# ST. XAVIER'S COLLEGE (AUTONOMOUS)

# PALAYAMKOTTAI - 627 002

(Recognized as "College with Potential for Excellence" by UGC)
(Accredited by NAAC at "A$^{++}$" Grade with a CGPA of 3.66 in IV Cycle)
(Star College Programme by DBT, Govt. of India.)

*Affiliated to Manonmaniam Sundaranar University*
*Tirunelveli*

## SYLLABUS

**Preserve this copy of the syllabus until you complete the course, as it is an important document of your present course of study.**

Name _____

# B.Sc. CHEMISTRY

**(w.e.f. June 2021)**

# Programme Specific Outcomes

**PSO1**. The students should demonstrate, understand and solve the major concepts in all disciplines of chemistry including physical, inorganic, organic, polymer, environmental and industrial chemistry.

**PSO2.** They will easily assess the properties of all elements discovered and their compounds with applications

**PSO3**. They should develop analytical skills and problem solving skills using spectral, structural and thermo-analytical methods.

**PSO4.** They will act as representatives to create awareness of the impact of chemistry on the welfare of environment, society and industrial growth.

**PSO5.** They will find and apply suitable techniques for the quantitative and qualitative analysis of chemicals in laboratories and in industries.

**PSO6.** They will acquire enough skill in handling and using organic and inorganic reagents for industrial applications.

**PSO7.** They will familiarize in using instruments like UV and IR spectrophotometers, other decent equipments and Chemistry softwares.

**Programme structure for B.Sc. Chemistry**

Course Pattern for UG- Science Programmes: Hours and Credit allotments

| Semester | Status | Code | Papers | Hours | Credit |
|---|---|---|---|---|---|
| I | Lang | 21UGT11 | Tamil/French/Hindi | 6 | 3 |
| | Lang | 21UGF11 | English | 6 | 3 |
| | Core | 21UCH11 | Inorganic Chemistry – I | 4 | 4 |
| | Core | 21UCHP11 | Practical - Inorganic Volumetric Estimations – I | 2 | 1 |
| | Allied | 21UMTA11 | Allied Mathematics – I | 6 | 5 |
| | NME1 | 21UNM11 | Food Chemistry | 2 | 2 |
| | SBE1 | 21USB11 | Personality Development | 2 | 2 |
| | VE | 21UVE11 | Religion 1/Ethics | 2 | 2 |
| | | | **Sub Total** | **30** | **22** |
| II | Lang | 21UGT21 | Tamil/French/Hindi | 6 | 3 |
| | Lang | 21UGF21 | English | 6 | 3 |
| | Core | 21UCH21 | Organic Chemistry – I | 4 | 4 |
| | Core | 21UCHP21 | Practical - Inorganic Volumetric Estimation – II | 2 | 1 |
| | Allied | 21UMTA21 | Allied Mathematics – II | 6 | 5 |
| | NME-2 | 21UNM21 | Agricultural Chemistry | 2 | 2 |
| | SBE – 2 | 21USB21 | Religion II/Life Skills | 2 | 2 |
| | SBE – 3 | 21USB22 | Professional English For Physical Sciences | 2 | 2 |
| | | | **Sub Total** | **30** | **22** |
| III | Lang | 21UGT31 | Tamil/French/Hindi | 6 | 3 |
| | Lang | 21UGF31 | English | 6 | 3 |
| | Core | 21UCH31 | Inorganic Chemistry – II | 4 | 4 |
| | Core | 21UCHP31 | Practical - Inorganic Qualitative Analysis – I | 2 | 1 |
| | Allied | 21UCHA31 | Allied Physics – I | 4 | 4 |
| | Allied | 21UCHA32 | Physics Practical – I | 2 | 1 |
| | SBE – 4 | 21USB31 | Human Right and Social Analysis | 2 | 2 |
| | SBE – 5 | 21USB32 | Material Science | 2 | 2 |
| | ES | 21UES31 | Environmental Studies | 2 | 2 |
| | | | **Sub Total** | **30** | **22** |
| IV | Lang | 21UGT41 | Tamil/French/Hindi | 6 | 3 |
| | Lang | 21UGF41 | English | 6 | 3 |
| | Core | 21UCH41 | Organic Chemistry – II | 4 | 4 |
| | Core | 21UCHP41 | Practical - Inorganic Qualitative Analysis – II | 2 | 1 |
| | Allied | 21UCHA41 | Allied Physics – II | 4 | 4 |
| | Allied | 21UCHA42 | Allied Physics Practical – II | 2 | 1 |
| | Elective | 21UCHE41 | Thermodynamics and Solid State/Environmental Chemistry | 4 | 4 |
| | SBE | 21USB41 | Everyday Chemistry | 2 | 2 |
| | | | **Sub Total** | **30** | **22** |

| | | | | | |
|---|---|---|---|---|---|
| V | Core | 21UCH51 | Organic Chemistry – III | 4 | 4 |
| | Core | 21UCH52 | Inorganic Chemistry – III | 4 | 4 |
| | Core | 21UCH53 | Physical Chemistry – I | 4 | 4 |
| | Core | 21UCH54 | Physical Chemistry – II | 5 | 4 |
| | Core | 21UCHP55 | Practical - Inorganic Gravimetric Estimation | 2 | 1 |
| | Core | 21UCHP56 | Practical - Preparation of Coordination Compounds | 2 | 1 |
| | Core | 21UCHP57 | Practical - Preparation of Organic Compounds | 2 | 1 |
| | Core | 21UCHP58 | Practical - Estimation of Organic Compounds | 2 | 1 |
| | Elective | 21UCHE51 | Bio molecules and Pharmaceutical Chemistry (Interdisciplinary) | 5 | 5 |
| | | | **Sub Total** | **30** | **25** |
| VI | Core | 21UCH61 | Organic Chemistry – IV | 5 | 5 |
| | Core | 21UCH62 | Inorganic Chemistry – IV | 5 | 5 |
| | Core | 21UCH63 | Physical Chemistry – III | 5 | 5 |
| | Core | 21UCHP64 | Practical - Qualitative Analysis of Organic Compounds | 4 | 2 |
| | Core | 21UCHP65 | Practical - Physical Chemistry | 4 | 2 |
| | Core (Internal) | 21UCHS61 | Comprehensive Chemistry | - | 3 |
| | Elective (Internal) | 21UCHE61 | Computer Applications and Analytical Techniques/Green Chemistry | 5+2 | 4 |
| | | | **Sub Total** | **30** | **26** |
| | | | **STAND** | | **1** |
| | | | Grand Total | 180 | 140 |

| **List of Extra Credit Courses** | | | |
|---|---|---|---|
| **Semester** | **Subject Code** | **Title of the paper** | **Credit** |
| I | 21UCHECC01 | Dairy Chemistry | 2 |
| II | 21UCHECC02 | Leather Chemistry | 2 |
| III | 21UCHECC03 | Forensic Chemistry | 2 |
| IV | 21UCHECC04 | Pollution Control | 2 |
| V | 21UCHECC05 | Applied Chemistry | 2 |
| VI | 21UCHECC06 | Space Chemistry | 2 |

**Compulsory programmes to be completed.**

1. Internship programme before the competition of fourth semester- 2 credits

## CORE-INORGANIC CHEMISTRY-I

**(Subject code: 21UCH11)**

| Semester: I | Core: 1 | Credits: 4 | Hours / W: 4 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will have a firm foundation in elements of periodic table and periodic properties(K1)
- Students will explain the types of chemical forces in inorganic compounds (K2)
- Students will be able to explore the importance of alkali and alkaline metals and its significance in the field of energy and biology (K3)
- Students will infer the occurrence of elements, separation and purification process etc (K4)
- Students will be skilled in quantitative measurements using titrimetric experiments, accurately record and analysing results (K5)
- Students can generate accurate results using quantitative methods. (K6)

**Unit I Periodic table and periodic properties** **12hrs**

Modern periodic law-long form of periodic table-Cause of periodicity and recurrence of properties-Division of elements into s,p,d and f-blocks-atomic properties – justification for their variation, factors influencing periodic trends and irregularities. Ionic radii – determination by Pauling's method-Slater rules – screening constant and effective nuclear charge.Ionization energy – successive ionization enthalpy and factors affecting ionization energy. Electron affinity–Factors influencing and trends of electron gain enthalpy. Electronegativity – Sanderson's and Allred – Rochow's scale. Group electronegativity. Factors influencing electronegativity-Applications of electronegativity

**Self-study:** Pauling's scale of electronegativity, covalent and van der Waals radius

**Unit II Chemical Bonding – I** **12hrs**

Cause of chemical combination-Ionic bond - Formation with examples- Properties of ionic compounds- Factors influencing the formation of ionic compounds. Lattice energy – Born – Lande equation (derivation not required) and Born-Haber cycle. Ionic crystal structure of NaCl, CsCl, Zinc Blende, Wurzite and $TiO_2$ Covalent bond – Lewis concept-Orbital overlap – concept of covalency – s-s, s-p and p-p overlapping with examples. σ and π bonds – formation of $N_2$ and $O_2$ molecule-Characteristics of covalent compounds. Coordinate covalency (or) dative bond-Formation with example. Characteristics of coordinate covalent compounds. Polar molecules and non-polar molecules-Covalent character in ionic bond-Fajan's rules -Polarisability and polarization of ions. Hydrogen bonding and intermolecular forces

**Self-study:** Percent ionic character of a polar covalent bond and some important bond characteristics

**Unit III s– Block elements** **12hrs**

General characteristics of s block elements. Anomalous behaviour of lithium-Role of Na+ and K+ ions in biological systems. Anomalous behaviour of beryllium-Extraction of beryllium-Cause of diagonal relationship – diagonal relationship between lithium and magnesium-Inert pair effect- Compounds of Be and Mg -Role of $Mg^{2+}$ and $Ca^{2+}$ ions in biological systems.Alkali metal ion batteries – application.Comparative study of group I A elements. Comparative study of group II A elements.

**Self-study:** Flame tests – Alkali and alkaline earth metals. Uses of alkali and alkaline earth metals

**Unit IV Metallurgical principles** **12hrs**

Occurrence of metals- Minerals and ores-Native, sulphide, oxide, carbonate, halide and sulphate ores. Metallurgy-Extraction of metals-Concentration of ores-hand picking, gravity separation, magnetic separation, electrostatic separation, froth flotation and leaching. Furnaces-reverberatory, blast, open–hearth and Bessimer Converter-Calcination and roasting-Reduction to free metals – smelting, heating in air, thermite process, Electrometallurgy, amalgamation and hydrometallurgy. Outline of extraction of the metals from their oxide, sulphide, carbonate, chloride and sulphate ores. Purification of metals – liquation, distillation, oxidation, thermal decomposition, electrorefining, zone refining and vapour phase refining. Thermodynamics of the oxidation of metal to metal oxides – Ellingham diagram

**Self-study:** Solvent extraction technique for the extraction of metals

**Unit V Theoretical basis of titrimetry and redox process** **12hrs**

Equivalent weight of acids, bases, salts, oxidizing and reducing agents. Different concentration units – molarity, molality, mole fraction, normality and percentage concentrations. Standard solutions - primary and secondary standards. Law of normalities – calculation of strengths of solutions and amount of solute in solutions. Theory of permanganimetry, dichrometry, iodometry, iodimetry and complexometric (EDTA) titrations. Redox processes: Electronic concept of oxidation and reduction-Oxidation number rules- Calculation of oxidation number of elements in neutral molecules and in ions-Oxidation and reduction in terms of oxidation number-Oxidizing agent and reducing agent-Advantages and disadvantages of oxidizing number concept-Balancing ionic equation-Ion-electron method-Oxidation number method

**Self-study:** Common accidents and precautionary measures in chemistry laboratories. Precautions to avoid errors in titrimetric analysis.

**REFERENCES:**


1. B.R. Puri, L.R. Sharma and KaliaPrinciples of Inorganic chemistry, 2006, Milestone Publications.
2. Albert Cotton, Wilkinson, Basic Inorganic chemistry, 3rdEdn, 2007, John Wiley Pvt.Ltd.
3. J.D.Lee, Concise Inorganic Chemistry, 5th Edn,1996, Blackwell Pub.Com.
4. D.E. Shriver, P.W.Atkins, Inorganic chemistry, 3rd Edn,2009, Oxford Univ.Press.
5. Albert Cotton, Wilkinson, Basic Inorganic chemistry, 3rdEdn, 2007, John Wiley PvtLtd.
6. R.D. Madan, Principles of Inorganic chemistry, Revised Edn, 2011, S.Chand& Co Ltd.
7. Vogel A. I., Textbook of Quantitative InorganicAnalysis, 1978, ELBS.
8. Alan G.Sharpe, Inorganic chemistry, 2nd Edition, 2005, Pearson Education Ltd

## Core- INORGANIC VOLUMETRIC ESTIMATIONS – I (Micro Level)

**(Subject code: 21UCHP11)**

| Semester: I | Core: P1 | Credit: 1 | Hours/W: 2 |
|---|---|---|---|

**ESTIMATION OF**

1. Oxalic acid using analar Oxalic acid (Link $KMnO_4$)
2. Mohr salt using analar Mohr salt (Link $KMnO_4$)
3. Ferrous sulphate using analar Mohr salt (Link $KMnO_4$)
4. Calcium by direct method
5. Lead by indirect method
6. $MnO_2$ and available $O_2$ in pyrolusite
7. Mohr salt using analar Mohr salt (link $K_2Cr_2O_7$)
8. Ferrous sulphate using analar Mohr salt (Link $K_2Cr_2O_7$)
9. Potassium dichromate using analar potassium dichromate (Link $Fe^{2+)}$
10. Ferric iron using analar potassium dichromate
11. Potassium permanganate using analar potassium dichromate (Link $Fe^{2+}$)
12. Oxalic acid (from tomato) using standard oxalic acid solution and potassium permanganate link solution.

**Applied experiments**

1. Citric acid in lemon using standardized sodium hydroxide solution
2. Ascorbic acid in citrus fruit juices
3. Antacid capacity of antacid tablet

**Reference:** J.Mendhem, R.C. Denney, D. Barnes, M.J.k.Thomas, Vogel's Textbook of Quantitative chemical Analysis, 6th edition, 2002, Pearson Education Ltd.

**NOTE :** Laboratory manual will be supplied

**ALLIED MATHEMATICS – I**
**(PHYSICS AND CHEMISTRY)**
**(Course Code: 21UMTA11)**

| Semester - I | Allied - 1 | Hours - 6 | Credits - 5 |
|---|---|---|---|

**Course outcomes:** By the end of the course the student will be able to

- define the rank of matrix (K1)
- discuss hyperbolic functions and inverse hyperbolic functions (K2)
- explain the relation between the coefficients and the roots of algebraic equation (K2)
- solve the system of linear equations (K3)
- analyze binomial series, exponential series and logarithmic series (K4)
- compare two sets of data using correlation (K5)

**UNIT - I:**

Binomial Series – Exponential Series – The Logarithmic series

**(Text book 1: Chapter 1: Sections 1.2-1.4)**

**UNIT - II:**

Nature of roots - Relation between the coefficients and the roots of an algebraic equation -Transformation of equations

**(Text book 1: Chapter 2: Sections 2.1-2.3)**

**UNIT- III:**

Rank of a matrix - Simultaneous linear equations - Cayley - Eigen values and Eigen vectors

**(Text book 1: Chapter 3: Sections 3.2 – 3.4)**

**UNIT - IV:**

Expansion of sin θ and cos θ tan □in a series of ascending powers of θ - Hyperbolic function - Inverse hyperbolic function – Logarithm of complex numbers.

**(Text book 1: Chapter 5: Sections 5.3 – 5.5)**

**UNIT - V:**

Correlation – Rank Correlation – Regression

**(Text book 2: Chapter 1)**

**Text books:**


1. S. Narayanan, R. Hanumantha Rao, T.K. Maicavachagom Pillai and P. Kandaswamy, Ancillary Mathematics Volume I, S. Viswanthan (Printers and Publishers) Pvt. Ltd., 2009.
2. S. Arumugam and Issac, Allied Mathematics paper V, New Gamma Publishing House, 2004

**FOOD CHEMISTRY**

**(For Other Major Students)**

**(Subject code: 21 UNM 11)**

| **Semester: I** | **NME: 1** | **Credits: 2** | **Hours/W: 2** |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will quote the importance of food (K1)
- They will differentiate different types of food and their biological importance. (K2)
- They will illustrate the ill effects of contaminated food (K3)
- They will infer the relation between biology and chemistry (K4)
- They will analyse the additives and preservatives present in food. (K5)
- They will create awareness towards healthy, balanced food and avoid taking contaminated food. (K6)

**Unit I Food Adulteration and Testing** **6hrs**

Introduction- Legal aspects of Food adulteration and Prevention. Common food adulterants-Analysis of various food adulterants-Pesticide contaminants- Toxicants.

**Unit II Food Allergy** **6hrs**

Food as Allergens-Types of reactions-Symptoms- Diagnosis- Treatment

**Unit III Food Additives** **6hrs**

Food additives –Introduction, types & functions-Categories of food additives- Safety concerns and Legal Regulations of Food additives-Food flavour-Sensation of smell & taste-Flavour of some important foods-Natural Food colours - Carotenoids, Caramel, Tannins, Betalains-Important Artificial colours.

**Unit IV Food Processing and Preservation** **6hrs**

Introduction-Aims of food processing-Food preservation -introduction-Means of Preservation-Types of spoilage-Various methods of food preservation

**Unit V Edible Oils** **6hrs**

Fats and Oils-Production of refined vegetable oils-Saturated and unsaturated fatty acids- Role of MUFA and PUFA in preventing heart diseases-Estimation of I2 value & RM value -Estimation of saponification value and their significance

**TEXTBOOKS *:***


1. Alex V Ramani, Food Chemistry, MJP publishers
2. H. K. Chopra & P. S. Panesar, Food Chemistry, Narosa Publishing House
3. B. Srilakshmi, Dietetics, New age international (P) Ltd. Publishers
4. Swaminathan M., Food Science and Experimental methods, Ganesh and Company.
5. S. A. Joshi, Nutrition and dietetics, tata McGraw-Hill publishing companies

**Core- ORGANIC CHEMISTRY-I (theory)**

**(Comprises Inorganic Volumetric Estimations – II)**

**(Subject code: 21UCH 21)**

| **Semester: II** | **Core: 2** | **Credits :4** | **Hours/W - 4** |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will Identify the stereochemical behaviour of molecules (K1)
- They will Strongly explain the fundamental naming of organic compounds (K2)
- They will determine the 3D structures organic molecules (K3)
- They will classify the aliphatic systems with reference to organic compounds (K4)
- They will evaluate the substituent effect in the aromatic reaction systems (K5)
- They will modify the importance and the uses of Organometallic compounds in the field of organic synthesis (K6)

**Unit I Basic Concepts in Organic Chemistry** **12hrs**

Classification and nomenclature: Nomenclature of alkanes, alkenes, alkynes, cycloalkanes, and mono - & poly functional aliphatic compounds. Cleavage of bonds: Homolytic and heterolytic cleavages, bond energy, bond length and bond angle. Hybridisation; Types - sp, $sp^2$ and $sp^3$ with reference to methane, ethylene and acetylene- Electron displacement effects: Inductive effect, electromeric effect, mesomeric effect, hyperconjugative effect and steric effect - Reagents and intermediates - Shape, structure, stability and reactions of carbocation, carbanion, free radical, carbene and nitrene

***Self study:*** Classification of organic compounds, Nucleophiles and electrophiles, Types of organic reactions

**Unit II Optical Isomerism and Geometrical Isomerism** **12hrs**

Optical isomerism - Asymmetric carbon atom - Asymmetric, dissymmetric, chiral and achiral molecules - Optical activity - cause of optical activity - optical isomerism exhibited by tartaric acid (eryhtro, threo, meso and dl forms) - Molecular chirality - biphenyls, allenes and spiranes - Walden inversion - racemisation – resolution - asymmetric synthesis - Stereospecific and stereoselective - examples. Concept of entatiomerism and diastereoisomerism - Determination of configuration of organic compounds - R and S notation - Geometrical isomerism - Geometrical isomerism in compounds containing carbon - carbon double bond and carbon - nitrogen double bond - Designation of geometrical isomers - cis and trans, syn and anti & E and Z notations

***Self study:*** Le Bel - van't Hoff theory, Symmetry elements

**Unit III Aliphatic Compounds** **12 hrs**

Alkenes - General methods of preparation by dehydrogenation, dehydrohalogenation, dehydration, Hoffmann and Saytzeff rules, cis and trans eliminations - Mechanism of

addition reactions to alkenes - Markownikoff's rule - Peroxide effect - hydroboration and ozonolysis - Classification and stability - isolated, cumulated and conjugated dienes - Conjugated diene - 1,2- and 1,4 - addition reaction - Diels - Alder reaction - Alkynes Reductions using Lindlar's catalyst and Na/liq.$NH_3$ and hydrolysis - Internal and terminal alkynes - Acidic nature of alkanes, alkenes and alkynes - a comparison.

***Self study:*** Polymerization - addition polymerization, Ziegler Natta catalysed polymerization

**UNIT IV Alicyclic Compounds And Conformation** **12 hrs**

Alicyclic compounds - General methods of preparation – Freund's method, ieckmann condensation, Thrope - Ziegler and Simmon - Smith reactions - Baeyer's strain theory and its modification - Conformation - Rotomers- potential energy diagram - Staggered and eclipsed conformations - Conformational analysis of ethane and n- butane - comparison of the population in gauche form in n - butane and ethylene glycol - Conformations of cyclohexane - chair and boat forms - potential energy diagram - monosubstitutedcyclohexanes

***Self study:***Banana bond, Fused ring structures – Prismane, Cubane, adamantine, decalin

**UNIT V Aromatic Compounds and Organometallic Compounds** **12 hrs**

Aromatic hydrocarbons - Aromaticity - concept and condition - Huckel rule - benzene, naphthalene, pyrrole, pyridine, cyclopentadienyl anion, cyclopropenylcation and tropyliumcation - Structure of benzene - Orientation (electronic concept) and reactivity in monosubstituted benzene - Mechanism of aromatic electrophilic and aromatic nucleophilic substitution reactions - Introduction - Organo magnesium compounds - Grignard reagent – Preparation - Reactions and synthetic application - Organo lithium compounds – Preparation and reactions

***Self study:*** Organo copper compounds

**TEXTBOOKS :**

**Units I- V**


1. M.K. Jain & S.C. Sharma, Modern Organic chemistry, 3rd edition, 2009, Vishal Publishing Co.
2. B.S. Bahl and ArunBahl, Advanced Organic Chemistry, Reprint-2010, S. Chand & company Ltd.


**REFERENCES:**


1. Morrison R.T. and Boyd R.N., Organic Chemistry (6th edition), New York, Allyn& Bacon Ltd., (1976).
2. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997). [Textbook]

3. Pine S.H, Organic Chemistry, (4th edition) New Delhi, McGraw- Hill, International Book Company. (1986).
4. Mehta, B. and Mehta.M, Organic chemistry, PHI learning Pvt. Ltd., New Delhi (2012). [Textbook]
5. Andrew F Parson, Key Notes in Organic Chemistry, Blackwell Science Publishers, (2003).

## CORE-INORGANIC VOLUMETRIC ESTIMATIONS -II (MICRO LEVEL)

**(Subject code: 21UCHP21)**

| Semester: II | Core: P2 | Credit: 1 | Hours/W - 2 |
|---|---|---|---|

**ESTIMATION OF**

1. FAS (Link $Ce^{4+}$)
2. $NaNO_2$ (Cerimetry)
3. Potassium permanganate using analar potassium dichromate (link thio)
4. Potassium dichromate using analar potassium dichromate (link thio)
5. Copper sulphatepentahydrate using analar copper sulphatepentahydrate (link thio)
6. Arseneous oxide using analararseneous oxide (link $I_2$ solution)
7. Available chlorine in bleaching powder
8. Copper in brass
9. Temporary and permanent hardness of water sample (acidimetry - alkalimetry)
10. $Mg^{2+}$ using analar $MgSO_4 .7H_2O$ or $MgCl_2.6H_2O$ (link EDTA)
11. $Zn^{2+}$ using analar $ZnSO_4.7H_2O$ (link EDTA)
12. Total and permanent hardness of water sample (EDTA method)
13. Mg and Ba in a mixture (Ba removed as $BaSO_4$)
14. Calcium in milk powder

**Reference:**


**1.** J.Mendhem, R.C. Denney, D. Barnes, M.J.k.Thomas, Vogel's Textbook of Quantitative chemical Analysis, 6th edition, 2002, Pearson Education Ltd.


**NOTE:** Laboratory manual will be supplied

**ALLIED MATHEMATICS – II**
**(FOR CHEMISTRY)**
**(Course Code: 21UMTA21)**

| **Semester - II** | **Allied - 2** | **Hours - 6** | **Credits - 5** |
|---|---|---|---|

**Course Outcomes:** By the end of the course the student will be able to

- define group, subgroup, cyclic group and order of an element (K1)
- recall reduction formulae for trigonometric functions(K1)
- discuss the relation between order of an element and order of the group using Lagrange's theorem (K2)
- solve ordinary differential equation and partial differential equation(K3)
- classify the types of partial differential equations (K4)
- evaluate double and triple integrals (K5).

**UNIT - I:**

Groups - Subgroups - Cyclic groups - Order of an element - Cosets and Lagrange's theorem.

**(Text book 1: Sections 2.5, 2.6, 2.10)**

**UNIT - II:**

Linear equations with constant coefficients - Methods of finding complementary functions - Methods of finding particular integrals - Homogeneous linear equations.

**(Text book 2: Chapter 5 (Sections 1- 4))**

**UNIT - III:**

Formation of partial differential equations - First order partial differential equations - Some standard forms.

**(Text book 2: Chapter 6)**

**UNIT - IV:**

Definite integrals - Integration by parts - Reduction formulae for $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, and
$\int \tan^n x\,dx$ only

**(Text book 3: Sections 1.2 and 1.3)**

**UNIT - V:**

Double integrals - Triple integrals - Jacobians - Change of variables in double and triple integrals.

**(Text book 3: Chapter 6)**

**Text books:**


1. S. Arumugam and Issac, Allied Mathematics paper IV, New Gamma Publishing House, 1996
2. S. Arumugam and Issac, Allied Mathematics paper III, New Gamma Publishing House, 2004
3. S. Arumugam and Issac, Allied Mathematics paper II, New Gamma Publishing House, 2003

## AGRICULTURAL CHEMISTRY

**(for other major students)**

**(Subject code: 21 UNM 21)**

| Semester: II | NME: 2 | Credits :2 | Hours/W - 2 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will define the soil quality parameters (K1)
- They will differentiate and select a suitable manure for a specific crop (K2)
- They will demonstrate the functioning mechanism of different fertilizers (K3)
- They will prepare organic manures (K4)
- They will recommend natural pesticides and insecticides for different plants (K5)
- They will analyze and recommend water for various purposes. (K6)

**UNIT I Soil Chemistry** **6hrs**

Introduction - Soil classification - Properties of soil – soil texture, soil water, soil temperature, soil colloids, soil minerals - Soil pH - Soil acidity and alkalinity - Soil formation

**UNIT II Manures, Compost and Saw Dust** **6hrs**

Farmyard manure - Compost - Reinforcing manure - Green manure crops - Saw dust, night soil - Sewage and sludge - Biogas production and manure

**UNIT III Fertilizers** **6hrs**

Introduction - Plant nutrients - Micro and macro nutrients and their role - Fertilizer types- Need for fertilizers - Essential requirements - Classification of fertilizers - Natural inorganic and organic fertilizers - Artificial fertilizers - Nitrogenous fertilizers - Urea – manufacture and properties - Phosphate Fertilizers – super phosphate, triple super phosphate – preparation and

Properties - Potassium fertilizers – NPK Fertilizers

**UNIT IV Pesticides** **6hrs**

Introduction: Classification of pesticides - Insecticides - Classification - Inorganic insecticides – the arsenic compounds, mercury compounds - Natural insecticides – nicotine, rotenone. Organic insecticides – DDT, BHC – preparation and properties - Gammexane, Chlorodane, aldrin – Fungicides – Bordeaux mixture.

**UNIT V Water and Soil Pollution** **6hrs**

Introduction: Classification of water pollutants –Total Dissolved Solids (TDS) Chemical Oxygen Demand (COD) and Biological oxygen demand (BOD)- Industrial waste and pesticide pollution -

Soil pollution – industrial contaminants - Heavy metals and its toxicity - Organic contaminants – soil erosion in India – soil conservations

**TEXTBOOKS :**


1. JayashreeGhosh, Fundamental concepts of applied chemistry, S.Chand& Co
2. B.K. Sharma, Industrial chemistry, Goel publishing House

**SBE - PROFESSIONAL ENGLISH FOR PHYSICAL SCIENCES**

**(For chemistry & other major students)**

**(Subject Code: 21 USB 22)**

| **Semester: II** | **SBE: 3** | **Credits :2** | **Hours/W - 2** |
|---|---|---|---|

**COURSE OUTCOMES:**

- Recognise their own ability to improve their own competence in using the language (K5)
- Use language for speaking with confidence in an intelligible and acceptable manner (K4)
- Understand the importance of reading for life (K1)
- Read independently unfamiliar texts with comprehension (K2)
- Understand the importance of writing in academic life (K2)
- Write simple sentences without committing errors of spelling or grammar. (K3)

**UNIT 1 Communication 6hrs**

Listening : Listening to audio text and answering questions - Listening to Instructions

Speaking : Pair work and small group work.

Reading : Comprehension passages –Differentiate between facts and opinion

Writing : Developing a story with pictures.

Vocabulary : Register specific - Incorporated into the LSRW tasks

**UNIT II Description 6hrs**

Listening : Listening to process description.-Drawing a flow chart.

Speaking : Role play (formal context)

Reading : Skimming/Scanning-Reading passages on products, equipment and gadgets.

Writing :Process Description –Compare and Contrast paragraph-Sentence Definition and Extended definition-Free Writing.

Vocabulary : Register specific -Incorporated into the LSRW tasks

**UNIT III Negotiation Strategies 6hrs**

Listening : Listening to interviews of specialists / Inventors in fields (Subject specific)

Speaking : Brainstorming.(Mind mapping). Small group discussions (Subject-Specific)

Reading : Longer Reading text.

Writing : Essay Writing (250 words)

Vocabulary : Register specific - Incorporated into the LSRW tasks

**UNIT IV** **Presentation Skills** **6hrs**

Listening : Listening to lectures.
Speaking : Short talks.
Reading : Reading Comprehension passages
Writing : Writing Recommendations. Interpreting Visuals inputs
Vocabulary : Register specific - Incorporated into the LSRW tasks

**UNIT V** **Critical Thinking Skills** **6hrs**

Listening : Listening comprehension- Listening for information.
Speaking : Making presentations (with PPT- practice).
Reading : Comprehension passages –Note making.
Comprehension: Motivational article on Professional Competence, (Professional Ethics and Life Skills)
Writing : Problem and Solution essay– Creative writing –Summary writing
Vocabulary : Register specific - Incorporated into the LSRW tasks

**NOTE:** STUDY MATERIAL WILL BE PROVIDED TO THE STUDENTS.

## CORE- INORGANIC CHEMISTRY –II

**(Subject code: 21UCH31)**

| Semester: III | Core: 3 | Credits :4 | Hours/W : 4 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will describe the basics of nuclear reactions and its applications in different fields (K1)
- They will interpret the properties of acids, bases and zero group elements (K2)
- The will demonstrate properties of the important compounds of p block elements (K3)
- They will classify the chemistry of compounds of sulphur, nitrogen and phosphorous (K4)
- They will evaluate the efficiency of micro level qualitative analysis of acid and basic radicals (K5)
- They will integrate the properties of different group elements to get new compounds (K6)

**UNIT I Radioactivity and Nuclear Chemistry 12hrs**

Natural radioactivity: Radioactive emanations - characteristics of α, β and γ rays - Detection and measurement of radioactivity – Geiger Muller counter and Wilson cloud Chamber - Radioactive disintegration and half-life period - Average life period - Radioactive equilibrium - Soddy's group displacement law - Radioactive series - Isotopes, isobars, isotones, and molecular isomerism. Mass defect and binding energy–stability of nuclei–numerical calculations.Types of nuclear reactions - Capture, particle-particle, fission, fusion, and spallation reactions.Nuclearfission and atom bomb. Nuclear fusion and hydrogen bomb-Breeder reactor - Stellar energy - Induced radioactivity. Nuclear reactors - Components of a nuclear reactor. Applications of radioactive isotopes as tracers in the fields of medicine, agriculture,industry and study of reaction mechanisms.

**Self-study:** Types and components of nuclear reactors, radiation protection and waste disposal

**UNIT II Concepts of Acids and Bases and Noble Gases 12hrs**

Concept of acids and bases - Arrhenius concept - Bronsted-Lowry concept – conjugate acids and bases - The Lux-Flood concept - Lewis concept - Hard and soft acids and bases (HSAB) –Pearson concept - HSAB principle and its applications - Effect of solvents and substituents on relative strengths of acids and bases - Superacids and superbases - Classification of solvents and chemical reactions in liquid $NH_3$ - Noble gases - Position in the periodic table - Isolation, separation and uses. Compounds of xenon-preparations and structures of $XeF_2, XeF_4, XeF_6, , XeOF_2, XeOF_4, XeO_3, and XeO_2F_2$.

**Self-study:** Effect of charge, electronegativity, hydration energy and oxidation on the strength of acids and bases and generalized acid-base concept for cations and anions

**UNIT III p – Block Elements** **12hrs**

General characteristics with reference to configuration, oxidation state, electropositive character and inert pair effect - Hydrides of boron - classification - Types of bonding in boranes. Diborane,,carboranes and metallaboranes - preparation, bonding and structure - Wades rule - Structure and bonding in $B_4H_{10}$ and $B_4H_9$ Boron – tri halides as Lewis acids – Relative strengths - Compounds of boron and nitrogen – boron nitride and borazine – preparation, structure and properties. Carbon - Graphite and diamond – structure and properties. Silicon - Silica – different forms and structure - Silicates – different types of silicates - Silicones – preparations, properties and uses - Carborandum - preparation, structure and uses.

**Self-study:** Zeolites as molecular sieves

**UNIT IV Nitrogen, Phosphorous, Sulphur and Halogens** **12hrs**

Nitrogen - Active nitrogen-preparation and properties - Theories of active nitrogen - Structure, bonding and properties of hydrazine, hydrazoic acid and hydroxylamine - Liquid $NH_3$ as a non-aqueous solvent - Conversion of $NH_3$ into $HNO_3$ by Ostwald's process - Action of nitric acid on metals and non- metals - Phosphorus - Structure of oxides and oxyacids of phosphorous – Structure of oxides of oxyacids of phosphorus - Sulphur - Structure of $S_8$ , $SO_2$, $SO_3$ and peracids of sulphur - Preparation and structure of di, tri and tetrathionic acids - Structure of sulphurous acid - Halides of sulphur- $SCl_2$&$S_2Cl_2$ - Halogens - Interhalogen compounds – types and structure - Basic iodine - Pseudohalogens – Preparation and reactions of cyanogens

**Self-study:** Types of phosphazines, preparation of Caro's acid and Marshall's acid

**UNIT V Inorganic Qualitative Analysis** **12hrs**

Salts –reactions of ions- Types of reactions (Addition, decomposition, dissociation, displacement, double decomposition, hydrolysis, redox reactions) - Complex formation reactions- Separation of Cu & Cd in a mixture and Ni&Co in a mixture - Dry heating test- evolution of gases, sublimation, colour change, precipitation and swelling - Charcoal cavity reduction and cobalt nitrate tests - Analysis of anions: Tests (with equations) - Dilute $H_2SO_4$, conc.$H_2SO_4$, $KMnO_4$, HCl - $Na_2CO_3$ extract test for certain combination of anions ($CO_3^{2-}$ and $SO_3^{2-}$, $CO_3^{2-}$ and $C_2O_4^{2-}$ , F- and $SO_4^{2-}$)- nature of interference - Elimination of interfering anions and preparation of original solutions (with equations) - Analysis of cations - Solubility product concept and common ion effect concept, pH and buffer - Group reagents and separation of analytical groups (with equations)

Self-study: One spot test for each of Pb, Cu, Cd, Bi, Sb, $Fe^{2+}$, $Fe^{3+,}$ Al, Co, Ni, Mn, Zn, Ba, Ca, Sr, Mg ions

**REFERENCES :**


1. B.R. Puri and L.R. Sharma, Principles of Inorganic chemistry, 33rd Revised Edn, 2016, Vishal Publishing Co.
2. J.D.Lee, Concise Inorganic Chemistry, 5th edition, 1996, Blackwell Science Ltd.
3. J.E. Huheey, Inorganic chemistry, Principle of structure and reactivity, 4thEdn ,1996, Pearson Education.
4. D.E. Shriver, P.W. Atkins, Inorganic chemistry, 5th Edn,2010, Oxford Univ. Press.
5. A.G. Sharpe, Inorganic chemistry, 3rdEdn, 1992, Longman Group Ltd.
6. Albert Cotton, Wilkinson, Basic Inorganic chemistry, 3rdEdn, 2007, John Wiley Pvt.Ltd.
7. G.L. Miessler and D.A. Tarr, Inorganic chemistry, 3rd Edn,2004, Pearson Education.
8. Alan G.Sharpe, Inorganic chemistry, 2nd Edition, 2005, Pearson Education Ltd
9. R.D. Madan, Principles of Inorganic chemistry, Revised Edn, 2011, S.Chand& Co Ltd.
10. 10 H.J.ArinikarEssentials of Nuclear Chemistry, 4th edition New AgeInternational, New Delhi, 1995.
11. Vogel A. I., Textbook of QualtitativeInorganicAnalysis, 1978, ELBS.

## CORE-INORGANIC QUALITATIVE ANALYSIS-I (MICROLEVEL)

**(Subject code: 21UCHP31)**

| Semester: III | Core :P 3 | Credit :1 | Hours/W: 2 |
|---|---|---|---|

**Micro level qualitative analysis of simple salt containing one anion and one cation.**

Anions: Carbonate, Sulphide, Halides, Nitrate, Borate, Chromate, Fluoride, Oxalate, Tartrate, and Phosphate.

Cations: Lead, Bismuth, Copper, Cadmium, Antimony, Iron, Zinc, Cobalt, Nickel, Manganese, Calcium, Strontium, Barium, & Ammonium.

Qualitative examination of chlorine and fluorine in biological sample (Demonstration only)

**References:**


1. Vogel A. I., Textbook of Qualtitative Inorganic Analysis, 1978, ELBS.
2. V. V. Ramanujam, Inorganic semi micro Qualitative analysis, 3rd edition, 1974, The National Publishing Company.


**Note : Laboratory manual will be supplied.**

## ALLIED PHYSICS – I (FOR CHEMISTRY)

**(Course Code: 21UCHA31)**

| SEMESTER III | HOURS - 4 | CREDITS - 4 |
|---|---|---|

**Course Outcomes:** At the end of the course the students will be able to

- understand the fundamental concepts of properties of matter
- understand the principles' and development in properties of matter and heat and
- thermodynamics
- understand specific heat capacity of various liquid
- understand the differences between surface tension and viscosity
- understand the various sources and energy resources.

### Unit I Elasticity

Elasticity - bending of beams - expression for bending moment - uniform bending—pin and microscope - theory - twisting couple on a cylindrical wire (Torsion) - expression for couple per unit twist - work done - torsion pendulum - experiment to determine rigidity modulus of a wire using torsion pendulum - Acceleration due to gravity - compound pendulum - theory and experiment.

### Unit II Surface tension

Surface tension - excess of pressure over curved surface - drop weight method - coefficient of viscosity and its dimension. Stokes formula for viscous drag - experiment to determine the coefficient of viscosity of a highly viscous liquid - flow of liquid through a uniform capillary tube - method of dimensions Poiseuille's method.

### Unit III Specific heat capacity

Specific heat capacity - Callendar and Barnes continuous flow method Variation of specific heat capacity of solids with temperature - Variation of atomic heat of solids with temperature - Theory of specific heats - Einstein's theory - Debye's theory

### Unit IV Thermal conductivity

Lees disc experiment to determine the thermal conductivity of a bad conductor (cardboard only) - analogy between heat flow and electric current Weidmann-Franz law - Newton's law of cooling - experimental verification - Experiment to determine the specific heat capacity of a liquid - concept of pressure, volume and temperature of a gas -- expression for mean free path, viscosity, thermal conductivity.

**Unit V Energy resources**

Energy resources - coal, oil and natural gas - energy released in molecular fission and fusion - nuclear reactor - non conventional energy sources - wind energy - tidal energy - wave energy - photo voltaic effect solar cell - solar ponds.

**TEXT BOOKS:**


1. Ubald Raj & G. Jose Robin - Properties of Matter and Optics, Indra Publications, 1st Edition.
2. Ubald Raj & G. Jose Robin - Allied Physics Vol. II (Thermal Physics and Sound), Indra Publications, 1st Edition.


**REFERENCE BOOKS:**


1. N. Sundararajan, George Thomas, Syed Azeez - College Physics Vol. I, United Publishers, 1st Edition.
2. A Ubald Raj & G. Jose Robin - Oscillations, Properties of Matter and Energy Physics and Optics and Spectroscopy - Indra Publication, 1st Edition.
3. Brij Lal - Heat and TYhermodynamics and Statistical Physics, S. Chand & Company, 2010.
4. R. Murugesan - Properties of matter, S. Chand & Company, 2010.

## ALLIED PHYSICS – I (PRACTICALS) (FOR CHEMISTRY)

**(Course Code: 21UCHA32)**

| SEMESTER III | HOURS - 2 | CREDITS - 1 |
|---|---|---|

1. Compound pendulum - Determination of 'g'
2. Uniform bending (Pin & microscope ) - Young's modulus
3. Surface tension - Drop weight method
4. Viscosity - Stoke's method
5. Viscosity - - Constant pressure head method
6. Newton's law of cooling - Verification
7. Newton's law of cooling - speciic heat capacity of a liquid
8. Comparison of viscosities of two liquids
9. Torsion pendulum - Rigidity modulusLee's disc method
   - Thermal conductivity of a bad conductor

**SBE-MATERIALS SCIENCE**
**(For chemistry major students only)**
**(Subject Code: 21USB32)**

| Semester: III | SBE: 6 | Credits: 2 | Hours/W - 2 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will tabulate the chemistry of materials using fundamental theories (K1)
- Explain the superconducting behavior and magnetism in molecular and atomic level (K2)
- Demonstrate and familiarize with semiconductor devices and energy efficient light emitting diodes (K3)
- They will classify semiconducting materials based on their functions.(K4)
- They will categorise different materials in the advancement of energy harvesting system with new materials (K5)
- They will develop new devices for energy energy harvesting and storage. (K6)

**Unit I Electron theory of solids** **6hrs**

Classical free electron theory.Fermienergy.Bandtheory.Zone theory. Differences – conductors, semiconductors and insulators. Concept of hole

**Unit II Superconducting and magnetic materials** **6hrs**

Mechanism and properties of superconductors.Types and applications of superconductors.Magnetism.Para, dia, ferro & antiferromagnetic materials.Molecular magnetism - hysteresis. Applications of magnetic materials

**Unit III SEMICONDUCTING MATERIALS** **6hrs**

Intrinsic and extrinsic semiconductors.P-N junction.Working principle of LED and QLED. Forward and reverse biasing of P-N junction diodes. Variation of Fermi level with temperature and distribution of atoms.Semiconductor quantum dots- advantages and applications.

**Unit IV ENERGY HARVESTING/GENERATING MATERIALS** **6hrs**

Photovoltaic effect- principle of solar energy conversion into electricity. Dye sensitized solar cells. Thin film polymer and Si material for solar energy. Hydrogen production methods. Fuel cells. Elementary ideas about materials used in fuel cell

**Unit V ENERGY STORAGE MATERIALS** **6hrs**

Rechargeable batteries. Materials used – applications - Li-ion battery - Lithium-air and Li-S batteries - Ni-MH battery - Differences between fuel cells – storage batteries. Super-

capacitor materials - Similarities and differences between batteries and supercapacitors. Hydrogen storage materials

**TEXTBOOKS:**


1. Dr. M. Arumugam, Material Sciences, Anuradha Publications.
2. P.K.Palanisamy, Material Sciences, Scitech Publications.
3. Ryan P.O Hayre, Suk-Won Cha and Whitney Colella, Fuel cell fundamentals, John Wiley & Sons (2006)
4. B. Viswanathan, Nano Materials, Narosa Publications (2009)
5. Fuel cells, Bruce E Logan.

## CORE – ORGANIC CHEMISTRY – II (THEORY)

**(Subject code: 21UCH41)**

| Semester: IV | Core: 4 | Credits: 4 | Hours/W - 4 |
|---|---|---|---|

**COURSE OUTCOMES:**

Students will be able to explain the nucleophilic and electrophilic mechanistic approach in aliphatic halogen compounds (K2)

- Apply the physical and chemical properties of aryl halogen compounds in synthetic use. (K3)
- They will infer the chemical reactivity hydroxyl and carbonyl compounds in industrial and synthetic part (K3)
- They will outline usage of synthetically important aryl halogen compounds in synthetic chemistry. (K4)
- Design new reactions with reference to the available naming reactions. (K6)
- Decide the importance of various synthetically active compounds for making new compounds (K5)

**UNIT I Halogen Compounds** **12 hrs**

Aliphatic halogen compounds -General methods of preparation and reactions of monohalogen compounds- Mechanisms of $SN_1$, $SN_2$, SNi, E1, E2 and E1cB reactions - Aromatic halogen compounds - General methods of preparation and reactions of aryl halides - Preparation and reactions of benzyl chloride - Nuclear and side chain halogen compounds – distinction - Preparation, structures and uses of DDT and BHC -Unsaturated halogen compounds – reactions of vinyl chloride and allyl chloride- Comparison of the reactivity of the above halides

***Self study:*** Impact of Fluorocarbons on environment, comparison between aryl and alkyl halides

**UNIT II Hydroxy Compounds and Their Derivatives** **12 hrs**

Aliphatic alcohols - Classification – $1^o$, $2^o$ and $3^o$ alcohols, mono, di- and trihydric alcohols - Reactions of monohydric alcohols - Acidic nature and hydrogen bonding in alcohols-Phenols - Classification-mono, di, and trihydric phenols and examples - General methods of preparation and reactions of monohydric phenols - Influence of nature and position of substituents on acidity of phenols- Thio alcohols - General methods of preparation and reactions - Comparison of acidic nature of alcohols, thio alcohols and phenols

***Self study:*** Reactions of analytical importance of phenols

**UNIT III Carbonyl Compounds 12 hrs**

Aliphatic aldehydes and ketones - Relative reactivity of their carbonyl groups - General reactions of aldehydes and ketones - Mechanisms of addition and condensation reactions - Aromatic aldehydes and ketones - General methods of preparation, reactions and tests - Mechanisms of aldol condensation, benzoin condensation, Cannizarro reaction, Claisen –Schmidt condensation, Knoevenagel reaction, Perkin reaction and iodoform reaction

***Self study:*** Comparative properties of aliphatic and aromatic aldehydes

**Unit IV Carboxylic Acids and Their Derivatives 12hrs**

Aliphatic monocarboxylic acids - Acidic nature and factors influencing the acid strength of carboxylic acids - Aliphatic dicarboxylic acids - Action of heat – Blanc's rule - Action of heat on hydroxy and amino acids, and saturated dicarboxylic acids, Addition to maleic and fumaric acids -Conversion into carboxylic derivatives – acid chloride, amide, ester, anhydride, Hundsdicker reaction and Hell VolhardZelinsky reaction - Ascent and descent of fatty acids - Trans esterification - Arndt - Eistert synthesis, Aromatic mono carboxylic acids - General methods of preparations - Acidity – effect of substitutents in benzene ring

***Self study:*** Aromatic dicarboxylic acids, Tests for carboxylic acids

**Unit V Synthetically Important Compounds 12 hrs**

Preparation, synthetic applications and structure of acetoacetic ester - Preparation and synthetic applications of malonic ester- Preparation and reactions of benzene sulphonic acid- Preparations and uses of saccharin and chloramine-T

***Self study:*** Tautomerism – keto – enol, Nitro and acinitro form, amide –imide, imine – enamine preliminary ideas

**TEXTBOOK:**

M.K. Jain & S.C. Sharma, Modern Organic chemistry, 3rd edition, 2009, Vishal Publishing Co.

**REFERENCES:**


1. Morrison R.T. and Boyd R.N., Organic Chemistry (6th edition), New York, Allyn& Bacon Ltd., (1976).
2. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997). [Textbook]
3. Pine S.H, Organic Chemistry, (4th edition) New Delhi, McGraw- Hill, International Book Company. (1986).
4. Mehta, B. and Mehta.M, Organic chemistry, PHI learning Pvt. Ltd., New Delhi (2012). [Textbook]

## CORE-INORGANIC QUALITATIVE ANALYSIS-II (Micro Level)

**(Subject code: 21UCHP41)**

| Semester: IV | Core :P 4 | Credit : 1 | Hours/W – 2 |
|---|---|---|---|

Micro level qualitative analysis of mixture of salts containing **two anions** and **two cations**.

**Anions:** Carbonate, sulphide, halides, nitrate, borate, chromate, fluoride, oxalate, tartrate, and phosphate.

**Cations:** Lead, bismuth, copper, cadmium, antimony, iron, zinc, cobalt, nickel, manganese, calcium, strontium, barium, & ammonium.

Qualitative examination of Iron, calcium and Magnesium in biological sample (Demonstration only)

**References:**


1. Vogel A. I., Textbook of Qualtitative Inorganic Analysis, 1978, ELBS.
2. V. V. Ramanujam, Inorganic semi micro Qualitative analysis, 3rd edition, 1974, The National Publishing Company.


**Note :**Laboratory manual will be supplied.

## ALLIED PHYSICS – II

**(Course Code: 21UCHA41)**

| SEMESTER IV | HOURS–4 | CREDITS - 4 |
|---|---|---|

**Course Outcomes:** At the end of the course the students will be able to

- understand the basic Principles and application of electricity, optics, electronics and relativity
- Understand the essence of coulomb's law and electric field.
- Understand the differences between self induction and of the coil.
- understand the basic of electronics
- Understand the differences between general and special theory of relativity.

**Unit I Electricity**

Coulomb's law - Electric field - electric field due to a point charge - electric dipole - electric flux – Gauss law - applications - electric field due to a charged conducting sphere (point inside and outside) - uniformly charged cylinder (line charge) - electric potential - potential difference - relation connecting electric field and electric potential at a point - equipotentialsurface.

**Unit II Induction**

Self induction of a coil - calculation of self inductance of a long straight solenoid - alternating current - calculation of average value of alternating current - Phase difference between current and voltage in alternating circuits with resistance only, capacitance only and inductance only - LR circuit - LCR series resonance circuit - LCR parallel resonance circuit.

**Unit III Electronics**

Junction diode - biasing - pn diode equation - volt-amp characteristics - zener diode - experiment - uses - voltage regulator using zener diode - thejunctiontransistor-voltagedividerbiasing-transistoramplifier-CEmodefeedbackprincipleBarkhaysancriterionforoscillations-Colpit'soscillator.

**UnitIV Optics**

Interference-airwedge-Newton'srings-Diffractionoflight-experiment to determine the wavelength of monochromatic light using plane trans- mission grating - polarization - double refraction - Nicol prism - production of plane, circularly, elliptically polarizedlight.

**Unit V Relativity**

Frame of reference - Michelson and Morley experiment - special theory of relativity - Lorentz transformation equation - velocity transformation equations - relativistic velocity addition - length contraction - time dilation - variation of mass with velocity (Explanation only) - Einstein's mass energy relation.

**TEXT BOOK:**


1. Ubald Raj & G. Jose Robin - Allied Physics Vol. I - Indra Publication 1st Edition.


**REFERENCE BOOKS:**


1. N.Sundararajan, George Thomas, Syed Azeez - College Physics Vol. II United Publishers, 1st Edition,2009.
2. N.Sundararajan, George Thomas, Syed Azeez - College Physics Vol. III United Publishers, 1st Edition,2009..
3. A.Ubald Raj & G. Jose Robin - Relativity, Wave Mechanics and Nuclear Physics, Indra Publication 1st Edition,2009.
4. N.Subramanyam, Brij Lal, M.N. Avadhanulu - A Textbook of Optics, S.Chand & Company Ltd., 23rd Edition,2006.

## PRACTICALS (CHEMISTRY – ALLIED PHYSICS – II)

**(Course Code: 18 UCH A42)**

| SEMESTERIV | HOURS-2 | CREDITS - 1 |
|---|---|---|

1. Grating - Obliqueincidence
2. Airwedge - Thickness of awire
3. Seriesresonance
4. Parallelresonance
5. Newton'sRings
6. Zener diodecharacteristics
7. Dioderectifier
8. Single stageamplifier
9. Colpit'sOscillator
10. Transistor characteristics – CE mode

**Elective- THERMODYNAMICS AND SOLID STATE**

**(Subject code : 21UCHE41)**

| Semester: IV | Elective: 1 | Credits: 4 | Hours/W - 4 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will identify the principles of heat movement in any natural process (K1)
- They Will examine the structure of unknown solid crystals and suggest their regularity.(K3)
- They will classify and explain the principles of thermodynamics (K4)
- They will explain spontaneity and non spontaneity of processes (K2)
- Students will analyse a given solid crystal using X-ray diffraction data (K5)
- Design new solid crystals with desired physical and chemical properties (K6)

**Unit I Thermodynamics – I** **12hrs**

Introduction – various forms of energy – scope of equilibrium therodynamics - Thermodynamic systems, surroundings and walls - Thermodynamic properties – extensive and intensive properties - Thermodynamic state – state variables or functions - Thermodynamic processes -Zeroeth law and concept of temperature - Thermodynamic work (w) – general expression for w – free expansion – expansion against constant pressure – reversible expansion- Thermodynamic heat (q) – w and q as path functions – exact and inexact differentials - First law of thermodynamics (i) as law of conservation of energy (ii) in terms of change ininternal energy (U) – U as a state function – w in reversible and irreversible evaporation and condensation -Heat capacity – Cp and Cv of gases – variation with temperature – molar heat capacities – relation between Cp and Cv for ideal gas – Cp and Cv as state functions - Enthalpy (H) – DH in physical and chemical processes – Bomb calorimetry – calculation of DH using Hess law – bond energy – variation of H with temperature (Kirchoff equation)

**Unit II Thermodynamics – II** **12hrs**

Application of First law to an ideal gas - Calculation of w, q and DU in isothermal and adiabatic processes -Joule – Thomson (J.T) effect – μJT of ideal gases and real gases – inversion temperature for van der Waals gases and its significance - Second law - Conversion of heat into work – Clapeyron's restatement of Carnot's ideas for ideal gases – thermodynamic efficiency – Carnot theorem – thermodynamic scale of temperature - Spontaneous processes – need for II law – Kelvin-Planck statement and Clausius statement of II law - Concept of entropy (S) – S as state function – "isolated system" – Clausius inequality for systems other than "isolated system" - S and spontaneity - Calculation of DS for ideal gases and for physical changes - S as a measure of (i) randomness (ii) probability.

**Unit III Thermodynamics – III** **12hrs**

Conditions for material equilibrium - At constant T and P – Gibbs energy (G) – G as state function - At constant T and V – Helmholtz energy (A) – A as state function - Change in A and G - A as a maximum work for a reversible isothermal process - G as non-PV work for reversible isothermal process at constant P – relation between A and G - A and G as criteria for spontaneity - Variation of G with P at constant T for a pure substance in one phase – evaluation of G for ideal gases - Concept of fugacity, activity and activity coefficient with respect to gases - Variation of G with T at constant P – Gibbs-Helmholtz equation and its application - Clapeyron equation, Clausius – Clapeyron equation and applications - G in chemical changes - Reaction isotherm – thermodynamic equilibrium constant and its significance.- Standard Gibbs energy change – prediction of reaction yield and reaction feasibility - van't Hoff equation for gas phase reactions- An elementary idea of partial molar quantities and chemical potential - Third law – Nernst heat theorem leading to III law – III law entropies – calculation of S of chemical reactions.

**Unit IV Solid state – I** **12hrs**

Characteristics of solids - Crystals, crystallography, unit cell, space lattice - Crystal forms and crystal lattices - First law of crystallography (Steno's law) - Lengths and axes required to define unit cell -Seven crystal systems and their conventional cell axes and angles - Cube – Simple cubic, f.c.c and b.c.c lattices- Naming of crystal planes – law of rationality of indices (Hauy's law) – Weiss coefficients and procedure for finding Miller indices - Spacing between lattice planes from X-ray diffraction -Diffraction pattern - Two approaches of viewing the origin of observed diffraction pattern – Laue equations & illustration using primitive cubic unit cell – Bragg equation - Total scattering intensity related to the periodic structure of electron density in the crystal -Experimental methods – Powder method – Rotating crystal method - Internal structure analysis of NaCl and KCl crystals - Determination of Avogadro number from crystal studies.

**Unit V Solid state – II** **12hrs**

Binding energy of ionic crystals - Cohesive energy and lattice energy - Theoretical calculations of the lattice energy – The Born – Mayer potential, Madelung energy and Madelung constant – The Born Lande (BL) equation - The Born Haber (BH) cycle – BH cycle for NaCl and calculation of the lattice energy. The structure of metals: The closest packing spheres (CCP, HCP, BCC). Heat capacity of solids. Imperfections in solids – Stoichiometric (Schottky and Frenkel defects) and non-stoichiometric (metal excess and metal deficiency) defects. New materials: Fullerenes, clays and zeolites – structure and applications.

**TEXTBOOKS :**


1. J. Brockington, Peter Stamper and David Browning, Physical chemistry for higher
2. education, Longmann, 1985
3. Peter Atkins and Julio de Paula, Atkin's Physical chemistry, Oxford University Press.
4. K.J.Laidler and J.H. Meiser, Physical chemistry, CBS.
5. CNR Rao, University general chemistry, Macmillan, 1986 print
6. S.H. Maron and C.F. Prutton, Principles of Physical Chemistry, Oxford & IBH Publishing Co. Pvt. Ltd.
7. Puri, Sharma and Pathania, Principles of Physical chemistry, 2001, ShobanLalNagin& Co., Vishal.

**Elective- INDUSTRIAL AND ENVIRONMENTAL CHEMISTRY**

**(Subject code : 21UCHE41)**

| Semester : IV | Elective : 1 | Credits : 4 | Hours/W - 4 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will explain the functioning of of glass, ceramic, sugar and paper industries (K1)
- Students can explain the sources and effects of different types of pollution. (K2)
- They can apply their expertise in the industrial field (K3)
- They can select suitable raw materials for the preparation of glass, paper and cement products (K4)
- Can act as agents to fight against environmental degradation (K5)
- Will be able to fabricate materials using clay and other fillers. (K6)

**Unit I Glass Industry** **12hrs**

Physical properties of glass. Chemical properties of glass. Manufacture of glass- raw materials, chemical reactions, formation of barch materials, melting, shaping, annealing and finishing. Types of glass-flint glass, bottle glass, pyrex glass, optical glass, fibre glass, coloured glass, glass wool and glass laminates.

**Unit II Ceramic Industry** **12hrs**

What are ceramics? .permeable and impermeable wares. Manufacturing process-raw materials-grinding of raw materials, mixing or preparation of bodies, filtering, kneading, throwing, jollying, slit casting, pressing, drying, firing glazing and decorating. Applications of colours to pottery. Porcelain and china clay.

**Unit III Paper and Sugar Industries** **12hrs**

Paper industry - Raw materials - Manufacture of pulp-mechanical process, chemical process -Manufacture of paper-beating, refining, filling, sizing and colouring - Calendaring-Manufacture of hard board. Sugar industry -Manufacture of sugar-extraction of juice, purification of juice, defecation, sulphitation and carbonation, concentration, crystallisation, separation of crystals, drying, refining and grading of sugar crystals - Manufacture of sucrose from beet root.

**Unit IV Air Pollution** **12hrs**

Composition of air. Structure of atmosphere. Sources of air pollution-gaseous pollutants. Greenhouse effect. Global warming. Theory of acid rain-adverse effects of acid rain. Depletion of ozone layer and its mechanism, effects of ozone depletion. Photochemical

smog-components of photochemical smog. Effects of photochemical oxidants on human beings and plants. Control of air pollution.

**Unit V Water and Soil Pollution** **12hrs**

Water pollution- Types of water pollutants - Sources of water pollution - Adverse effects of water pollution- Treatment of sewage and effluent water. Soil pollution - Composition of soil sources of soil pollution - Adverse effects of soil pollution - Treatment of soil pollutants - Basic knowledge about noise pollution.

**Reference**

1. Industrial Chemistry. B. K. Sharma.

**SBE - EVERYDAY CHEMISTRY**

**(For other major students)**

**(Subject Code: 21 USB 41)**

| Semester : IV | SBE : 5 | Credits : 2 | Hours/W : 2 |
|---|---|---|---|

**COURSE OUTCOMES:**

- They can train others to prepare the substances like soaps, detergents etc., (K3)
- They will talk about the advantages of certain substances in our regular life (K2)
- They will assess the quality of different day care substances available in the market. (K4)
- They can modify the important chemical substance as per their requirements. (K5)
- Describe the preparation of many chemicals which are important to our day to day life (K1)

**Unit I Matter and Energy** **6hrs**

Introduction- Need for chemical studies-Chemical substances useful to men. Matter-Definition of matter- states of matter- Elements, atoms and molecules- Mixtures and pure substances- Change of matter around us. Energy-Nature of molecular motion-Forms of energy-Energy and matter-Kinetic and potential energies – Law of conservation of energy.

**Unit II Binary System** **6hrs**

Solutions- Solvent, solute and solutions- Filtration- Distillation- Dilute, concentrated, saturated and super saturated solution- Colligative properties- Antifreeze in automobiles.

**Unit III Acids and Bases** **6hrs**

Introduction- Acids- Characteristics of acids- Action of acids on metals- Bases-Characteristics of bases-Antacids- Salts- Characteristics of salts.

**Unit IV Everyday applications of Chemistry-I** **6hrs**

Chemistry of water- Water in our body- Principal functions of water in our body Water and digestion-Chemistry of food and nutrition- Carbohydrates and their biological functions-Proteins and their biological functions- Chemistry of digestion-Chemistry of Drugs and medicines- Antiseptics- Disinfectants- Laxatives- Anaesthetics.

**Unit V Everyday applications of Chemistry-II** **6hrs**

Chemistry of cosmetics- Face creams- Face Powder-Soaps and Shampoos- Chemistry of fuels- Solid fuel-Coal and kinds of coal-Water gas-Complete and incomplete combustion of fuels.

**Text books.**


1. Maurice R. Ahrens, Norrish F. Bush & Ray K. Easley, Living chemistry, 1955, Ginn and Company.
2. P.S. Kalsi, M. R. Manrao, Textbook of Applied Chemistry, Lalyani Publishers.

## CORE – ORGANIC CHEMISTRY – III (THEORY)

**(Subject Code : 21UCH51)**

| Semester : V | Core : 7 | Credits : 4 | Hours/W - 4 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will tabulate the importance of nitrogen compounds (K1)
- They will explain the preliminary ideas in fused cyclic systems (K2)
- They will illustrate the fundamental concepts of pericyclic reactions (K3)
- They will summarize the importance of redox reagents in organic synthesis (K5)
- They will classify different spectral techniques based on the source they use. (K4)
- They will find and apply suitable techniques for the quantitative and qualitative analysis of chemicals in laboratories and in industries. (K6)

**UNIT I Nitrogen Compounds 12 hrs**

Aliphatic nitro compounds -General reactions-acidic nature of α- hydrogen atom, reduction. Aromatic nitro compounds - General methods of preparation and reactions. Aliphatic amines - Classification – $1^o$,$2^o$ and $3^o$ amines - General methods of preparation and reactions of 1oamines. Aromatic amines -General methods of preparation and reactions. Comparison of basic strength of aliphatic and aromatic amines. Preparation and reactions of diazomethane. Reactions of benzene diazonium salt.

***Self study: Commercial*** methods of preparation, structure and estimation of urea

**Unit II Pericyclic Reactions 12hrs**

Fundamental concepts of concerted reactions. Classification of pericyclic reactions. Woodward-Hoffmann rules. FMO and MO correlation diagram methods to electrocyclic (1,3 - butadiene) and cycloaddition reactions (2+2 additions). Sigmatropic rearrangements – Cope rearrangement

***Self study: Electrocyclic***and Cycloaddition reactions of 4n+2 system

**Unit III Condensed Systems 12hrs**

Polynuclear compounds. Binuclear compounds -Synthesis, reactions and structure of naphthalene -Structural elucidation of naphthalene -Preparations and reactions of naphthols and naphthoquinones. Trinuclear compounds - Reactions of anthracene - Preparations and reactions of anthraquinone - Preparation and reactions of anthracene. Comparison of benzene, naphthalene and anthracene based on their resonance energy

***Self study:***Isolation of naphthalene and anthracene from petroleum products

**Unit IV Redox Reagents 12hrs**

Periodic acid ($HIO_4$).Ozone ($O_3$).Lead Tetra Acetate (LTA).Selenium Dioxide ($SeO_2$). Osmium Tetroxide ($OsO_4$). Lithium Aluminium Hydride

(LAH).SodiumBoroHydride (NaBH).Stannous Chloride ($SnCl_2$). Phase transfer catalyst. N-Bromo Succinimide (NBS)

***Self study:*** Preparation of above listed reagents

**Unit V UV – Visible and Infrared Spectroscopy 12hrs**

Ultra violet – visible spectroscopy - Chromophore, auxochrome, bathochromic shift, hypsochromic shift, hyperchromic effect and hypochromic effect - Various types of electronic transitions and their relative energies – allowed and forbidden transitions with respect to carbonyl group and olefinic bond - Effect of solvent polarity on max - Woodward-Fieser empirical rules – calculation of $\lambda$ max for conjugated dienes and unsaturated ketones. Infrared spectroscopy - Hooke's law - Vibrational frequency of a bond and bond strength- Modes of vibrations and their relative energies - Sampling techniques for solids, liquids and gases - Positions of IR absorption frequencies for functional groups like aldehyde, ketone, alcohol, acid and amide - Factors affecting the frequency of absorption – conjugation (resonance effect), inductive effect and hydrogen bond - Finger print region.

***Self study:*** Instrumentation of UV – Visible and IR spectroscopy

**TEXTBOOKS :**

**Units I & III**

1. M.K. Jain & S.C. Sharma, Modern Organic chemistry, 3rd edition, 2009, Vishal Publishing Co.

**Unit II**

1. Depuy C H and Chapmann, Molecular reactions and Photochemistry, Prentice-Hall of India, New Delhi, 1988
2. Ian Fleming, Pericyclic Reactions, Oxford Science Publications, Cambridge, 1999

**Unit IV**

1. V.K.Ahluwalia, Organic Reaction Mechanisms, 3rd edition, 2007,Narosa Publishing House

**Unit V**

1. Y. R. Sharma, Elementary organic spectroscopy, S.Chand& company Ltd.

**REFERENCES:**


1. Morrison R.T. and Boyd R.N., Organic Chemistry (6th edition), New York, Allyn& Bacon Ltd., (1976).
2. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997). [Textbook]
3. Pine S.H, Organic Chemistry, (4th edition) New Delhi, McGraw- Hill, International Book Company. (1986).
4. Mehta, B. and Mehta.M, Organic chemistry, PHI learning Pvt. Ltd., New Delhi (2012). [Textbook]

**Core- INORGANIC CHEMISTRY –III**

**(Subject code: 21UCH52)**

| Semester : V | Core : 6 | Credits : 4 | Hours/W – 4 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will define the theories, list the nomenclature and explain the isomerism of coordination compounds (K1)
- Students will gain the ability to explain the structure and nature of bonding of inorganic compounds (K2)
- Students will demonstrate the importance of transition and inner transition elements (K3)
- Students will get aware of applications of nanomaterials and fundamentals of supramolecular chemistry to solve many problems. (K4)
- Students will recommend nano materials for the energy conserving process. (K5)
- Students will apply their skills in the estimation of metal ions by gravimetric method. (K6)

**Unit I Coordination Chemistry-I** **12hrs**

Introduction – molecular or addition compounds. Double salts and co-ordination compounds – comparison.Co- ordination compounds-acceptors and donors (ligands), types of ligands.Werner's co-ordination theory-postulates and limitations.Chelation and its application. Stereochemistry of coordination compounds with respect to coordination number 2 to 6. Nomenclature of co-ordination compounds. Isomerism in co-ordination compounds - Ionization and hydrate isomerism - Co-ordination isomerism, linkage isomerism and co-ordination position isomerism - Polymerization isomerism - Geometrical and optical isomerism – four and six co-ordination - Sidgewick concept, limitations and EAN rule.

**Self-study:**Jorgenson's chain theory for coordination complexes

**Unit II Chemical Bonding – II** **12hrs**

Wave mechanical principles involved in the treatment of VBT and MOT -The valence bond theory - Formation of $H_2$ molecule - VSEPR theory and geometry of $H_2O$, $NH_3$, $CH_4$, $BF_3$, $PCl_5$, $SF_4$, $SF_6$, $IF_5$, $IF_5$, $ClF_3$, $ICl_2^-$ Geometry of $CO_3^{2-}$, $SO_4^{2-}$and $NO_3^-$ .Molecular orbital theory - Linear combination of atomic orbital method (LCAO) as applied to $H_2$ molecule - BMO and ABMO - MO diagrams for diatomic homo-nuclear species – $H_2$, $H_2^+$ , $He_2$ ,$He_2^+$ , $Li_2$, $Be_2$, $B_2$ , $C_2$, $O_2, O$, $O_2^+$, $O_2^-$ , $O_{22}^+$, $O_{22}^-$ and $F_2^-$ Bond order – Prediction of their existence and its correlation with stability - MO diagrams for hetero nuclear molecules – CO, NO, CN and HF - MO diagram for $BeH_2$ and $NH_3$. Comparison of VBT and MOT

**Self-study:**Octet rule, resonance, formal charge and hybridization

**Unit III d-Block and f-Block Elements** **12hrs**

Name and electronic configurations – first series of transition elements, lanthanides and actinides.Vanadium - Extraction of vanadium and uses - Polyvalency of vanadium. Titanium - Extraction of titanium and uses. Lanthanides - Oxidation state, colour, magnetic properties and stability - Separation of lanthanides - Lanthanide contraction – causes and consequences - Uses of lanthanides and their compounds – shift reagents. Actinides – Actinide series - Oxidation state and their relative stabilities - Comparison of lanthanides and actinides. Transuranic elements.

**Self-study:**The position of lanthanides and actinides in the periodic table. The minerals of lanthanides and actinides and their occurrences in India.

**Unit IV Nanoscience and Supramolecular Chemistry** **12hrs**

Introduction to nanomaterials–Aspect ratio- Dimensions of nanomaterials: 0D, 1D and 2D - Carbon nanostructures–Fullerenes, CNTs and graphene. Synthesis of nanomaterials -sol-gel, solvo/hydro thermal, chemical vapour deposition and electrochemical deposition, sonochemical and coprecipitation method - Metal and Metal oxide nanoparticles – Ag, Au, $Fe_2O_3$, ZnO and $TiO_2$. Characterization technique – SEM and TEM.Properties of nanomaterials- optical, electrical, magnetic, mechanical and electrochemical.Applications of nanomaterials in various fields.Supramolecular chemistry – Definition, various types of non-covalent interactions. Host-guest chemistry – Types of guests. Molecular hosts, self-assembly and supramolecular devices

**Self-study:**Bulkvsnanomaterials, high surface to volume ratio, quantum structures and quantum confinement

**Unit V Gravimetric Methods of Analysis** **12hrs**

Fundamental requirements of precipitation.Mechanism of precipitation- supersaturation, nucleation and crystal growth.Factors influencing particle size.Organic and inorganic precipitants - Specific and selective precipitants. Co-precipitation – surface adsorption and occlusion - Errors due to coprecipitation. Precipitation from homogeneous solution. Post precipitation. Digestion of the precipitate.Filtration and washing. Drying and weighing.

**Self-study:**Ostwald ripening, common ion effect, super saturation and relative supersaturation.

**References:**


1. B.R. Puri and L.R. Sharma, Principles of Inorganic chemistry, 2006, Milestone Publications.
2. Albert Cotton, Wilkinson, Basic Inorganic chemistry, 3rdEdn, 2007, John Wiley Pvt.Ltd.
3. J.E. Huheey, Inorganic chemistry, Principle of structure and reactivity. 4thEdn ,1996, Pearson Education.

4. J.D.Lee, Concise Inorganic Chemistry, 5th Edn,1996, Blackwell Pub.Com.
5. D.E. Shriver, P.W. Atkins, Inorganic chemistry, 5th Edn,2010, Oxford Univ. Press.
6. R.D. Madan, Principles of Inorganic chemistry, Revised Edn, 2011, S.Chand& Co Ltd.
7. Vogel A. I., Textbook of Quantitative InorganicAnalysis,ELBS,1978
8. M.A.ShahTokeer Ahmed, Principles of nanoscience and nanotechnology, 2011, Narosa publications.
9. B.Viswanathan, Nano Materials, 2011, Narosa publications.
10. T.Pradeep, "Nano: The essential", 2007, Mc-Graw-Hill education.
11. J.M.Lehn, Supramolecular Chemistry, Concepts and Perspectives, 1995, VCH; Weinhein.
12. J.W.Steed, J.L.Atwood, Supramolecular Chemistry 2000, John Wiley & Sons Ltd, New York.

## Core-PHYSICAL CHEMISTRY – I

**(Subject code: 21UCH53)**

| Semester: V | Core : 5 | Hours:4 | Credits : 4 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students can describe the distribution of velocities for the particles in a gas sample and what factors affect this distribution. (K1)
- List and explain several technological applications of colloids. (K2)
- Identify the types of intermolecular forces experienced by specific molecules based on their structures (K3)
- Constructs phase diagrams for single and multi-component systems (K5)
- Infer how changing the concentration, volume, or temperature of a system at equilibrium affects the equilibrium position (K4)
- They will formulate phase diagram for any system with the knowledge of phase transformation with temperature (K6)

**Unit I: Gaseous State** **12hrs**

Kinetic molecular gas model. Assumptions made to describe an ideal gas. Maxwell – Boltzmann distribution of molecular velocities (a qualitative discussion only) – its graphical representation and salient features – effect of temperature – most probable, mean and r.m.s velocities and their calculation – experimental verification of the distribution law. Kinetic equation for gases (PV = mnc2/3) (derivation not required). Collision properties – collision diameter, collision frequency, collision number, mean free path (λ).Viscosity of gases – relation between η and λ. Principle of equipartition of energy – Average translational kinetic energy per degree of freedom.Deviation of gases from ideal behaviour – compressibility factor as a function of P - van der Waals equation.

**Self Study:** Boyle's law, Charle's law, Avagadro's law, ideal gas equation, Graham's law of diffusion, Dalton's law of partial pressures.

**Unit II: Liquid State and Colloidal State** **12hrs**

Liquid state - Structural differences among solids, liquids and gases - Liquid crystals – Smectic, nematic and cholesteric liquid crystals – swarm theory – applications of liquid crystals. Colloidal state-Distinguishing characteristics of colloids, suspensions and solutions - Types of colloidal dispersions - (i) Optical properties of suspensoids – Tyndall effect, explanation and theory due to Gustau Mie – Determination of diameter by minimum intensity method, transmission method (ii) Kinetic properties – Brownian motion & Einstein's mathematical consideration – sedimentation and determination of radius.(iii) Electrical properties – Helmholtz and diffuse double layers – electro kinetic or zeta potential – electrophoresis and its applications – stability of suspensoids - Coagulation – methods of

coagulation – Hardy Schultz law – Hofmeister series - Protective colloids – protective action – gold number – applications - Emulsions – classification, preparation, identification - Gels – preparation – properties (thixotropy, syneresis and imbibition) - Donnan membrane equilibrium.

**Self Study:** Different states of matter, isotropic and anisotropic properties of solids, dispersed phase, dispersed medium, different colloidal systems with examples.

**Unit III : Molecular properties & Surface Chemistry** **12hrs**

Molecular forces - Polar and non-polar molecules - dipole moment Dipole – dipole, dipole – induced dipole, induced dipole – induced dipole forces - Hydrogen bond – conditions for formation – intermolecular and intramolecular hydrogen bonding – effect of hydrogen bonding on melting point, solubility, physical state – unique properties of water. Molecular properties -Electrical properties: electrical polarization of dielectrics and polarisability – Clausius-Mossotti equation – orientation of dipoles in an electric field and Debye equation Dipole moment - Applications of dipole moment studies - estimation of ionic character, calculation of bond moments, distinguishing geometrical isomers and o-, m-, p- isomers, study of shapes of simple triatomic molecules. Influence of resonance on dipole momentSurface Chemistry-adsorption on solids-types of adsorption-differences between physisorption and chemisorption -Adsorption isotherms- Freundlich Adsorption isotherms-Langmuir Adsorption isotherms.

**Self Study:** Pure covalent bond, polar molecules, dipole moment, adsorbent, adsorbate with examples.

**Unit IV: Phase Equilibria** **12hrs**

Phase equilibrium -Basic concepts – phase, number of components, degrees of freedom - Gibbs phase rule - Phase diagram and discussion - (i) water system (ii) sulphur system (iii) Pb-Ag system (iv) Sn-Mg system (v) NaCl-$H_2O$ (freezing mixture) (vi) Fe$Cl_3$-$H_2O$ (System with congruent melting compounds) (vii) $Na_2SO_4$-$H_2O$(System with incongruently melting hydrates i.e peritectic change)

**Self Study**: Homogeneous system and heterogeneous system with examples. Mixtures.

**Unit V: Chemical Equilibria** **12hrs**

Chemical equilibrium . Equilibrium constant and need for its knowledge. The thermodynamic equilibrium constant.Kp and Kc for gaseous reactions. Properties of equilibrium constant.Equilibria in gaseous systems and Le Chatlier principle (i ) Decomposition of HI,P$Cl_5$ and ammonia (ii) the phosgene equilibrium – relation between formation constant and dissociation constant – effect of inert gas on equilibrium. Equilibrium constant for heterogeneous reactions (i) dissociation of cupric oxide (ii) carbon disulphide equilibrium – Effect of pressure. Variation of Ka, Kp and Kc with temperature.

**Self Study:** reversible and irreversible reactions, equilibrium, forward and backward reactions, extent of a reaction.

**TEXTBOOKS:**


1. P.L Soni and D.P. Dharmarha, Textbook of Physical Chemistry, 1980 ed, Sultan Chand & sons.
2. S.H. Maron and C.F. Prutton, Principles of Physical Chemistry, Oxford & IBH Publishing Co. Pvt. Ltd.
3. Puri, Sharma and Pathania, Principles of Physical chemistry, 2001, ShobanLalNagin& Co., Vishal
4. Philip Matthews, Advanced chemistry, Low price ed. 1996, Cambridge University press.

## Core - PHYSICAL CHEMISTRY – II

**(Subject code: 21UCH54)**

| Semester : V | Core : 8 | Credits : 5 | Hours/W - 5 |
|---|---|---|---|

**COURSE OUTCOMES:**

- The students will be able to identify different types of electronic excitations in a molecule (K1)
- Predict the applications and buffer actions of various solutions (K3)
- Assign the point group of any molecules (K5)
- Explain the basic principles of wave mechanics (K2)
- Calculate the stability of molecules. (K5)
- They will collect, accurately record, organise, interpret and draw conclusions from spectral data. (K6)

**Unit I: Biophysical Chemistry of Acids & Bases** **15hrs**

Strength of acids and bases – Basic strength of solvent – Dielectric constant of the solvent – effect of structure on the strength of acids – meaning of strength of acid – titration does not reflect the strength of an acid. Acid – base equilibria in water – LMA – The ionization of water – The equilibrium constant and ionization constant of water. The concept of pH – place of various materials in the pH scale – pOH.Ionisation of weak acids and weak bases – dissociation constants – pKa & pKb. Hydrolysis of salts ($CH_3COONa$, $NH_4Cl$, NaCl).Effect of salts upon the dissociation of acids.Buffers – The Henderson – Hasselbalch equation – buffer capacity – The good buffers. Titration curves of weak acids, strong acids and polybasic acids with a strong base. pH dependent function and structure of biomolecules (ionization of amino acids, ionization of proteins, biological activity of proteins). Biologically important buffers.

**Self Study:** pH, pH scale, acid base concepts

**Unit II: Group Theory** **15hrs**

Symmetry and importance of symmetry aspects.Geometry of different types of molecules with and without lone pair of electrons. Symmetry elements and associated symmetry operations.Definitions and examples - Axis of rotation(Cn) – order of C - Plane of reflection (σ) – σ v, σh and σd - Centre of inversion (i) - Rotation – reflection axis (Sn) – examples - Identity (E) - Knowledge of polarity and chirality from symmetry elements. Successive Cn, **σ** and Sn operations. Mathematical group – Characteristics of a group – construction of group multiplication table (GMT) for $H_2O$ and $NH_3$ – Abelian and non - Abelian groups. Point groups – Schoenflies notations and subscripts – systematic procedure for identification of molecular point groups.

**Self Study:** Draw the structure simple molecules like water, ammonia, carbon di oxide, benzene, boron tri fluoride, Hydrogen peroxide (cis and trans). Xenon tetra fluoride, etc.

**Unit III: Quantum Chemistry** **15hrs**

Dynamic variables- postulates of classical mechanics-conservation laws-coordinate systems-Newtonian equation of motion- Inadequacy of classical physics - Blackbody radiation – Wein's equation – Rayleigh - Jeans equation – Planck's equation - Photoelectric effect – Einstein equation and the quantization of energy, work function, threshold energy – Dual theory of radiation. The foundations of Quantum Mechanics - The wave nature of electrons – Prince de Broglie concept and wavelength - Heisenberg uncertainty principle in different forms - Development of Schrodinger wave mechanics by analogy with wave theory of electromagnetic radiation – equation for a wave traveling in one direction – eigen function or wave function –Hamiltonian time independent Schrodinger equations (Derivations not expected) – Eigen equation - Born interpretation of $\Psi$ – Probability and probability density of electron - Normalisation and normalized eigen functions - Q.M. postulates – linear operators, commuting operators, Hermitian operators, orthogonality of wave functions - Q.M. of a simple system – The free particle.

**Self Study:** Quantum theory, electromagnetic wave

**Unit IV: Spectroscopy-I** **15hrs**

Electromagnetic radiation- quantization of energies in molecules ( translational, rotational, vibrational and electronic). Microwave spectroscopy- condition- theory- selection rule- effect of isotopic substitution- application - Calculation of μ and bond length of diatomic molecules. UV visible spectroscopy-conditions- theory of electronic spectrosopy - Types of electronic transitions-Frank-condon principle-predissociation - Dissociation energy –Applications of electronic spectra

**Self Study:** Electromagnetic radiations

**Unit V: Spectroscopy-II** **15hrs**

Infra red spectroscopy-condition-molecular vibration-modes of vibration of linear and non-linear molecules - Diatomic-$CO_2$,$H_2O$- streching and bending vibrations-selection rules - Calculation of force constant-isotope effect - Applications of IR spectra-group frequencies, finger printing and hydrogen bonding. Raman spectroscopy-condition- Rayleigh and Raman scattering - Stokes and Antistokes –difference between Rraman and IR spectroscopy - Rotational Raman spectra-application to covalent compounds-mutual exclusion.

**Self Study:** atomic weight, Isotopes, center of symmetry, conditions to form hydrogen bonding.

**TEXTBOOKS :**


1. P.L Soni and O.P. Dharmarha, U.N.Dash, Textbook of Physical Chemistry, Sultan Chand & sons, 23rd revised edition 2010 reprint .
2. S.H. Maron and C.F. Prutton, Principles of Physical Chemistry, Oxford & IBH Publishing Co. Pvt. Ltd.

3. Puri, Sharma and Pathania, Principles of Physical chemistry, 2001, ShobanLalNagin& Co., Vishal
4. AvinashUpadgyay,KakoliUpadhyay and NirmalenduNath, Biophysical chemistry, Himalaya Publishing House.
5. Philip Matthews, Advanced chemistry, Low price ed. 1996, Cambridge University press.
6. K.J.Laidler and J.H. Meiser, Physical chemistry, First Indian edition, reprint 2006
7. Skoog, Holler and Nieman, Principles of instrumental analysis, 5th edition First reprint 2006. Thomson.
8. C.N. Banwell and E.M. McCash, Fundamentals of molecular spectroscopy, 4th ed. Tata McGraw Hill Publishing 2002 Reprint. Co. Ltd.,

## Core-INORGANIC GRAVIMETRIC ESTIMATIONS (Practical)

**(Subject Code : 21UCHP55)**

| Semester : V | Core :P7 | Credit : 1 | Hours/W - 2 |
|---|---|---|---|

**Gravimetric Estimation of**

1. Barium as barium chromate
2. Barium as barium sulphate
3. Lead as lead chromate
4. Calcium as calcium oxalate monohydrate
5. Nickel as nickel dimethylglyoxime
6. Copper as copper thiocyanate
7. Nickel by gravimetric and copper by volumetric method (mixture)
8. Copper and iron by colorimetric method

**For demonstration only**

1. Sulphate as Barium sulphate 2. Iron as oxide

**Reference:**

1) J.Mendhem, R.c. Denney, D. Barnes, M.J.k.Thomas, Vogel's Text Book of Quantitative chemical Analysis, 6th edition, 2002, Pearson education Ltd.

**Note:** Laboratory Manual will be supplied.

## Core- PREPARATION OF COORDINATION COMPOUNDS (Practical)

**(Subject code : 21UCHP56)**

| Semester: V | Core :P8 | Credit : 1 | Hours/W - 2 |
|---|---|---|---|

**Preparation of**

1. Tetramminecopper (II) sulphate
2. Tris(thoiurea)copper(I) sulphate
3. Potassium trioxalatochromate(III)
4. Hexamminenickel(II) chloride
5. Hexamminecobalt(III) chloride
6. Hexaaquochromium(III)chloride
7. Tetramminecarbanatocobalt(III)nitrate
8. Sodium trioxalatoferrate (III) hydrate

**Applied Experiments** (demonstration only)

1. UV-visible spectral studies of metal nanoparticles and coordination compounds
2. Cyclic Voltammetric studies of nanomaterials and coordination compounds
3. Differential Pulse Voltametry (DPV) and Linear Sweep Voltametry (LSV) studies of nanomaterials.

**REFERENCES :**

1. R. Gopalan, P.S. Subramanian, K. Rangarajan, Elements of Analytical chemistry, Third edition, 2003, Sultan Chand and sons, Educational publishers, New Delhi.

2. R. Gopalan, V. Ramalingam, Concise Coordination Chemistry, 2001, Vikaspublishing House pvt.Ltd.

## CORE – PREPARATION OF ORGANIC COMPOUNDS (PRACTICAL)

**(Subject code: 21UCHP57)**

| Semester : V | Core : 11 | Credit : 1 | Hours/W - 2 |
|---|---|---|---|

**Single stage preparations**

1. Oxidation of an aldehyde
2. Hydrolysis of (i) an ester and (ii) an amide
3. Acetylation of an amine or a phenol
4. Benzoylation of an amine or a phenol
5. Bromination of (i) phenol and (ii) an anilide
6. Nitration of (i) nitrobenzene and (ii) phenol
7. Osazone from glucose

**NOTE:**

Laboratory manual will be supplied

## CORE - ESTIMATION OF ORGANIC COMPOUNDS (PRACTICAL)

**(Subject code: 21UCHP58)**

| Semester : V | Core : 12 | Credit : 1 | Hours/W - 2 |
|---|---|---|---|

**Estimation of**

1. Phenol
2. Aniline
3. Amino Acid

**Demonstration experiments**

1. Estimation of glucose by Bertrend's method
2. Estimation of citric Acid

**NOTE:**

Laboratory manual is supplied

**ELECTIVE - BIOMOLECULES AND PHARMACEUTICAL CHEMISTRY**

**(interdisciplinary)**

**(Subject code: 21UCH51)**

| **Semester: V** | **Elective : 2** | **Credits : 5** | **Hours/W - 5** |
|---|---|---|---|

**COURSRE OUTCOMES:**

- Students will understand the functions of carbohydrates & proteins (K1 & K2)
- They can interpret the structures and analyse the properties of different biomolecules and natural products (K3)
- They can understand the basic idea of Drug Chemistry (K2)
- They can develop fundamental aspects of common diseases.(K1 & K2)
- They will understand the principle behind the estimation of glucose and lipids (K2)
- They will understand the causes and treatment of common infectious diseases (K2)
- They will be able to interpret the data from biochemistry laboratory (K4 & K5)

**Unit 1 Carbohydrates** **15hrs**

Introduction and classification - Epimers and epimerization, anomers ,reducing and nonreducing sugars- Reactions of glucose and fructose- Structures of glucose and fructose – open chain structure , limitations , configuration , mutarotation and ring structure- Interconversion of glucose and fructose and vice-versa- Ascending the series – Kiliani synthesis. Descending the series – Wohl's synthesis- Properties, reactions and structure of sucrose- Structure of maltose and lactose (elucidation not included)- Starch – bonding – amylase – amylopectin – reactions- Structural differences between starch and cellulose- Cellulose derivatives – preparation and uses of cellulose nitrate and cellulose acetate.

**Unit II Heterocyclic Compounds and Amino Acids** **15hrs**

Introduction - Preparations and reactions of furan and thiophene, aromaticity and resonance- Preparations and reactions of pyridine - Preparations and reactions of quinoline. Amino Acids -Introduction and classification– dipolar ion and isoelectric point - General methods of preparation and reactions of amino acids – test for amino acids - Peptide – peptide linkage , nomenclature, variations and polypeptides, End group analysis C - terminal and N - terminal analysis.

**Unit III Alkaloids and Terpenoids** **15hrs**

Alkaloids - Definition, classification, occurrence and extraction - General methods of identification – functional nature of oxygen, functional nature of nitrogen , unsaturation , oxidation and Hofmann exhaustive methylation - Structure and synthesis of coniine, piperine and nicotine - Terpenoids - Introduction, classification and isolation of terpenoids – isoprene rule - Structure and synthesis of citral, geraniol, camphor and menthol

**Unit IVDrugs, Action of Mechanism and Metabolism of Drugs** **15hrs**

Introduction, Sources of drugs - Pharmacodynamics, Pharmacokinetics & molecular pharmacology - Pharmacophore, chemotherapy - Mechanism of action- drug-receptor

complex- - Chemistry Drug-receptor binding - metabolism of drugs- Absorption of drugs- Routes of Administration.

**UNIT VClinical Chemistry and Common Diseases 15hrs**

Determination of sugar in serum - Folin and Wu's method - o-toluidine method.Sackett's method of determination of total cholesterol. Detection of Diabetes and Anaemia. Infective and hereditary diseases - Insect borne diseases and their treatment - Airborne diseases and their treatment - Water borne diseases. First aid for accidents

Self study: First Aid for Accidents

**TEXTBOOKS:**


1. M.K. Jain & S.C. Sharma, Modern Organic chemistry, 3rd edition, 2009, Vishal Publishing Co.
2. B.S. Bahl and Arul Bahl, Advanced Organic Chemistry, Reprint 2010, S. Chand & Company Ltd.,.
3. JayashreeGhosh, Fundamental concepts of Applied chemistry, Reprint –2008, S. Chand & Company Ltd.,
4. Dr.JayashreeGhosh, A Textbook of Pharmaceutical Chemistry, Reprint 2010. S.Chand& company Ltd.
5. I. L. Finar, Organic Chemistry, Vol.2, 5 th ed., Pearson education, London, 1975.
6. U. Satyanarayana and U. Chakrapani, Essentials of Biochemistry, Reprint 2013, Books and Allied (P) Ltd.,

## ELECTIVE – MEDICINAL CHEMISTRY

**(Subject code: 21UCH51)**

| Semester : V | Elective : 2 | Credits : 5 | Hours/W - 5 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students can name important medicinal plants and medicinal products (K1)
- They can interpret medicinal products for different applications (K2)
- They can develop the habit of an attitude of critical thinking in day today life. (K3)
- They will classify and find reasons for causing some many common diseases.(K4)
- They will prepare their own natural medicines using plant products (K5)

**Unit I Drugs and classifications** **15hrs**

Introduction - Source of drugs - Pharmacodynamics, molecular pharmacology - Pharmacophore, chemotherapy - Classification- chemical classification - Biological classification

**Unit II Mechanism and metabolism of drugs** **15hrs**

Mechanism of action-Action at cellular and extracellular site - Drug receptors and biological responses - Mechanism of different types of drug action - Physical and chemical properties of drugs - Chemical pathways of drugs metabolism-absorption of drugs - Route of Administration

**Unit III Causes and common diseases** **15hrs**

Infective and hereditary diseases - Insect borne diseases and their treatment -Air born diseases and their treatment - Water borne diseases - other diseases-jaundice,asthma,leprosy - First aid for accidents

**Unit IV Pharmaceuticals Drugs** **15hrs**

Sulpha drugs- synthesis of various sulphadrugs ,sulphonamides,sulpha pyridine, sulphadiazine.Antibiotics- classification-Stertomycin, Chloramphenical synthesis-mode of action of antibiotics. Anti malarial drugs (4-aminoquinolinederivatives, chloroquine-synthesis, pharmacological properties, and mode of action. Antipyretics and analgesics – aspirin, paracetamol( synthesis and application). narcotics – morphine, codeine (structure). Tranquilizers, hypnotics, anesthetics – procaine.

**Unit V Medicinal plants** **15hrs**

Introduction – imporatance and uses. Hibisscusrosa-sinesis-constituents and properties. Adathodavasica.Ocimum sanctum. Mangiferaindica .Azadirachtaindica. Phyllanthusniruri and solanumtrilobatum

**Text books**


1. J. Ghosh, A Text Book of Pharmaceutical chemistry, S. Chand Publishing,
2. G.R.Chatwal,synthetic drugs,Himalaya publishing house
3. J. Ghosh, Fundamental concepts of applied chemistry, S.Chand Publishing,

## ORGANIC CHEMISTRY – IV

**(Subject Code : 21UCH61)**

| Semester : VI | Core : 15 | Credits : 5 | Hours/W – 5 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will be able to assess the chemistry of polymers, dyes and their industrial needs (K5)
- Predict the typical approach of molecules in rearrangements (K2)
- Describe how to write mechanisms of some name reactions (K1)
- Apply different analytical tools in predicting molecules (K5)
- have an exposure in environmental benign chemistry (K4)
- Create new polymer composite materials (K6)

**Unit I Polymers and Dyes** **15 hrs**

Basic definitions – monomer – polymer – degree of polymerization.Classification of polymers – thermosetting and thermoplastics. Chemistry of commercial polymers - General methods of preparation, properties and uses of the following – PVC, Orion, Teflon, polystyrene, Nylon-6,6, Nylon-6, PVC, Bakelite, neoprene rubbers, SBR, butyl rubber. Dyes -Theory of colour and constitution - Classification – preparation and uses of Methyl orange, Malachite green, Phenolphthalein, Alizarin and Indigo

***Self study:*** Introduction to biopolymers and biomaterials

**Unit II Molecular Rearrangements** **15 hrs**

Wolff rearrangement. Pinacol – pinacolone rearrangement.Dienone-phenol rearrangement.Beckmannrearrangement.Lossenrearrangement.Favorskiirearrangement.Steven s rearrangement. Neber rearrangement.Friesrearrangement.Benzidine rearrangement

***Self study:*** Classification of molecular rearrangement reactions

**Unit III Name Reactions and Their Mechanisms** **15 hrs**

Birch reduction. Kolbe's Schmidt reaction. Bayer-Villigeroxidation .Mannichreaction.Etard reaction. Dakin reaction. Bouveault – Blanc reaction. Kolbe electrolytic reduction. Michaeladdition. Chichibabin reaction

***Self study:*** Isotopic labelling studies

**Unit IV $H^1$ NMR Spectroscopy and Mass Spectrometry** **15 hrs**

Principle - solvent.Equivalent and non-equivalent protons.Shielded and deshielded protons – anisotropy. Chemical shift and internal reference–TMS-and scales. Peak area and proton counting. Splitting of signals – spin-spin coupling. Mass spectrometry. Principle of mass

spectrometry - Fragmentation pattern - m/z values of various fragments - Nitrogen rule - McLafferty rearrangement - Interpreting the mass spectra of Pentane, Pentane-3-one and 3-methyl butane.

***Self study:*** Instrumentation of NMR spectroscopy and Mass spectrometry

**Unit V Photochemistry and Green Chemistry 15 hrs**

Introduction.Thermal and photochemical reactions - comparison. Naturally occurring photochemical process - examples. Allowed and forbidden transitions. Jablonski Diagram. Photochemical process- photoreduction, photodimerization, photoisomerization and photochemical rearrangements - Definition and example.Norrish type – I & II reactions and mechanism. Introduction - Need for green chemistry - Twelve principles of green chemistry - Selection of appropriate solvents – supercritical carbon dioxide, ionic liquids and water - Solvent free reactions – Deacetylation and saponification

***Self study:*** Microwave Assisted Organic Synthesis

**TEXTBOOKS:**

**Unit I**

M.S. Bhatnagar, A Textbook of polymers Vol 1, First edition, 2004, S. Chand & Company Ltd,

**Unit II & III**

V.K. Ahluwalia & P.K. Parashar, Organic Reaction Mechanism, 2nd Edition, 2005, Narosa Publishing House.

**Unit IV**

1. Y. R. Sharma, Elementary organic spectroscopy, S.Chand& company Ltd.
2. Jagdambasingh, Jaya singh, Photochemistry and pericyclic reactions, Revised second edition, New Age International publishers.

**Unit-V**

V. Kumar, An introduction to Green chemistry, First edition, 2007, Vishal publishers.

**REFERENCES:**


1. Morrison R.T. and Boyd R.N., Organic Chemistry (6th edition), New York, Allyn& Bacon Ltd., (1976).
2. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997). [Textbook]
3. Pine S.H, Organic Chemistry, (4th edition) New Delhi, McGraw- Hill, International Book Company. (1986).
4. Mehta, B. and Mehta.M, Organic chemistry, PHI learning Pvt. Ltd., New Delhi (2012). [Textbook]

**Core- INORGANIC CHEMISTRY –IV**

**(Subject code: 21UCH62)**

| **Semester: VI** | **Core :10** | **Credits : 5** | **Hours/W – 5** |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will be able to ambulate metal-ligand bonding in organometallic compounds and their applications in catalysis and industry (K1)
- Demonstrate the coordination theories and nature of chemical bonding in coordination compounds (K3)
- Explain the kinetics and reaction mechanism involved in the formation of coordination compounds (K2)
- Select suitable spectral methods for the analysis of metal complexes (K4)
- Decide the biological functions of coordination complexes, toxicity, excess and deficiency problems of metals in biological systems.(K5)
- Evaluate the functions of different catalysts in biologically important reactions. (K6)

**Unit I Coordination Chemistry-II** **15hrs**

Valence bond theory (VBT) - Assumptions - Applied to octahedral, tetrahedral and square planar complexes - Limitations - Crystal field theory(CFT) - Assumptions - Splitting of d-orbitals in octahedral and tetrahedral complexes - Crystal field splitting, pairing and crystal field stabilization energies - $\Delta o$& $\Delta$ t - comparison - Factors affecting the magnitude of crystal field splitting - High spin and low spin complexes - Consequences of crystal field splitting - Applications of CFTto octahedral, tetrahedral and square planar complexes - Limitations of CFT. Comparison of VBT and CFT

**Self-study:**Colour and magnetic properties of metal complexes (CFT)

**Unit- II Coordination Chemistry-III** **15hrs**

MO theory-sigma bonding in octahedral complexes. Sigma bonding in octahedral complexes $[CoF6]^{3-}$and $[Co(NH3)6]^{3+}$ . Jahn Teller distortion.Labile and inert coordination compounds.Stability and factors affecting the stability of metal complexes.$S_N1$ – Dissociative mechanism.$S_N2$ –Associative mechanism.$S_N1_CB$ –mechanism.Substitution reactions.Square planar substitution reaction. Factors affecting reactivity of square planar complexes. Trans effect and its series - Theories of trans effect.

**Self-study:**Thermodynamic and kinetic stability of metal complexes

**Unit III Organometallic Chemistryand Catalysts** **15hrs**

Organometallic compounds. Types of organometallic compounds.Hapticity - Ligands in organometallic compounds. 18-Electron rule-applications and limitations.Nature of bonding in metal carbonyls.$\sigma$ and $\pi$ back donation. Zeise's salt. Bonding and structure of mono and poly nuclear – Fe, Co and Ni carbonyls. Organometallic compounds-catalysts - Oxidative addition - Reductive elimination -Hydrogen abstraction - Insertion reaction - Hydrogenation of olefins-Wilkinson's catalyst - Ziegler-Natta catalyst

**Self-study:**Synthesis and properties of metal carbonlys, bridging and terminal carbonlys

**Unit IV Physical Methods in Inorganic Chemistry** **15hrs**

Electronic spectra - Types of electronic transitions -Spin and Laporte selection rules - Spectroscopic ground state term symbol - Microstates -Combined Orgel-energy diagram for $d^1$ and $d^2$ states - Electronic spectrum of[Ti ($\square_2\square$)6]$^{3+}$ and [V(($\square_2\square$)6]$^{3+}$ complex ions - Electronic spectrum of Co(II), Ni(II) and Cu(II) complexes.Spectra of the lanthanides and actinides. Electron paramagnetic spectra - Hyperfine splitting and g-factor - Zero field splitting and Kramer's degeneracy - Applications of ESR spectra to Cu (II) and Mn (II) complexes

**Self-study:**Charge transfer spectra – Ligand to metal and metal to ligand

**Unit V Bio-Inorganic Chemistry and Coordination Polymers** **15hrs**

Essential and trace elements in living system. Haemoglobin -Structural features and functions of Haemoglobin. Cyanide poison.-Carbon monoxide poison. Electrontransfer-Cytochromes.Rubredoxin.Ferredoxin.Photosynthesis-Chlorophyll.Vitamin B12. Iron Inventory and storage in human body. Porous coordination polymers – Metal organic framework (MOF).Synthesis methods – conventional and unconventional.Self-assembly. Application of MOF materials – Catalysis, absorption of gas, storage and sensors

**Self-study:** Biological functions and toxicity of metal ions and role of myoglobin in biological system

**REFERENCES :**


1. B.R. Puri and L.R. Sharma, Principles of Inorganic chemistry, Revised Edn, 2006, Milestone Publications.Albert Cotton, Wilkinson, Basic Inorganic chemistry, 3rdEdn, 2007, John Wiley Pvt.Ltd.
2. J.D.Lee, Concise Inorganic Chemistry, 5th Edn,1996, Blackwell Pub.Com.
3. D.E. Shriver, P.W.Atkins, Inorganic chemistry, 5th Edn,2010, Oxford Univ.Press.
4. J.E. Huheey, Inorganic chemistry, Principle of structure and reactivity. 4thEdn ,1996, Pearson Education.
5. R.S.Drago, Physical methods in chemistry, 1st edition, Philadelphia, W.B. Saunders Company.
6. E.A.V.Ebsworth – Structural methods in Inorganic chemistry, 1st edition, Blackwell scientific publications
7. Bertini, H.B. Lippardans J.S. Valentine, Bioinorganic Chemistry, University Science Books
8. R.D. Madan, Principles of Inorganic chemistry, Revised Edn, 2011, S.Chand& Co Ltd.
9. R.Gopalan, V.Ramalingam, Concise Coordination chemistry, Vikas Publishing House Pvt Ltd.
10. Asim K. Das, Bioinorganic chemistry, Books and Allied (P) Ltd.

## PHYSICAL CHEMISTRY – III

**(Subject code : 21UCH61)**

| Semester : VI | Core : 13 | Credits : 5 | Hours/W - 5 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will be able to discuss the factors that affect the rate of chemical reactions and determine the rate of a reaction(K1)
- Predict the quantum yield and types of reaction (K3)
- Compare the variation of conductance with different factors (K5)
- Explain thermodynamically the operation of a concentration cell, and be able to predict the concentration in the cell based on the cell potential.(K2)
- Identify the differences and similarities of the different types of batteries.(K4)
- They can design and fabricate a series of batteries. (K6).

**Unit I Chemical Kinetics – I** **15hrs**

Thermodynamic feasibility and kinetic feasibility. Fundamental concepts – rate of formation, rate of consumption, extent of reaction and rate of reaction – initial rate and average rate. Conventional methods of measuring rates. Qualitative idea of the factors affecting rate. Empirical rate equations – partial order, overall order – examples of first order, second order, third order, zero order and fractional order reactions – pseudo first order reactions – units of rate constant. Isolation method and initial rate method of determination of kinetic order and rate constant. Integrated rate laws for first order and second order reactions – derivation and discussion – half-life time. Elementary reactions and molecularitY. Kinetic study - First order reactions – dehydration of oxalic acid, inversion of cane sugar, decomposition of aqueous $H_2O_2$, hydrolysis of methyl acetate in aqueous solution, thermal decomposition of azoisopropane - Second order reactions – saponification of an ester by an alkali - Zero order reaction – iodination of acetone in presence of mineral acid.

**Self Study:** Order, molecularity, half life, activation energy.

**Unit II Chemical Kinetics –II and Photochemistry** **15hrs**

Theories of rates of homogeneous reactions - Effect of temperature on reaction rate – Arrhenius rate equation – activation energy – significance and determination of Arrhenius parameters - Collision theory of bimolecular reactions – Lindemann's theory of unimolecular reactions - Simple version of transition state theory of bimolecular reactions - Catalysis – homogeneous and heterogeneous catalysis – auto catalysis – negative catalysis – catalytic poisoning – intermediate compound formation theory and adsorption theory – Biological or enzyme catalysis and discussion of its mechanism characteristics of enzyme catalysis. Photochemistry - Difference between thermal and photochemical reactions - Photon energy –

Einstein energy – Intensity - Lambert's law – Beer's law – Beer-Lambert's law and its limitations - Grotthus and Draper law – Stark &Einstein's law -Quantum yield – low and high quantum yields – experimental determination using uranyl oxalate actinometer - Free radicals and chain reactions – $H_2 + O Cl_2$and $CH_4 + Cl_2$(derivation of rate laws not expected) - Qualitative description of fluorescence and phosphorescence and their mechanism - Chemiluminescence and bioluminescence – Photography

**Self Study:** Homogeneous reactions, heterogeneous reactions with examples

**Unit III Electrolytic Conductance** **15hrs**

Electrical conductance, cell constant and electrolytic conductivity - kappa and its determination.Molar conductivity (λ) and its variation with concentration of strong electrolytes and Kohlrausch's empirical relation. Weak electrolytes – Arrhenius theory – degree of dissociation and its relation to λ – evidence in favour of the theory of electrolytic dissociation – Kohlrausch law of independent migration of ions and Ostwald's dilution law and their applications – experimental verification of Ostwald's law. Drawbacks of Arrhenius theory.Theory of strong electrolytes – relaxation effect – electrophoretic effect – Onsager conductivity equation (derivation not expected). Influence of temperature, solvent and viscosity on conductance. Contribution of individual ions to λ0 – transport number (λ) and ionic mobility (u) – relation between them – determination of't' by Hittorf method and by moving boundary method – Applications of t and u. Conductometric titrations.Applications of conductivity measurement

**Self-Study:** Electrolytes, conductance, conductivity, specific conductance, equivalent conductance, molar conductance.

**Unit IV Electromotive Force (EMF) – I** **15hrs**

Requirements of an electrochemical change.Distinction between electrolytic and galvanic cells. Origin of `potential – standard electrode potential – electrochemical series. Conventions in electrode / half cell representation– half cell reactions - cell representation – cell reaction.Types of electrodes – metal and metal ion, metal amalgam, metal – insoluble metal salt and metal – salt ion electrodes – redox, gas and membrane electrodes – description of hydrogen gas electrode, calomel electrode and glass electrode. Reversible cells and cell reactions. Weston standard cell – measurement of emf – calculation of single electrode potentials. Nernst emf equation and calculation of cell emf. Calculation of $\Delta G^o$, $\Delta H^o$, $\Delta S^o$ and K from emf data.

**Self-Study: Electrode- Cell-emf**

**Unit V EMF – II** **15hrs**

Activity, activity coefficients, mean activity, mean molal and mean molar ionic activity coefficients with regard to solutions. Chemical cell without transference – calculation of

activity and mean activity.Chemical cell with transference – liquid junction potential (LJP) – salt bridge.Concentration cell without transference – calculation of emf.Concentration cell with transference – calculation of LJP and transport number. Potentiometrictitrations. Determination of pH using hydrogen electrode, quinhydrone electrode and glass electrode.Primary and secondary cells.Fuel cells. Commercial cells – Dry cells (Zn, $MnO_2$, alkaline cell, Ni-Cd cell) – Storage batteries (lead storage battery, Edison storage battery). Corrosion – electrochemistry of corrosion. Corrosion inhibitors – corrosion control – use of corrosion inhibitors - sacrificial anode – cathodic protection. Applications of electrolysis: Purification of metals and Electroplating

**Self study:** Electrochemistry, anode, cathode, electrode reactions

**TEXTBOOKS:**


1. P.L Soni and D.P. Dharmarha, Textbook of Physical Chemistry, 1980 ed, Sultan Chand & sons.
2. S.H. Maron and C.F. Prutton, Principles of Physical Chemistry, Oxford & IBH Publishing Co. Pvt. Ltd.
3. Puri, Sharma and Pathania, Principles of Physical chemistry, 2001, Shoban Lal Nagin& Co., Vishal
4. Philip Matthews, Advanced chemistry, Low price ed. 1996, Cambridge University press.
5. K.J.Laidler and J.H. Meiser, Physical chemistry, CBS

## CORE – QUALITATIVE ANALYSIS OF ORGANIC COMPOUNDS (PRACTICAL)

**(Subject code: 21UCHP64)**

| Semester : VI | Core : 16 | Credits : 2 | Hours/W - 2 |
|---|---|---|---|

**Systematic analysis of mono functional organic compounds for**

1. Aliphatic/aromatic nature
2. Saturated/unsaturated nature
3. Elements present and absent (N,S and halogens)
4. Functional group present
5. Confirmation of the functional group by preparing a solid derivative or a colour reaction.

**NOTE:**

Laboratory manual will be supplied.

## CORE- PHYSICAL CHEMISTRY PRACTICAL

**(Subject code: 21UCHP65)**

| Semester : VI | Core : 17 | Credits : 2 | Hours/W – 4 |
|---|---|---|---|

**Electrical and Non – electrical experiments**

1. Determination of Molal depression constant (Kf) of naphthalene and molecular weight of a solid solute (Rast Method)
2. Determination of Integral heat of saturated solution of oxalic acid (solubility method)
3. Determination of Solubility product of calcium hydroxide using common ion effect at tow temperatures
4. Determination of Critical solution temperature (C.S.T) and composition at C.S.T of phenol – water system
5. Determination of Transition temperature of a salt hydrate (thermometric method)
6. Determination of Rate constant of hydrolysis of ethyl acetate catalysed by dilHCl.
7. Determination of Partition coefficient of iodine between CCl4 and H2O and stability constant of the complex KI3
8. Determination of Eutectic temperature and eutectic composition from the experimentally constructed phase diagram of a system involving one eutectic.
9. Determination of Strength of HCl solution using standard NaOH solution (conductometry)
10. Determination of Strength of HCl solution using standard NaOH solution (potentiometry)
11. Determination of Strength of ferrous ammonium sulphate (FAS) solution using standard KMnO4 solution (potentiometry)
12. Verification of Onsager conductivity equation using KCl and determination of the strength of a test KCl solution.
13. Verification of Beer – Lambert's law of KMnO4 and determination of molar absorptivity() at wave length of maximum absorption (max) (for demonstration only)

**NOTE :**Laboratory manual will be supplied.

**CORE – COMPREHENSIVE CHEMISTRY (INTERNAL ONLY)**

**(Subject code: 21UCHS61)**

| **Semester : VI** | **Core : 16** | **Credits : 2** |
|---|---|---|

**This paper contains all the portions studied in the previous semesters. Objective type online test will be conducted. Internal examination only.**

**COMPUTER APPLICATIONS AND ANALYTICAL TECHNIQUES**

**(For internal evaluation only)**

**(Subject code: 21UCHE61)**

| **Semester: VI** | **Elective: E3** | **Credits: 5** | **Hours/W: 6** |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will use C language to solve chemistry problems (K5)
- Gain the ability to apply chemdraw (K4)
- Ability to use chromatography techniques in research (K4)
- They will describe easy way to solve problems using computer languages (K2)
- They will recite the important terms related with computer and analytical techniques. (K1)
- They will be familiarized in analyzingthermoanalytical data and using Chemistry softwares.(K5)

**UNIT I C Programming** **15hrs**

Character set in C and C key words - Variables and constants - Operations and expressions - General structure of 'C' program - Assignment statement- Different forms of if statement- Switch statement – go to statement- Loop structures – while-do while-for statements-Arrays – strings – Library functions – user defined functions- Writing C program using the various features of C language- Determination of /Calculation of (1) Bohr radius (2) Energy of electromagnetic radiations (given: Wavelength or frequency) (3) Enthalpy change using Clapeyron-Clausius Equation (4) Rate constant for a first order reaction (5) pH of a buffer solution (using Henderson's equation)

**UNIT II Chemware** **15hrs**

Introduction to chemware - Drawing chemical structures using chemdraw/chemsketch/chembio office/KingDraw chemical structure editor - Drawing 3-dimensional chemical structures - Analysing structural data - Prediction of properties of compounds- Interpretation of $^{1}H$ and $^{13}C$ NMR details of simple compounds - SMILES coding - Chemical database - Full structure search - Origin tool for data presentation

**UNIT III Thermo and Electro Analytical Techniques** **15hrs**

Thermogravimetric analysis -TGA - Principle and instrumentation of TGA - Derivative thermogravimetry and factors affecting thermogram - TGA of $AgNO_3$and $CaC_2O_4.H_2O$ - Applications of TGA - Differential thermal analysis - DTA - Principle and instrumentation of DTA - Differential thermogram – DTG and TGA curve together - DTA of $CaC_2O_4.H_2O$and simultaneous DTA and TGA of $CuSO_4.\ 5H_2O$ - Applications of DTA - Differential scanning calorimetry- DSC- Principle and instrumentation of DSC - Applications

- DSC curve of polyethylene terephthalate and drug phenacetin- Determination of calcium sulphate hydrates and purity of pharmaceuticals- Principle, instrumentation and applications of eletcrogravimetry

**UNIT IV Adsorption and Partition Chromatography 15hrs**

Introduction - Different types of chromatography - Adsorption chromatography – adsorbents, solvents and solutes - Column chromatography- Stationary phase, common solvents and packing of column - Advantages and disadvantages - Thin layer chromatography - Basic principles and common stationary phases - Methods of preparing TLC plates - Selection of mobile phase, visualization methods and Rf value - Applications of TLC - Paper chromatography - Basic principles, ascending and descending types - Selection of mobile, phase development of chromatograms and visualization methods - Applications of paper chromatography

**UNIT V Gas Chromatography and High Performance Liquid Chromatography 15hrs**

Gas chromatography - Basic principles and different types of GC techniques - Selection of columns and carrier gas - Instrumentation, detectors and RT values - Applications of GC - High performance liquid chromatography -Principles of HPLC - Normal and reversed phases - Selection of column and mobile phase - Instrumentation, detectors and RT values - Applications of HPLC - GC-MS - Principle, instrumentation and applications

**REFERENCES:**


1. Balagurusamy, Programming in C, 5th Edition, Tata McGraw-Hill Education, 2007
2. K.V. Raman, Computers in Chemistry, Tata McGraw Hill, New Delhi, 1993
3. Douglas A. Skoog and Donald M. West, Fundamentals of Analytical Chemistry, 4thEdn, CBS
4. College Publishing, New York, 1982.
5. Instrumental methods of chemical analysis by H. willard, L.Merrit, J.A. Dean andF.A. settle. Sixth edition CBS (1986)
6. Vogel A. I., Text book of Quantitative Inorganic Analysis, 1978, ELBS.

## GREEN CHEMISTRY

**(Subject code: 21UCHE61)**

| Semester: VI | Elective: E3 | Credits: 4 | Hours/W: 6 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will apply 3R principles to reduce the consumption of natural resources (K3)
- They will explain the principles of green chemistry (K1)
- They will try to develop new technology using microwave assisted mechanisms. (K6)
- They will describe the functioning of PTCs. (K2)
- They will do experiments with biocatalysts (K3)
- They will outline applications of sound reactions (K4)

**UNIT I Introduction to Green Chemistry** **15hrs**

Introduction - Green chemistry - relevance and goals,- Anastas' twelve principles of green chemistry -Tools of green chemistry: alternative starting materials, reagents, catalysts, solvents and processes with suitable examples.

**UNIT II Microwave Mediated Organic Synthesis (MAOS)** **15hrs**

Introduction - Microwave activation - advantage of microwave exposure - specific effects of microwave - Neat reactions - solid supports reactions- Functional group transformations - condensations reactions - oxidations – reductions reactions - multi-component reactions

**UNIT III Ionic Liquids and PTC** **15hrs**

Introduction - synthesis of ionic liquids - physical properties - applications in alkylation – hydroformylations – expoxidations – synthesis of ethers – Friedel-craft reactions – Diels-Alder reactions – Knoevengal condensations – Wittig reactions. Phase transfer catalyst - Synthesis – applications

**UNIT IV Supported Catalysts and Bio-Catalysts for Green chemistry** **15hrs**

Introduction.The concept of atom economy.supported metal catalysts – mesoporoussilicas. The use of Biocatalysts for green chemistry-Modified bio catalysts – fermentations and biotransformations – fine chemicals by microbial fermentations – vitamins and amino acids-Baker's yeast mediated biotransformations- Bio-catalyst mediated Baeyer-Villiger reactions – Microbial polyester synthesis

**UNIT V Sonication and Electro Organic Reactions** **15hrs**

Sonication reactions - Introduction.Barbier reaction-Reformatsky reaction- Simmons-Smith reaction, -Ullmann coupling reaction-Wurtz reaction.electroorganic chemistry – introduction – anode, cathode, cell and electrolyte- Kolbe oxidation-Electroreduction reactions.

**References:**


1. Green Chemistry – Environmentally benign reactions – V. K. Ahluwalia. Ane Books India (Publisher). (2006).
2. Green Chemistry – Designing Chemistry for the Environment – edited by Paul T. Anastas & Tracy C. Williamson. Second Edition, (1998).
3. Green Chemistry – Frontiers in benign chemical synthesis and processes- edited by Paul T. Anastas& Tracy C. Williamson. Oxford University Press, (1998).
4. Green Chemistry – Environment friendly alternatives- edited by RashmiSanghi& M. M. Srivastava, Narora Publishing House, (2003).
5. Green Chemistry- V. K. Ahluwalia,; 2nd Ed., Ane Books Pvt Ltd., New Delhi, 2016.
6. Organic electro chemistry by Henning Lund & Ole Hammerich, , 4th edition, Publisher: Marcel Dekker, Inc, New York.

**EXTRA CREDIT COURSES For U. G.**
**Offered By DEPARTMENT OF CHEMISTRY**
**ECC- DAIRY CHEMISTRY**
**(SUB CODE:21UCHECC01)**

| **Semester: I** | **Elective: ECC-I** | **Credits: 4** |
|---|---|---|

**COURSE OUTCOMES:**

- Students will be able to tell about macro and micro structure of milk (K1)
- Have a comprehensive look at the composition of milk, its chemicals, physical and organoleptic properties (K3)
- Determine the important functions of food and milk products (K3)
- Integrate knowledge and day to day life (K4)
- Know the processing of milk (K5)

**UNIT I Milk**

Definition of milk-Constituents of milk-Composition of milk.Physical properties of milk – colour, odour, acidity, specific gravity, viscosity and conductivity-Food and nutritive value of milk

**UNIT II Microbiology of Milk**

Microbiology of milk-Destruction of microorganisms in milk-Pasteurisation – definition, objectives and methods of pasteurization -Use of ionizing radiations – high frequency sound waves.

**UNIT III Milk Preservation**

Preservatives and thickeners used in milk, their detection -Hygienic methods of milk production-Treatment of milk - Cooling milk-Hydrogen peroxide and its role in facilitating milk collections.

**UNIT IV Types of Milks**

Special milks - Definition and preparation of Sterilized milk-Homogenised milk -Flavored milk-Skim milk-Evaporated milk-Sour milk-Imitation milk-Toned milk-Condensed milk.

**UNIT V Milk Products**

Dried milk (milk powder)-Composition-Types of dry milk- Uses of dry milk-Principles involved in manufacture- Roller dried milk powder- Spray dried milk powder.

**TEXTBOOKS:**

1. N.K Roy and D.C. Sen, A Text book of practical Dairy chemistry
2. S.M. Srivastava, Milk and its properties

## ECC- LEATHER CHEMISTRY

**(SUB CODE:21UCHECC02)**
**(For self study only)**

| SEMESTER-II | ECC -2 | CREDITS -4 |
|---|---|---|

**COURSE OUTCOMES:**

- Students will gain the ability to formulate and solve problems (K5)
- Design their own life oriented application of chemistry (K5)
- Classify the applications of leather in different segments. (K4)
- Assess the impact of leather making on society (K5)
- Define the properties of leather and leather products (K1)
- Explain the composition, types, preservation and uses of milk and milk products (K1)

**UNIT I Introduction to Leather Chemistry**

Importance of leather industry-Scope of leather chemistry-Distinction between hides, skins and leather – a detailed study of the structure and composition of hides and skins. Proteins and their characteristics-Anatomy and histology of protein constituents of leather.

**UNIT II Tanning Processes**

Basic principles involved in pre-tanning, soaking, liming, deliming, bating, pickling and depickling-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 tanning – classification – general methods.

**UNIT III Chemistry of Tanning**

The preparation and chemistry of chrome tanning liquids-Olation, oxolation and hydrolysis of chrome liquids-Effects 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 tanning agents like Al, Zr and Te salts and their relative merit in contrast with chrome tanning.

**UNIT IV Preservation and Processing of Leather**

Chemical methods of curing and preservation of hides and skins in acid and alkaline solutions. Principle of methods employed in curing, liming, deliming, bating and pickling -Process of dyeing leather – use of mordants. Dyeing auxiliaries such as leveling, wetting and dispersing agents – Dye fixation

**UNIT V Environmental Impact of Tannery Industries**

Tannery effluent and treatment – Types of water pollution-Different types of tannery effluents and wastes – solid waste – Origin and disposal-A small group project on collecting tannery effluents from various sources and their chemical analysis.

**TEXTBOOK:** Woodroffe, Fundamentals of leather science, John Wiley

**ECC- FORENSIC SCIENCE**

**(SUB CODE: 21UCHECC03)**

**(For self-study only)**

| SEMESTER-III | ECC -3 | CREDITS -4 |
|---|---|---|

**COURSE OUTCOMES:**

- Develop Critical thinking and analysis abilities. (K5)
- Generate laboratory skills to exacting standards of precision and care (K6)
- Ability of problem-solving skills (K4).
- Ability to apply diverse information to solve a real problem (K5)
- Conceptual understanding of the criminal justice system (K3)
- Create awareness among people on food adulteration (K6)

**UNIT I Food Adulteration**

Contamination of wheat, rice, dhal, milk, butter, etc. with clay, sand, stone, water and toxic chemicals (e.g. Kesari dhal with mentanil yellow, Ground nut with afflatoxins). Food poisons: natural poisons (alkaloids, nephrotoxins), pesticides (DDT, BHC, Follidol),

Chemical poisons (KCN). First aid and Antidotes for poisoned persons.Heavy metal (Hg, Pb, Cd) contamination of Seafood. Use of neutron activation analysis in detecting poisoning (e.g., As in human hair)

**UNIT II Transportation**

Drunken driving: breathanalyzer for ethanol. Incendiary and time bombs in road and railway tracks.Defusing live bombs. Hit -and-go traffic accidents: paint analysis by AAS. Soil, toxic and corrosive chemicals (e.g., conc.acids) from tankers.

**UNIT III Crime Detection**

Accidental explosions during manufacture of matches and fire-works (as in Sivakasi).Human bombs, possible explosives (gelatinsticks,RDX). Metal detector devices and other security measures for VVIP. Composition of bullets and detection of powder burns.Scene of crime: finger prints and their matching using computer records. Smell tracks and police dogs. Analysis of blood and other body fluids in crimes.Typing of blood.DNA finger printing for tissue identification in dismembered bodies.Blood stains on clothing.Cranial analysis (head and teeth).

**UNIT IV Forgery and Counterfeiting**

Detecting forgery in bank cheques / drafts and educational records (mark lists, certificates), using UV-light. Alloy analysis using AAS to detect counterfeit coins. Checking silver

linewater mark in currency notes. Jewellery: detection of gold purity in 22 carat ornaments, detecting gold plated jewels, authenticity of diamonds (natural, synthetic, glassy).

**UNIT V Medical Aspects**

AIDS: Cause and prevention. Misuse of scheduled drugs.Burns and their treatment by plastic surgery.Metabolite analysis, using mass spectrum - gas chromatography.Detecting steroid consumption among athletes and race horses.

**Text book:**

K. S. Narayan Reddy, The Essentials of Forensic Medicine and Toxicology, 12 $^{th}$ ed., Sri Lakshmi Art Printers, Hyderabad, 1990.

**ECC- POLLUTION CONTROL**

**(SUB CODE: 21UCHECC04)**

**(For self study only)**

| SEMESTER IV | ECC - 4 | CREDITS - 4 |
|---|---|---|

**COURSE OUTCOMES:**

- Ability to solve the current forms of environmental pollution (K4)
- Label an overview of causes and consequences of natural systems' problems (K1)
- Summarize the fundamental principles governing interaction between men and environment (K5)
- Exposition to good practice of technologies (K4)
- Formulate remedies to environmental problems (K6)
- Predict the radiation hazardous materials. (K3)

**UNIT I Chemical Toxicology**

Toxic chemicals in the environment-Impact of toxic chemicals on enzymes-Sources and biochemical effects of lead, mercury, carbon monoxide and sulphur dioxide-Biochemical effects of pesticides-Carcinogens.

**UNIT II Air Pollution**

Air Pollutants-Air quality standards-Sampling and monitoring- Air pollution control – use of automobiles

**UNIT III Water Pollution**

Aquatic environment-Water pollutants-Trace elements in water-Water quality parameters and standards-Sampling – Preservation -Sewage treatment – Factory effluent treatment .

**UNIT IV Radiation Hazards**

Radiation sources-Cosmic radiation -Effects of Radiation-Prevention measures- Radiation safety methods

**UNIT V Energy Conservation**

Forestation-Wood a major renewable resource-World energy resources – consumption and conservation- Wind energy and tidal power-Environmental management

**TEXTBOOKS:**

1. A.K. De, Environmental chemistry, Wiley Eastern Limited
2. S.S. Dara, A Textbook of Environmental Chemistry and Pollution Control, S.Chand

**ECC- APPLIED CHEMISTRY**

**(SUB CODE: 21UCHECC05)**

**(For self-study only)**

| SEMESTER - V | ECC - 5 | CREDITS - 3 |
|---|---|---|

**COURSE OUTCOMES:**

- Identify the application of chemistry in industries (K1)
- Identify some important compounds and processes of industrial application (K3)
- Describe the relation between theoretical knowledge and the application in industries (K2)
- Knowing the importance of industrial revolution (K3)
- Application of knowledge in all wants of life (K4)

**UNIT I Water Treatment**

Impurities in water-Temporary and permanent hardness-Softening methods-Lime soda process-Zeolite or Permutit process-Treatment of Brackish water -Treatment of domestic water.

**UNIT II Cement**

Lime- Classification of lime-Manufacture of lime- Cement - definition-Classifications of cement-Portland cement-Manufacture of Portland cement- Setting of cement.

**UNIT III Polymers**

Polymers and Polymerisation-Degree of polymerization-Functionality of polymers-Types of polymers-Homopolymer-Copolymer – Homochain polymer – Heterochain polymer- stereo specific polymer-Types of polymerization and mechanism-Chain-growth polymerization-Condensation polymerization-Copolymerisation.

**UNIT IV Plastic and Rubbers**

Plastics and resins-Thermoplastics and thermosetting plastics-Preparations, properties and uses of Polyethylene – Polystyrene – PVC – Bakelite-Advantages and disadvantages of plastics- Natural and artificial rubbers- Vulcanization.

**UNIT V Lubricants**

Definition of lubricants-Functions of lubricants-Requirements of a lubricant-Mechanism of lubrication-Hydrodynamic lubrication-Boundary lubrication-Extreme pressure lubrication-Classification of lubricants-Vegetable and animal oils-Mineral or Petroleum oil- Blended oils-Synthetic lubricating oils,Semi- solid lubricants or Greases

**TEXTBOOKS:**

1. N.Ravisankar, B. Narayanansamy, K. Ilangovan, Applied Chemistry, National Pathippaham
2. N. Krishnamurthy, P.Vallinayagam, K.Jeyasubramanian, Applied Chemistry, Tata McGraw Hill.

**ECC- SPACE CHEMISTRY**

**(SUB CODE: 21UGCHECC06)**

**(For self-study only)**

| SEMESTER-VI | ECC - 6 | CREDITS - 4 |
|---|---|---|

**COURSE OUTCOMES:**

- Identify the theory and mechanism of forces governing the universe (K1)
- Ability to make observations regarding earth or space and infer conclusions from them (K4)
- Explain chemical nature of different planets (K2)
- Gaining idea about the fusion reactions taking place in sun and stars (K2)
- Understanding laws of the universe.(K2)

**UNIT I Research Methods Used in Space Chemistry**

Electromagnetic radiation-Interaction of light radiation with matter-Light rays and chemical composition-Optical specifications of an atom-Cosmic matter on earth.

**UNIT II Chemical Composition of Celestial Bodies**

Meteorites-Abundance of certain elements in meteorites - Chemistry of the solar system-The planets in the solar system-Elements present in the earth crust -Composition of lunar soil and lunar rock.

**UNIT III: Chemistry of Matter**

Effect of pressure on matter-Effect of temperature on matter-Plasma state of matter-Optical pyrometry.

**UNIT IV Stars**

Brightness and luminosity of stars-The Hertzsprung-Russell diagram and stellar evolution-Chemical composition of stars-Stellar atmosphere – light and gravitation, Novae – Super Novae – Comets.

**UNIT V Nuclear Reactions and Sources of Stellar Energy**

Constituents of the atomic nucleus-Properties of elementary particles of atom-Nuclear reactions – Types of nuclear reactions-Nuclear energy sources – sources of solar energy

**TEXTBOOK:**

L. Nikolaev, Space Chemistry, Mir Publishers, Moscow.

**ALLIED CHEMISTRY-I (for Bot and Zoo)**

**(Subject code:21UCHA11)**

| Semester: I | Allied: A1 | Credits : 4 | Hours/W :4 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will be able to identify bonding and structure of organic and inorganic compounds (K2)
- Use acids and bases for different applications (K5)
- Understand the role of hydrogen bonding and other molecular forces through different applications(K1)
- Get the knowledge of different functionalities and their properties(K1)
- Assimilate the importance of protiens and aminoacids in biological systems.(K3)

**Unit I: Chemical Bonding** **12 hrs**

Valency and valence electrons - Electronic theory of valency -Electrovalecy- conditions favouring electrovalency-illustration -Electrovalent compounds and their properties - covalency- conditions favouring covalency-illustration- Covalent compounds and their properties-Coordinate covalency-conditions favouring formation of the bond-illustration-Transition from electrovalency to covalency- polarisation and polarizability- Fajan's rules-statement and illustration- Atomic orbitals-Definition-charge cloud interpretation-shapes of s,p and d orbitals- Overlappin gof atomic orbitals-conditions for overlap-types(s-s, s-p,and p-p) with illustrations-sigma and pi overlaps- hybridisation $sp^3$ in $CH_4$, $sp^2$ in $BF_3$ and sp in $BeCl_2$. Geometry of $H_2O$ and $NH_3$ molecules-VSEPR theory.

**Self Study:** Atomic number, mass number, isotopes, electronic configuration of atoms and ions.

**Unit II: Redox Systems and Analytical Chemistry-I** **12 hrs**

Redox systems- Redox reactions in terms of electron transfer - Oxidation number-Definition-Rules for assigning oxidation number- Calculation of oxidation number- Redox processes in terms of oxidation number- Advantages and disadvantages of the concept- Acids and bases-Arrhenius concept –illustration- Lowry-Bronsted concept-conjugate acid and conjugate base - Types of reactions relevant to qualitative analysis - Displacement reaction – Decomposition - Double decomposition- Hydrolysis- redox reaction- Complex formation- Interfering anions and their elimination- Group reagents and analytical group classification- Explanation and application of the following principles in qualitative analysis- Solubility and solubility product- Common ion effect- pH- Buffer

**Self Study:** oxidation, reduction, acids and bases.

**UNIT III: Intermolecular Forces and Properties of Liquids** **12 hrs**

Polar and non-polar molecules - Dipole-dipole (Debye) forces, dipole-induced dipole (Keesom) forces, Induced dipole-Induced dipole (London) forces. Repulsive forces - Resultant intermolecular energies- Hydrogen bonding-Nature of hydrogen bonding-conditions favouring hydrogen bonding- Types of hydrogen bonding-illustrations-impact of hydrogen bonding on melting points, boiling points and solubilities. Electrolysis - What is electrolysis-strong and weal electrolytes - Mechanism of electrolysis - Electrical units-coulomb,Amphere, Ohm and Volt- Faradays laws of electrolysis and their importance - Conductance of electrolyte – Conductance- Specific conductance and molar conductance-Units – Variation of equivalent conductance with concentrations

**Self Study:** pure covalent bonds with examples, electro negativity, conductors, insulators, boiling point, melting point

**UNIT IV: Aldehydes, Ketones, Acids and Amides** **12 hrs**

Aliphatic aldehydes and ketones-Nomenclature-General reactions- Formaldehyde- a comparison with other aldehydes of the series - Aromatic aldehydes-Reactions of benzaldehyde-benzaldehyde compared with acetaldehyde - Aromatic ketones-Aceton, acetophenone and benzophenone-distiction- Aliphatic saturated monocarboxylic acids-Nomenclature, general reactions-comparison of formic acid with other acids of the series. Aromatic saturated monocarboxylic acids-distinction between benzoic acid and acetic acid - Aliphatic amides-nomenclature, general reactions - Aromatic amides-Distiction between benzaldehyde and acetamide.

**Self Study**: aliphatic compounds, aromatic compounds, Functional group of aldehydes, ketones and amides

**UNIT V: Amines, Amino Acids and Proteins** **12 hrs**

Aliphatic monoamines - Nomenclature and classification - General reactions- Aniline-Reactions of aniline- Distinction between aniline and ethylamine- Amino acids-classification-zwitter ions-isoelectric point-preparation and properties of glycine and alanine- Proteins-introduction-peptides and polypeptides-partial hydrolysis and terminal residue analysis in the determination of structure of peptides.

**Self Study:** Functionalities of amino acids and amines, Functionalities of proteins (nitrogen containing compounds)

**NOTE :** Course materials will be supplied to the students**.**

## ALLIED CHEMISTRY PRACTICAL-I (For BOT and ZOO)

**Inorganic qualitative analysis**

**(Subject code:21UCHAP11)**

| **Semester : I** | **Allied : AP1** | **Credit :1** | **Hours/w :2** |
|---|---|---|---|

Qualitative analysis of a simple salt containing one anion and one cation

**Anions** : Carbonate, Borate, Fluoride, Oxalate and Phosphate

**Cations** : Lead, Bismuth, Copper, Cadmium, Cobalt, Nickel, Manganese, Zinc, Barium, Strontium and Ammonium

**Note:** Laboratory manual will be supplied.

**ALLIED CHEMISTRY-II (for Bot and Zoo)**

**(Subject code:21UCHA21)**

| Semester: II | Allied: A2 | Credits : 4 | Hours/W :4 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will explain fundamental thermodynamic properties (K1)
- They will list and explain several technological applications of colloids (K2)
- Able to Summarize the roles carbohydrates, alkaloids and terpenoids play in biological systems.(K3)
- Figure out how many stereoisomers a compound has, and synthesis of a few heterocyclic molecules.(K4)
- Prepare and standard solutions and standardize an unknown solution.(K5)

**Unit I Thermodynamics** **12 hrs**

Introduction - Basic terminology and functional concepts- System, boundary and surrounding- Types of systems: open, closed and isolated- Properties of a system: extensive and intensive - State of a system and state variables (or state functions)-Thermodynamic equilibrium - Process and types: Isothermal, adiabatic, isochoric, isobaric, cyclic, reversible, and irreversible- comparison between isothermal and adiabatic processes, reversible and irreversible processes - Internal energy as a state function- components of internal energy- Work: Thermodynamic concept-types of work - Heat : Thermodynamic concept- Heat and work as path functions - First law of thermodynamics- Statement of the law of conservation of energy- Mathematical expression of the law- Application of the law- Heat capacity, specific heat capacity and molar heat capacity of asystem- Relation between molar hear capacities of gases- Enthalpy and enthalpy change- Enthalpy as a state function- Relation between $\Delta H$ and $\Delta E$- Enthalpies of reaction, formation and combustion-Definition and illustration- standard state- Calculation of enthalpy change using Hess law- Bond enthalpies and bond dissociation enthalpies-Definition and illustration using $CH_4$ as example (Numerical problems not expected)- Spontaneous (natural) process- Entropy-it's meaning of disorder- Gibb's free energy-its meaning as available energy- Criteria for spontaneity

**Self study:** ideal gas, ideal gas equation, homogeneous reactions and heterogeneous reactions, heat.

**UNIT II Surface Chemistry and Colloidal Chemistry** **12 hrs**

Adsorption chemistry-introduction-definition-distinction from adsorption- Adsorption and adsorbate-definition and explanation- Chromatography-introduction- Adsorption chromatography-column chromatography, TLC- Partition chromatography-ascending chromatography- $R_f$ value and its significance- Ion exchange chromatography-gas liquid

chromatography (GLC), high - Types of colloidal systems- Classification of colloids- Lyophilic and lyophobic sols-a comparison- Stability of colloids-origin of charge-electrical double layer-salvation- Electrical properties-electrophoresis and electro-osmosis- Gels-gelation-classificatio-properties of gels-hydration, swelling or inhibition, syneresis and thixotropy- Emulsions-types of emulsion-identification of emulsion-dilution test, dye test, spreading test, viscosity and electrical conductivity-de-emulsification- Application of colloid in food, medicine, industry, purification of water, artificial rain, blue colour of the sky and cleaning action of soap.

**Self study:** Adsorbent, adsorbate, molecular interactions.

**UNIT III Carbohydrates, Alkaloids and Terpenoids 12 hrs**

Introduction- Monosaccharide- Reaction of glucose- Open chain structure and ring structure of glucose (elucidation not expected)- Epimers, mutarotation- Interconversion of glucose into fructose and vice versa- Disaccharides- Reactions and structure of sucrose (elucidation nor expected)- Structure of maltose and lactose (elucidation not expcted)- Polysaccharide- Starch-amylase and amyl pectin-type of glycosidic linkage- Reaction of starch-action of heat-, hydrolysis and with iodine- Alkaloids- Definition, classification, (based on structure) occurrence and extraction- General methods of identification-functional nature of oxygen-functional nature of nitrogen-unsaturation-exhaustive methylation- Structure of conine- Terpenoids- Introduction, classification of terpenoids-Isoprene rule- Structure of citral (synthesis not included)

**Self study:** Examples for food contains carbohydrates

**UNIT IV Stereoisomerism and Heterocyclic Compounds 12 hrs**

Optical isomerism- Plane polarized light - Optical activity - Asymmetric carbon-chirality - Elements of symmetry-plane of symmetry- axis of symmetry-centre of symmetry-dissymmetric- Van't Hoff-le Bel theory- Optical isomerism of tartaric acid- Racemization - Resolution of racemic-mixture-biochemical method, chemical method and chromatographic method- Geometrical isomerism- Cause for geometrical isomerism- Illustration of compounds containing C-C double bond - Heterocyclic compounds- Pyrrole- Introduction-aromatic character- Basic and acidic character of pyrrole- Pyridine- Electronic interpretation of electron-rich centers- Reaction of pyridine- Quinoline- Skaraup synthesis - Reactions of quinoline

**Self study:** Isomers, cyclic compounds, practice to draw the structure of simple molecules like $H_2O$, $NH_3$ etc.

**UNIT V Analytical Chemistry-II** **12 hrs**

Methods of expressing concentration of solution- Normality- Molarity- Molality- Mole fraction- Equivalent weight of acids, bases, oxidizing agent and reducing agent- Standard solution- Primary standard- Secondary standard-Preparation of standard solution- Principles underlying the following types of titration-Acid-base titration-theory of indicator- Permanganimetry-Dichrometry-Iodometry and Iodimetry-EDTA

**Self study:** Solvent, solute, solution, saturated solution, unsaturated solution, equivalent weight.

**Note:** Course materials will be supplied to the students.

**ALLIED CHEMSITRY PRACTICAL-II (For Bot and Zoo)**

**Inorganic Volumetric Estimations**

**(Subject Code : 21UCHAP21)**

| **Semester : II** | **Allied AP2** | **Credit : 1** | **Hours/W : 2** |
|---|---|---|---|

| **S.NO** | **Estimation** | **Link** | **Standard** |
|---|---|---|---|
| 1 | Strong acid | Weak base/ Strong base | Strong acid |
| 2 | Strong acid | Strong base | Weak acid |
| 3 | Strong base | Strong acid | Weak base |
| 4 | Oxalic acid | Potassium permanganate | Oxalic acid |
| 5 | Ferrous sulphate | Potassium permanganate | Ferrous ammonium sulphate |
| 6 | Potassium dichromate | Ferrous sulphate | Potassium dichromate |
| 7 | Ferrous ammonium sulphate | Potassium dichromate | Ferrous sulphate |
| 8 | Potassium permanganate | Sodium thiosulphate | Potassium dichromate |
| 9 | Magnesium sulphate | EDTA | Zinc sulphate |
| 10 | Zinc sulphate | EDTA | Magnesium sulphate |

**Note:** Laboratory manual is supplied.

## ALLIED CHEMISTRY- I (FOR PHYSICS)

## SUBJECT CODE:21UCHA31

| Semester: III | Core : 1 | Credits : 4 | Hours / W : 4 |
|---|---|---|---|

**COURSE OUTCOMES:**

- Students will be able to understand the atomic structure and periodicity(K1)
- Appreciate the mistery of existence of atoms together in molecular form(K2)
- Enjoy the regularity in solids(K3)
- Use different acids and bases for biological applications and evaluate redox processes.(K5)
- Use practical knowledge for Industrial backgrounds. (K4)

**UNIT I Atomic Structure and Periodic Table** **12 Hrs**

Bohr model of atom- Atomic spectrum of hydrogen and Bohr theory - Refinement of the Bohr theory- Duel nature of electrons particles or waves- Quantum numbers and its significance- Uncertainty principle- Paul's exclusion principle, Hund's rule- Periodic table- Modern periodic table- Long form of periodic table- Division of elements into s,p,d and f blocks-Bohr's aufbau principle electronic configuration of ground state of atoms up to K(Z=19)-Trends in atomic properties Ionization energy, successive ionization energy , electron affinity, electro negativity Pauling, Mulliken and Allred Rochow's scale

Self study: Fundamentals of atomic structure, atomic number, mass number

**UNIT II Structural and Chemical Bonding** **12 hrs**

Types of chemical bond - Electrovalent bond (conditions for formation and associated properties)- Covalent bond (conditions for formation and associated properties)- Coordinate covalent bond- Orbital overlap ss, sp, pp overlap- Sigma and pi bond formation of $N_2$ and $O_2$ properties- Polar and non-polar molecules- Dipole moment and its applications- VSPER theory application to $CH_4$ , $NH_3$ and $H_2O$ - Molecular orbital theory, bonding, antibonding and non-bonding orbitals- MO diagrams for $H_2$ , $He_2$ and $O_2$ bond order

Self study: Ionic bond, covalent bond, Coordinate bond

**UNIT III Solid State and Energetics** **12 hrs**

Macroscopic properties of solids- Types of characteristics of crystals- Covalent solids structure and properties of diamond and graphite- Ionic crystals solid NaCl- Metallic crystals- Molecular crystals intermolecular forces- Metals free electron theory and bond theory of metallic bond- Superconductors- Lattice energy- Born Haber cycle- Law of conversation of energy- Enthalpy of reactions- Entropy and Gibbs energy- Relationship between Gibbs energy and equilibrium.

Self Study: Difference between crystalline and amorphous substances

**UNIT IV Acid, Bases and Redox Processes** **12 hrs**

Concept of acids and bases- Arrhenius concept- Bronsted Lowry concept conjugate acids and bases- Lewis concept- Effect of solvents and substituents on relative strengths of acids and bases- Hydrolysis- Ionization of water- pH scale definition of pOH , $pK_a$, $pK_b$ simple numerical problem- Buffer solution - Redox processes- Electronic concept of oxidation and reduction- Oxidation number rules- Calculation of oxidation number of elements in neutral molecules and in ions- Balancing ionic equation by oxidation number method.

Self Study: Ideas on acids, bases and salts

**UNIT V Practical Chemistry-I** **12 hrs**

Introduction acquaintance with chemical laboratory laboratory equipments solid reagents, liquid reagents and test papers laboratory instructions and some don'ts Bunsen burner (self study) -Chemistry involved in the analysis of anion and cations - Dry tests (action of heat, flame test, filter ash test) -Wet test ( with acids , with $Na_2CO_3$ extract)- Elimination of interfering anions and preparation of original solutions-Classification of cations into analytical groups- Condition for precipitation, application of solubility product and common ion effect in qualitative analysis- Cleaning- Soap reaction with acids and hard water effect of high temperature- Chemistry of cleaning soap micelle cleaning action of soap- Dry cleaning general rules for stain removal chemicals used for spots and stains from fabrics- Synthetic detergent and their advantages over soap- Safety in laboratory- General safety measures (safety equipment, safety notices, personal protection, dangers to avoid )- Chemical hazards (corrosive, irritant substances, toxic compounds, flammable explosives)- Physical hazards (fire, pressure) fire extinguisher- Spillage and waste disposal- First aid ( immediate assistance, burns, eye injuries, bleeding, toxic materials) first aid kit.

Self Study: Simple salt analysis.

**Note: Course materials will be supplied to the students**

## ALLIED CHEMISTRY PRACTICAL – I (FOR PHYSICS)

**Inorganic qualitative analysis**

**(Subject Code: 21UCHAP31)**

| Semester: III | Allied: AP3 | Credit: 1 | Hours/W : 2 |
|---|---|---|---|

Qualitative analysis of a simple salt containing one anion and one cation

**ANIONS** **:** Carbonate, Borate, Fluoride, Oxalate and Phosphate

**CATIONS** **:** Lead, Bismuth, Copper, Cadmium, Cobalt, Nickel, Manganese, Zinc, Barium, Strontium and Ammonium

**Note: Laboratory manual is supplied**

## ALLIED CHEMISTRY- II (FOR PHYSICS)

## SUBJECT CODE: 21UCHA41

| Semester : IV | Core : 1 | Credits : 4 | Hours / W : 4 |
|---|---|---|---|

**COURSE OUTCOMES**:

- Students will be able to write nomenclature of organic compounds.(K2)
- Develop the knowledge in the area of electromotive force(K1)
- Use various processes involved in metallurgy for industrial applications(K5)
- Know the application of chemistry in industries(K3)
- Develop the practical knowledge in volumetric analysis.(K2)

**UNIT I Nomenclature and Isomerism of Organic Compounds 12 hrs**

Nomenclature of organic compounds - Alkane, alkene, alkyne, cycloalkane and alkyl groups- IUPAC names of alcohols, acids, aldehyde and ketones- Hybridization- Need for the concept of hybridization- sp, $sp^2$ and $sp^3$ hybridization with suitable examples- Isomerism in organic compounds- Structural isomerism types with example- Stereoisomerism conformational, geometrical and optical isomerism- Geometrical isomerism cis and trans nomenclature- Optical isomerism elemental of symmetry chirality optical activityenantiomers, diastereomers,mesomer and racemic mixture optical activity exhibited by lactic acid and tartaric acid.

Self study: Fundamentals of isomerism and hydridization.

**UNIT II Electromotive Force 12 hrs**

Introduction- Requirements of an electrochemical change- Electrochemical cells difference between electrolytic and galvanic cells- Salt bridge- Electrode potential and standard electrode potential- Electrochemical series and applications- Conventions used in electrode representation and in cell representation- Types of electrodes description of hydrogen, calomel and glass electrodes Nernst equation- Weston cadmium cell- Experimental determination of a cell emf and determination of electrode potential simple calculation- Potentiometric titrations and their advantages principle and method of acid base, redox and precipitation titrations- Determination of pH using hydrogen, glass and quinhydrone electrodes

Self study: Electrolysis and galvanic cells

**UNIT III Metallurgical Principles and Polymers 12 hrs**

Minerals and ores- Native,sulphide, oxide, carbonate, halide and sulphate ores- Metallurgy extraction metals- Concentration of ores hand picking, gravity separation,magnetic separation, froth flotation processes and leaching- Calcination and roasting- Purification of

metals electrolysis and zone refining method- Polymers - Properties of polymers ;Mechanical, physical, thermal, optical, electrical and chemical properties- Preparation and uses of thermoplastics polyethylene and PVC- Preparation and uses of thermosetting plastics nylon, epoxy resins, Bakelite- Rubber and uses of rubber- Vulcanization. - Biopolmers.
Self study: Simple extraction procedure

**UNIT IV Industrial Chemistry and Magneto Chemistry 12 hrs**

Silicones preparation, properties and uses- Manufacture and types of glass- Cement composition, manufacture and setting of cement- Fuel gases manufacture, composition and uses of producer gas, water gas, LPG and bio Gas- Softening of water: Ion exchange, electro dialysis and reverses osmosis methods - Volume, mass and molar susceptibility- Diamagnetism and temperature independent paramagnetism- Temperature dependent paramagetism- Ferro and antiferromagnetism- Measurements of magnetic susceptibility- Applications of magnetic susceptibility studies.
Self study: Fundamentals of magnetism

**UNIT V Practical Chemistryii and Solvent Extraction 12 hrs**

Introduction definition of various terms (titrations, volumetric analysis, titrant indicator, end point requirements of the reaction selected for the titration commom types of titration. Law of equivalence equivalent weight of acids, bases, oxidizing agents, reducing agents and salts calculation of molecular weights and equivalentweights. Requirements of a primary standard - Secondary standards- Numerical problems in the preparation of solutions- Law of normalities preparation of HCl, $H_2SO_4$, $HNO_3$(approximately 0.1N) from standard acids- Principles behind - Acid base titration - pH verses volume curves, choice of indicates form different acid base titrations- Permanganimetry- Dichrometrydiphenylamine and potassium ferricyanide as indicators- Iodimetry Preparation of iodine and starch solutions - starch as indicators- Iodometry role of $KMnO_4$ and $K_2Cr_2O_7$- Solution Nernst distribution law and solvent extraction numerical problems

Self study: Preparation of solution

**Note: Course materials will be supplied to the students**

## ALLIED CHEMISTRY PRACTICAL – II (FOR PHYSICS)

### Inorganic Qualitative Analysis

### (Subject Code: 21UCHAP41)

| Semester: IV | Allied: AP4 | Credit: 1 | Hours/W: 2 |
|---|---|---|---|

| S. No | Estimation | Link | Standard |
|---|---|---|---|
| 1 | Strong Acid | Weak Base/Strong Base | Strong Base |
| 2 | Strong Acid | Strong Base | Weak Acid |
| 3 | Strong Base | Strong Acid | Weak Base |
| 4 | Oxalic acid | Potassium Permanganate | Oxalic acid |
| 5 | Ferrous Sulphate | Potassium Permanganate | Ferrous Ammonium Sulphate |
| 6 | Potassium dichromate | Ferrous Sulphate | Potassium dichromate |
| 7 | Ferrous Ammonium Sulphate | Potassium dichromate | Ferrous Sulphate |
| 8 | Potassium Permanganate | Sodium thiosulphate | Potassium dichromate |
| 9 | Magnesium Sulphate | EDTA | Zinc Sulphate |
| 10 | Zinc Sulphate | EDTA | Magnesium Sulphate |

**Note: Laboratory manual will be supplied**