidases, catalases, oxidases and mono oxygeneases. Zinc enzymes - the structural role of zinc and zinc constellations of carbonic anhydrase, carboxy peptidase and alcohol dehydrogenase. Metal complexes as probes of nucleic acids. Gold compounds and anti-arthritic agents.

**Text Books:**


1. Horwood, E. (2010). NMR, NQR, EPR and Mössbauer Spectroscopy in Inorganic Chemistry. (1st ed.). New York: Ellis Horwood Ltd.
2. Brisdon, A.K. (1998). Inorganic Spectroscopic Methods. USA: Oxford Scientific Publications.
3. Puri, B.R., Sharma L.R. & Kalia, K.C. (2012). Principles of Inorganic Chemistry. (4th ed.), India: Milestone publishers.
4. Azaroff, L.V. (1989). Introduction to Solids. India: Tata McGraw Hill Publishing Ltd.
5. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. (2011). Inorganic Chemistry, Principles of Structure and Reactivity. (4th ed.). India: Pearson Education.


**Reference Books:**


1. Iggo, J.A. (2000). NMR Spectroscopy in Inorganic Chemistry. USA: Oxford Scientific Publications.
2. Puri, R.K. & Babber, V.K. (2001). Solid State Physics. India: S. Chand and Company Ltd.
3. West, A.R. (1987). Solid State Chemistry and Applications. New York: Jhon-Wiley and Sons.
4. Chatwal, G.R. & Bhagi, A.K. (2005). Bio-inorganic Chemistry. (2nd ed.). India: Himalaya Publishing House.
5. Miessler, G.L. (2004). Inorganic Chemistry. (3rd ed.), India: Pearson Education.
6. Malik, W.U., Tuli, G.D., & Madan, R.D. (2012). Selected topics Inorganic Chemistry. S. Chand Company Ltd.

**Semester IV**
**Physical Chemistry IV**
**Sub. Code: PG1743**

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives:**

1. To gain knowledge about applications of electrochemistry and nanocatalyst.
2. To know the importance of various spectroscopic techniques.
3. To study the structures of various crystals.

**Unit I: Advanced topics in electrochemistry**

Photoelectrochemistry - Introduction, band bending at the semiconductor/solution interface, photoexcitation of electrons by absorption of light, surface effects in photoelectrochemistry, photoelectrocatalysis, photoelectrochemical splitting of water, photoelectrochemical reduction of $CO_2$. Bioelectrochemistry - membrane potentials, electrochemical communication in biological organisms, enzymes as electrodes, electron transfer in p450 enzymes, electrochemical sensors, electrochemical biosensors, gas sensors and sensor arrays.

**Unit II: Nanomaterials for catalysis**

Nanocatalyst: fundamentals, homogeneous vs heterogeneous catalysis, effect of surface area, shape and morphology, particle size and composition on catalysis. Nanomaterials for photocatalysis - dye degradation, water splitting, organic transformations, plasmon assisted photocatalysis and band gap tuning. Nanomaterials for $CO_2$ capture and conversion.

**Unit III: Molecular Spectroscopy - II**

Electronic Spectroscopy: Principle, laws of light absorption, Born-Oppenheimer approximation. Franck-Condon principle, Wave-mechanical formulation, dissociation energy and dissociation products, predissociation, fluorescence and phosphorescence - principle and theory.

Nuclear magnetic resonance spectroscopy: Principle, Nuclear spin and nuclear moment, chemical shift and its measurements, factors influencing chemical shift, shielding and deshielding effects, spin-spin interactions, NMR of simple AMX type molecules, coupling constant, FTNMR, NMR of $^{19}F$, $^{31}P$ and $^{13}C$ .

**Unit IV: Molecular Spectroscopy - III**

ESR: Theory, hyperfine interactions in ESR. Double resonance (ENDOR, ELDOR), Mc Connell's relation - verification of the relation for cyclic polyene radical and calculation of electron density. Experimental Techniques.

Laser Raman Spectroscopy: Einstein treatment of absorption and emission phenomena. Einstein's coefficients. Probability of induced emission and its applications to lasers. Conditions for laser action. Properties and types of lasers. Advantages of lasers in Raman spectroscopy. Experimental Techniques.

**Unit V: Solid State Chemistry**

Ionic radii - determination. Gold Schmit'srule. Closed packing in solids. Structure of metallic crystals. Structure of typical lattices - Perovskite, CsCl, Zinc blende, Wurtzite, Rutile, fluorite and antifluorite. Covalent crystals - diamond and graphite. Mechanical properties of solids.

**Text Books:**


1. Hamann, C.H., Hamnett, A. & Vielstich, W. (2007). Electrochemistry. (4th ed.). New York: John Wiley and Sons.
2. Heiz, U. & Landman, U. (2006). Nanocatalysis. New York: Springer.
3. BanWell, C.N. & Mccash, E.M. (1997). Fundamentals of Molecular Spectroscopy. New Delhi: Tata Mc Grow Hill.
4. Aruldhas, G. (2011). Molecular Structure and Spectroscopy. (2nd ed.), India: PHI Learning Pvt. Ltd.
5. Puri, B.R., Sharma, L.R. & Pathania, M.S. (2016). Principles of Physical Chemistry (47th ed.). India: Vishal Publications.


**Reference Books:**


1. Holze, R. (2009). Experimental Electrochemistry. New York: John Wiley and Sons.
2. Gale, R.J. (2010). Spectroelectrochemistry. New York: Wiley.
3. Azaroff, L.V. (1989). Introduction to Solids. India: Tata McGraw Hill Publishing Ltd.
4. Chang, R. (1971). Basic principles of spectroscopy. India: Tata Mcgraw Hill.
5. Kittel, C. (1996). Introduction to Solid State Physics. (7th ed.). India: Tata McGraw Hill.
6. Atkins, P.W. (2009). Physical Chemistry. (9th ed.). USA: Oxford University Press.

**Semester IV**

**Energy for the Future (Elective IV)**
**Sub. Code: PG1744**

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 6 | 4 | 90 | 100 |

**Objectives:**

1. To acquire knowledge on conventional and non-conventional energy sources.
2. To enlighten the students with knowledge of solar radiation and its measurement.
3. To gain knowledge on wind energy, biogas and hydrogen energy.

Introduction - conventional energy sources - coal - oil - gas - agricultural and organic wastes - water power - thermal power and nuclear power. Non-conventional energy sources - solar energy - wind energy - energy from bio-mass and bio-gas - ocean thermal energy - tidal energy - geothermal energy and hydrogen energy. Advantages of renewable energy.

**Unit II** **(12 Hours)**

**Solar Energy:** Solar radiation and its measurement -introduction - solar constant - solar radiation at the earth's surface - solar radiation geometry and solar radiation data. Solar energy collectors - introduction - physical principles of the conversion of solar radiation into heat - flat plate and concentration collectors. Advantages and disadvantages of concentration collectors over flat collectors. Energy balance equation and collector efficiency.

**Unit III** **(12 Hours)**

**Wind Energy:** Introduction - basic principles of wind energy conversion - power of the wing and forces on the blades. Wind energy conversion - wind data and estimation - site selection. Types of wind machines - horizontal axis and vertical axis machines. Analysis of aerodynamic forces acting on the blade and performance of wind machines. Generating systems - introduction - schemes of electric generation - generator control - load control and energy storage. Application of wind energy.

**Unit IV** **(12 Hours)**

**Bio-energy:** Introduction - biomass conversion techniques - wet processes and dry processes. Biogas generation. Classification of biogas plants - floating drum plant and fixed dome type plant. Biogas from plant waste. Materials used for biogas generation - selection of site for a biogas plant and digester design. Problems related with biogas plants. Fuel properties of biogas and utilization of biogas.

**Unit V** **(12 Hours)**

**Chemical Energy Sources:** Fuel cells -introduction - conversion efficiency of fuel cells - types of electrodes - work output and EMF of fuel cells. Applications of fuel cells. Hydrogen energy. Hydrogen production - electrolysis - thermo-chemical - fossil fuel and solar energy methods. Hydrogen storage

and hydrogen transportation. Utilization of hygrogen gas. Hydrogen as an alternative fuel for motor vehicles. Safety and management.

**Text Books**


1. Rai, G.D. (2004). Non-conventional Energy Sources. India: Khanna Publications.
2. Wengenmayr, R., Bührke, T. &Brewer, W.D. (2012). Renewable Energy: Sustainable Energy Concepts for the Energy Change. (2nd ed.). New York: Wiley VCH.
3. Nelson, V. (2011). Introduction to Renewable Energy (Energy and the Environment). New York: CRC Press.
4. Twidell, J. & Weir, T. (2006). Renewable Energy Resources. (2nd ed.). New York: Taylor and Francis.


**References Books**


1. Chiras, D. (2006). Achieving Energy Independence through Solar, Wind, Biomass and Hydropower. Mother Earth News Wiser Living.
2. Tester, J.W., Drake, E.M., Driscoll, M.J., Golay, M.W., & Peters, W.A. (2006). Sustainable Energy. (2nd ed.). New Delhi: Prentice-Hall of India

**Semester IV**
**Nanochemistry (Elective IV (b))**
**Subject Code: PG2045**

| Hours per week | Credits | Total Hours | Marks |
|---|---|---|---|
| 4 | 3 | 60 | 100 |

**Objectives:**

- To acquire knowledge about basic concepts of nanochemistry.
- To understand the applications of carbon clusters.
- To learn about nanodevices and its applications.

**Course Outcomes (COs)**

| CO | *Upon completion of this course, the students will be able to:* | PO Addressed | CL |
|---|---|---|---|
| CO-1 | understand the basic concept of nanochemistry and its applications | PSO-1 | U |
| CO-2 | apply the principle of nanotechnology for the synthesis and characterization of nanomaterials in various fields | PSO-2,3 | A |
| CO-3 | analyze the physical and chemical properties of nanoparticles | PSO-2,3 | Y |
| CO-4 | evaluate the properties of nanoparticles using various analytical techniques | PSO-2,3 | E |
| CO-5 | create and characterize novel nanomaterials | PSO-3,4 | C |

**Unit I** **(12 Hours)**

**Basic Concepts of Nanochemistry:** Introduction to nanoscience and nanotechnology - discussion on various phenomenon at nanoscale - size - shape - surface - surface energy - surface stabilization - characteristic length - self-assembly - defects - size quantization - surface plasmon - conductivity - tunneling - magnetism and defects.

**Unit II** **(12 Hours)**

**Synthesis of Nanomaterials:** Basics of nanofabrication method - top-down - bottom-up approaches - gas phase - liquid phase - solid phase synthesis - self-assembly - templated synthesis - sol-gel - electrodepostion - fundamentals of nanoparticle formation - thermodynamic approach - supersaturation

- nucleation - growth and homo vs hetero nucleation. Synthesis of nanoparticles - metallic - semiconducting - quantum dots - oxides - hybrids - micelles and microemulsion as templates for synthesis. 0D, 1D and 2D nanoparticles - core-shell nanoparticles - special nanoparticles and shaped nanoparticles.

**Unit III** **(12 Hours)**

**Characterization Techniques:** Discussion on various techniques available for characterizing the nanomaterials - size - shape - morphology - crystalline phase - oxidation states - textural properties - surface area - pore volume - pore size - thermal stability - light absorption and band gap. Scanning electron microscope (SEM) - Transmission electron microscope (TEM) - X-ray powder diffraction (XRD) - X-ray photoelectron spectroscope (XPS) - Scanning tunneling microscope (STM) and Atomic force microscope (AFM). Thermal analysis - $N_2$ sorption techniques for textural properties of the material.Solid state NMR for characterizing functionalized materials.

**Unit IV** **(12 Hours)**

**Carbon Clusters and Nanostructures:** Bonding in carbon - new carbon structures - carbon clusters - discovery of $C_{60}$ - alkali doped $C_{60}$ - superconductivity in $C_{60}$ - larger and smaller fullerenes. Carbon nanotubes - synthesis - single walled carbon nanotubes - structure and characterization - mechanism of formation - chemically modified carbon nanotubes - doping - functionalizing nanotubes - application of carbon nanotubes - nanowires - synthetic strategies - gas phase and solution phase growth - growth control and properties.

**Unit V** **(12 Hours)**

**Nanotechnology and Nanodevices:** DNA as a nanomaterial. DNA - knots and junctions. DNA nanomechanical device designed by Seeman. Force measurements in simple protein molecules and polymerase. DNA complexes. Molecular recognition and DNA based sensor. Protein nanoarray - nanopipettes - molecular diodes - self-assembled nanotransistors and nanoparticle mediated transfection.

**Text Books:**


1. Rao, C.N.R., Muller, A. & Cheetam, A.K. (2004). The Chemistry of Nanomaterials. Vol. I. New York: Wiley-VCH.
2. Poole, C.P. & Owens, F.J. (2003). Introduction to Nanotechnology. New Jersey: Wiley Interscience
3. Klabunde, K.J. (2001). Nanoscale materials in Chemistry. New York: Wiley- Interscience.
4. Pradeep, T. (2007). Nano: The Essentials in Understanding Nanoscience and Nanotechnology. New Delhi: Tata McGraw Hill.


**Reference Books:**


1. Rao, C.N.R., Muller, A. & Cheetam, A.K. (2004). The Chemistry of Nanomaterials. Vol.I. New York: Wiley-VCH.
2. Tang, T. & Sheng, P. (2004). Nano Science and Technology-Novel Structures and Phenomena. New York: Taylor and Francis.
3. Heiz, U. & Landman, U. (2006). Nanocatalysis. New York: Springer.

**Semester III**
**Practical - III**
**Gravimetric analysis and Inorganic preparations**
**Sub. Code: PG17P3**

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 4 | 4 | 40 | 100 |

**Objectives:**

1. To carry out the titrimetric and gravimetric analyses.
2. To perform the preparation of compounds.

1. Separation and estimation of metal ions in a mixture by volumetric and gravimetric methods. Some typical recommended mixtures are:

Cu(II) and Ni(II)
Fe(II) and Cu(II)
Cu(II) and Zn(II)
Ca(II) and Ba(II)
Fe(II) and Ni(II)

2. Preparation of complexes:

Tris(thiourea)copper(I) chloride
Tetraamminecopper(II) sulphate
Potassium trioxalatoferrate
Potassium trioxalatoaluminate(III)
Potassium trioxalatochromate(III)
Hexamminecobalt(III) chloride

**References**


1. Vogel, A.I. (2000). Text Book of Quantitative Inorganic Analysis. (6th ed.). New Delhi: Longman.
2. Ramanujam, V.V. (1988). Inorganic Semimicro Qualitative analysis. (3rd ed.). Chennai: The National publishing Company.

**Semester IV**
**Practical IV**
**Physical Chemistry**
**Sub Code: PG17P4**

| Number of Hours Per week | Number of Credit | Total No. of hours | Marks |
|---|---|---|---|
| 6 | 5 | 60 | 100 |

**Potentiometry:**

1. Determination of solubility product of sparingly soluble salts using AgCl.
2. Determination of dissociation constant of a weak acid.
3. Potentiometric titrations.
   a) Redox titrations
      (i) $Fe^{2+}$ vs $Cr_2O_7^{2-}$
      (ii) $I^-$ vs $MnO_4^-$
      (iii) $Fe^{2+}$ vs $Ce^{4+}$
   b) Precipitation titrations
      (i) $Cl^-$ vs $AgNO_3$
      (ii) $I^-$ vs $AgNO_3$
      (iii) Mixture of $Cl^-$ and $I^-$ vs$AgNO_3$
4. Determination of strength of oxalic acid from the study of its adsorption on activated charcoal.
5. Conductivity:
   1. Estimation of the strength of strong acid.
   2. Estimation of the strength of weak acid.
   3. Estimation of the strength of $NH_4Cl$.
   4. Estimation of the strength of HCl and $NH_4Cl$ in a mixture.
   5. Estimation of the strength of strong and weak acids in a mixture
6. Estimation of Thermometric Experiments:
   Determination of heat of solution-
   Ammonium oxalate and water
   Naphthalene and toluene

**References:**


1. Viswanathan, B. &Raghavan, P.S. (2005). Practical Physical Chemistry. India: Viva Books Ltd.
2. Sienko, M.J., Plane, R.A. & Martu, S.T. (1984). Experimental Chemistry. International student Edn.
3. Shoemaker, D.P., Garland, C.W., &Nibler, J.W. (1974). Experiments in Physical Chemistry. McGraw-Hill International.
4. Levitt, B.P. (1972). Findlay's Practical Physical Chemistry. ($9^{th}$ ed.). New York: Longman Group Ltd.


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