Course Title	**:**	**Core: General Chemistry-I**	**Course Code**	**:**	**20UCH1C01**
Year	**:**	**I**	**Semester**	**:**	**I**
Hours/Week	**:**	**4**	**Credit**	**:**	**4**

COURSE OBJECTIVES

1. To make aware of the basic mathematical concepts.
2. To impart knowledge on IUPAC system of nomenclature.
3. To introduce about the various polar effects on molecules.
4. To create awareness in safe handling of glassware, chemicals and laboratory hygiene.
5. To provide skills on qualitative and quantitative analysis

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Have a sound knowledge on the basic mathematical concepts.	K1
CO2	Name the compounds according to IUPAC system of nomenclature.	K1&K2
CO3	Know about the various polar effects on molecules.	K2
CO4	Gain awareness in safe handling of glassware & chemicals and laboratory hygiene.	K1
CO5	Apply the skills of qualitative and quantitative analysis.	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	L		M	S	L	L	L
CO2	L	L	L	M	S		S	L	M	L	S
CO3	M	S	S	M	S		S	S	S	M	S
CO4	S	L	L	L	M		S	L	S	S	M
CO5	S	S	M	S	M		S	S	S	S	M

S – Strong; M – Medium; L – Low

UNIT- I

Basic mathematical concepts: Basic SI and derived units, inter conversion of units, significant figures, scientific notation, exponential numbers and logarithms. Basic idea on differential and integral calculus. Graph plotting - slopes, maxima and minima.

Basic Chemical concepts: Mole calculations. Concentration terms. Equivalent weight – acid, base, salt, ions and oxidising - reducing agents, principle of volumetric analysis.

Differential and integral calculus applications in chemistry. Applications of mole concept.*

UNIT- II

Classification and Nomenclature of organic compounds: Homologous series and its characteristics, functional groups. Systems of naming organic compounds- trivial, derived and IUPAC rules.

IUPAC system of nomenclature of aliphatic hydrocarbons with mono and poly functional groups, alicyclic, bicyclic, spiro and aromatic compounds.

IUPAC naming of hydrocarbons in petrochemistry and hydrocarbons containing both double and triple bonds.*

UNIT - III

Electronic effects and reaction intermediates: Polar, non-polar molecules, electron donating and withdrawing groups. Polar effects- inductive, mesomeric, electromeric, resonance, hyperconjugation and steric effects. Homolytic and heterolytic fission. Reactive intermediates- Carbocations, carbanions, free radicals and their structures and stabilities. Carbenes, Nitrenes and benzyne (electronic structure only).

Influence of polar effect on the strength of organic acid and bases. Comparison of stability of reaction intermediates.*

UNIT-IV

Laboratory hygiene and safety: Storage and handling of chemicals-corrosive, inflammable, explosive, toxic, poisonous and carcinogenic chemicals. First aid procedures for laboratory accidents involving toxic and poisonous chemicals, electrical shock, cuts and burns from hot objects. Filtration, Heating and stirring techniques.

Handling of Glassware: Cleaning agents and cleansing methods. Interchangeable glass ground joint apparatus and their advantages. Calibration and grading of pipette, burette and volumetric flask. Effect of temperature on volumetric glassware.

Weighing principle in chemical balance and single pan balance.*

UNIT-V

Principles and techniques of inorganic qualitative analysis: Semi-micro qualitative analysis - anions (interfering and non-interfering), reactions of some common anions (carbonate, sulphide, sulphate, nitrate, halides, oxalate, borate and phosphate), principle of preparation of sodium carbonate extract and elimination of interfering anions. Classification of cations into groups, reaction of Pb^{2+}, Cu^{2+}, Al^{3+}, Ni^{2+}, Ca^{2+}, Ba^{2+}, $Mg^{2+}$and NH_4^+cations, group reagents. Applications of solubility, solubility product principle and common ion effect in-group separation of cations.

Preparation of solution for cation testing on semi-micro scale.*

Self-study

Books for study:

1. ArunBahl, B. S. Bahl and G. D.Tuli, *Essentials of Physical Chemistry*,S. Chand, 28th Edition, 2020.
2. M. K. Jain and S. C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co., 1st Edition, Reprint 2020.
3. ArunBahland B. S. Bahl, *A Textbook of Organic Chemistry*,S. Chand, 22nd Edition, 2016.
4. R. Gopalan, P. S. Subramanian and K. Rengarajan, *Elements of Analytical Chemistry*, S. Chand &Sons, 1st Edition, 2003.
5. V. Venkateswaran, R. Veeraswamy and A. R. Kulandaivelu, *Basic Principles of Practical Chemistry*, S. Chand & Sons, 2nd Edition, Reprint 2017.

Books for reference:

1. B. R. Puri, L. R. Sharma and Madan S. Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., 47th Edition, 2016.
2. R. L. Madan, *Chemistry for Degree students*, S. Chand & CompanyPvt. Ltd., 2nd Edition, Reprint 2014.
3. D.A. Skoog, D. M. West, F.J. Holler and S. R. Crouch, *Fundamentals ofAnalytical Chemistry*, 5thedition, Cengage Learning EMEA, 9th Edition, 2014.

E-resources:

1. https://www.khanacademy.org/science/class-11-chemistry-india/xfbb6cb8fc2bd00c8:in-in-some-basic
2. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/nomen1.htm
3. https://khannapankaj.wordpress.com/category/basics-of-organic-chemistry/reaction-intermediates/
4. https://www.youtube.com/watch?v=vDwfhWt4-mg
5. https://www.youtube.com/watch?v=IlJ_OjR-WhE

Course Title	**:**	**Core: General Chemistry-II**	**Course Code**	**:**	**20UCH1C02**
Year	**:**	**I**	**Semester**	**:**	**I**
Hours/Week	**:**	**4**	**Credit**	**:**	**4**

COURSE OBJECTIVES

1. To give the basic concepts of atomic structure.
2. To provide ideas on periodic table and periodic properties of elements.
3. To deliver about the nature of bonding in inorganic compounds.
4. To convey the significances of hydrogen bonding.
5. To transfer the chemistry of alkanes and cycloalkanes.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Understand the basic concepts of atomic structure.	K2
CO2	Understand about the periodic table and periodic properties of elements.	K1&K2
CO3	Analyse the nature of bonding in inorganic compounds.	K4
CO4	Know the significances of hydrogen bonding.	K3
CO5	Apply the knowledge on chemistry of alkanes and cycloalkanes.	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	L	L		S	M	L	L	M
CO2	S	M	S	L	L		S	M	M	L	M
CO3	S	S	S	M	L		S	S	M	L	M
CO4	S	S	S	M	L		S	M	S	L	M
CO5	M	S	M	S	L		S	S	S	L	M

S – Strong; M – Medium; L – Low

UNIT- I

Atomic structure-I: Bohr model of an atom and its limitations, Sommerfeld atom model and hydrogen spectrum.Quantum theory of radiation – Photoelectric effect, Black body radiation and Compton Effect. Dual nature of matter - de Broglie equation and Heisenberg's uncertainty principle. Hund's rule, sequence of energy levels (aufbau principle) and its limitations. Pauli's exclusion principle and Hund's rule, aufbau principle, (n + l) rule, stability of half-filled and completely filled orbitals.

Bohr's explanation of hydrogen spectrum.Sommerfeld's extension of Bohr's theory and shortcomings of Bohr's theory.*

UNIT-II

Periodicity and properties: Description of the latest IUPAC periodic table. Atomic radii, ionic radii, covalent radii, ionisation energy (IE), electron affinity (EA) and electronegativity (EN) - variation along period and group. Ionic radii- comparison of size of cation and anion, neutral atom and isoelectronic species. Ionisation energy–first and successive, factors affecting IE. Electron affinity-factors affecting EA. Electronegativity - Pauling's, Mulliken's and Allred Rachow'sscales. Percentage of ionic character. Variation of EN with oxidation state, hybridisation, charge and bond order.

Electronegativity calculations using Pauling, Mulliken and Allred-Rochowmethods.*

UNIT-III

Chemical bonding-I: Ionic bonding- conditions for the formation of ionic bond, characteristics of ionic compounds.Lattice energy, Born-Lande equation (derivation not required), factors affecting lattice energy, Born-Haber cycle-enthalpy of formation of ionic compounds and stability.Covalentcharacter in ionic compounds- Fajan's rules, comparison of solubility, melting points, and thermal stability of typical ionic compounds.

Covalent bond: characteristics of covalent compounds, formation of $BeCl_2$, BCl_3, CH_4, H_2O and C_2H_4. Partial ionic character. Coordinate bond- NH_4Cl, BF_3-NH_3, $[Co(NH_3)_6]Cl_3$and $AlCl_3$.

Solubility and thermal stability of ionic compounds of alkali and alkaline earth metals.Comparison of the characteristics of ionic and coordinate compounds.

UNIT - IV

Chemical bonding-II: Valance bond theory-arrangement of electrons in molecules, hybridization of atomic orbitals and geometry of molecules. VSEPR model-effect of bonding and nonbonding electrons on the structure of molecules, illustration of structures by VSEPR model- BeF_2, BF_3, CH_4, NH_3, H_3O^+, SF_4, ClF_3, ICl_4^-, ICl_2^-, IF_7, XeF_2, $XeOF_2$, XeF_4, XeF_6. Molecular orbital theory- MO diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO and their ions - bond order and stability of molecules.

Weak Chemical Forces - Hydrogen bonding, Vander Waals forces.

The importance of lone pair-lone pair and lone pair-bond pair electron interactions in determining structure of molecules and illustration.Calculation and comparison of bond order and determining stability of homo- and heterodiatomicmolecules.*

UNIT- V

Alkanes: Alkanes-preparation by the reduction of alkyl halides, Sabatier- Senderens reduction. Wurtz reaction, decarboxylation and Kolbe's electrolysis. Relationship between structure and physical properties. Chemical properties - isomerisation, aromatization, pyrolysis, combustion, controlled oxidation, nitration, sulphonation, relative reactivity and selectivity of halogenations.

Cycloalkanes: Synthesis by internal Wurtz reaction, Freund's method, decarboxylation and Dieckmann's condensation. Chemical properties - substitution and ring opening reactions of cyclopropane and cyclobutane. Baeyer's strain andSache-Mohr theories.

Comparison of boiling point, melting point and density of alkanes.Relative stability of ring compounds.*

****Self-study***

Books for study:

1. ArunBahl, B. S. Bahl and G. D.Tuli, *Essentials of Physical Chemistry*,S. Chand & Company 28th Edition, 2020.
2. B.R. Puri, L. R. Sharma and K. C. Kalia, *Principles of Inorganic chemistry*, Vishal Publishing Co.,33rdEdition, 2020.
3. M. K. Jain and S. C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co., 1st Edition, Reprint 2020.
4. ArunBahland B. S. Bahl, A *Textbook of Organic Chemistry*,S Chand & Company 22nd Edition, 2016.

Books for reference:

1. R. L. Madan, *Chemistry of Degree students*, S. Chand & Company, 2nd Edition, Reprint 2014.
2. R. D. Madan, *Modern Inorganic Chemistry*, S. Chand Publishing, Revised Edition, 2019
3. B. R. Puri, L. R. Sharma and Madan S. Pathania, *Principles of Physical Chemistry*,Vishal Publishing Co., 47th Edition, 2016.

E-resources:

1. https://www.khanacademy.org/science/chemistry/electronic-structure-of-atoms
2. https://www.khanacademy.org/science/class-11-chemistry-india/xfbb6cb8fc2bd00c8:in-in-classification-of-elements
3. https://www.khanacademy.org/science/class-11-chemistry-india/xfbb6cb8fc2bd00c8:in-in-chemical-bonding-and-molecular-structure
4. https://www.youtube.com/watch?v=ev86NRGEuMY

Course Title	**:**	**Core: General Chemistry-III**	**Course Code**	**:**	**20UCH2C03**
Year	**:**	**I**	**Semester**	**:**	**II**
Hours/Week	**:**	**4**	**Credit**	**:**	**4**

COURSE OBJECTIVES

1. To impart knowledge about the nature of waves and filling of electrons in various orbitals.
2. To convey the properties and applications of s-block elements.
3. To provide the chemistry of alkadiene and alkyne compounds.
4. To deliver the properties and mechanisms of alkyl halides.
5. To equipwith the mechanisms of aromatic electrophilic substitution reactions.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Know about the nature of waves and filling of electrons in various orbitals.	K1&K2
CO2	Perceive the properties and applications of s-block elements.	K1&K2
CO3	Apply the knowledge on chemistry of alkadiene and alkyne compounds.	K3
CO4	Realize the properties and mechanisms of alkyl halides.	K3&K4
CO5	Analyze the mechanisms of aromatic electrophilic substitution reactions.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M		S	M	L	L	M
CO2	S	M	M	M	L		S	M	M	L	M
CO3	S	S	M	S	L		S	S	M	L	M
CO4	S	S	S	M	L		S	M	M	L	M
CO5	S	S	M	S	L		S	S	S	L	M

S – Strong; M – Medium; L – Low

UNIT - I

Atomic structure – II: Wave mechanical model - verification by Davisson and Germer experiment. Schrodinger wave equation- derivation, physical significance of Ψ and Ψ^2. Charge cloud concept and shapes of *s, p, d* and *f* orbitals. Nodes and nodal planes. Origin, description and salient features of quantum numbers (*n, l* and *m*). Zeemaneffect and spin quantum number.

Problems on de Broglie's equation. Filling of electrons in polyelectronicatoms.*

UNIT - II

s-Block elements -Properties – Lattice energy of ionic solids, hydration of ions, relative stability of different oxidation states, ionic conductance. Complexes of alkali metals - wrap around complexes. Comparison of Li and Be with their family members. Diagonal relationship between Li and Mg, Be and Al. Chemistry of sodamide and calcium carbide. Manufacturing and setting of Portland cement.

Factors favoring the formation of ionic compounds by s-block elements. Uses of s-block metals.*

UNIT- III

Alkadienes- classification, conjugated dienes-preparation from diol, alkyne, and dihalide. Chemical properties - 1,2 and 1,4 electrophilic addition, homo and intramolecular cyclisation, Diels-Alder reaction.

Alkynes- preparation from gem and vicinal dihalides, tetrahalides, lower alkynes. Chemical properties-acidity of alkynes, catalytic and chemical reductions, hydrohalogenation, hydration, hydroboration, oxidation with $KMnO_4$, ozonolysis and polymerization (dimer, trimer and tetramer), Tests for alkynes.

Stability of conjugated dienes.*

UNIT- IV

Alkyl halides-preparation from alkanes,alkenes, alkynes, alcohols, Hunsdiecker reaction and halide exchange. Chemical properties- reaction with aqueous and alcoholic alkali (Saytzeff and Hoffmann orientation).Aliphatic nucleophilic substitution-S_N1, S_N2 and S_Ni mechanisms with stereochemistry, relative reactivities of 1^o, 2^o, and 3^o alkyl halides towards S_N1 and S_N2 mechanisms.

Application of Hoffmann and Saytzeffrules.*

UNIT- V

Aromaticity - Huckle's rule. Aromaticity of benzene, naphthalene, antharacene, phenantharene, [10]annulene, [14]annulene, pyridine, pyrrole, cyclopropenyl cation, tropylium cation and cyclopentadienyl anion.

Mechanism of aromatic electrophilic substitution reactions of benzene and toluene - halogenation, nitration, sulphonation, Friedel-Crafts alkylation and acylation. Activating and deactivating substituents, orientation and ortho/para ratio, side chain reactions (chlorination & oxidation) of toluene.

Orientation of electrophiles on mono substituted benzene.*

****Self-study***

Books for study:

1. M. K. Jain and S. C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co., 1st Edition, Reprint 2020.
2. R. L. Madan, *Chemistry of Degree students*, S. Chand & Company, 2nd Edition, Reprint 2014.
3. ArunBahl, B. S. Bahl and G. D.Tuli, *Essentials of Physical Chemistry*, S. Chand &Company 28th Edition, 2020.

Books for reference:

1. R. D. Madan, *Modern Inorganic Chemistry*, S. Chand Publishing, Revised Edition, 2019.
2. B.R. Puri, L. R. Sharma and K. C. Kalia, *Principles of Inorganic chemistry*, Milestone Publishers, 33rd Edition, 2016.

E-resources:

1. https://www.khanacademy.org/science/chemistry/electronic-structure-of-atoms
2. https://www.askiitians.com/revision-notes/chemistry/s-block-elements/
3. https://www.khanacademy.org/science/ap-chemistry-beta/x2eef969c74e0d802:molecular-and-ionic-compound-structure-and-properties/x2eef969c74e0d802:intramolecular-force-and-potential-energy/v/lattice-energy
4. https://byjus.com/chemistry/aromaticity/

Course Title	**:**	**Core: General Chemistry-IV**	**Course Code**	**:**	**20UCH2C04**
Year	**:**	**I**	**Semester**	**:**	**II**
Hours/Week	**:**	**4**	**Credit**	**:**	**4**

COURSE OBJECTIVES

1. To provide knowledge on crystal structures and arrangements of ionic compounds.
2. To convey the applications of solutions and colloids.
3. To develop the problem solving capacity of gas laws.
4. To deliver the chemistry of ethers and epoxides.
5. To enhance the analyzing ability on compounds formed by p-block elements.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Know about the crystal structures and arrangements of ionic compounds.	K1
CO2	Hold the applications of solutions and colloids.	K1&K3
CO3	Solve problems on gas laws.	K3&K4
CO4	Apply the chemistry of ethers and epoxides.	K3
CO5	Analyze the compounds formed by p-block elements.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	L		S	S	M	L	L
CO2	S	S	S	M	L		S	S	S	M	M
CO3	S	S	S	S	M		S	S	S	L	M
CO4	S	S	S	S	M		S	S	S	M	M
CO5	S	S	M	S	L		S	S	S	M	M

S – Strong; M – Medium; L – Low

UNIT - I

Solid state-crystalline and amorphous solids - space lattice, unit cell, crystal systems, Bravais lattices. Weiss and Miller indices, number of atoms in simple, face centered and body centered cubic cells. Structure of CsCl and NaCl. Packing of ions in solids - radius ratio, coordination number in ionic crystals. Liquid crystals - types, properties and applications.Crystal defects - stoichiometric defects - Schottky and Frenkel defects. Non – stoichiometric defects-metal excess and metal deficiency defects.

Coordination numbers of cations and anions in ionic crystals from radius ratio.*

UNIT - II

Ideal solutions: Vapour pressure- composition diagrams of solutions. Raoult's law, positive and negative deviations from the law.

Solubility of gases in liquids - Henry's law and its relationship with Raoult's law. Lowering of vapour pressure - thermodynamic derivation for elevation of boiling point and depression of

freezing point. Relationship between osmotic pressure and vapour pressure. van't Hoff's theory of dilute solutions.

Colloids- classification, preparation and purification. Properties- Tyndall effect, Brownian movement, Helmholtz electrical double layer, electrophoresis, electro-osmosis, coagulation and protective action of sols (goldnumber).

Applications of Colloids.*

UNIT – III

Gas Laws - Boyle's, Charles's, Gay Lusac's, Avgadro's, Dalton's law of partial pressure and Graham's law of diffusion. Postulates of kinetic theory of gases-derivation of kinetic gas equation-derivation of gas laws and ideal gas equation. Maxwell's distribution of molecular velocities, root mean square velocity, average velocity and most probable velocity (derivation not necessary). Mean free path, collision diameter and collision frequency. Law of vander Waal's equation and critical state. Relationship between critical constants and vanderWaal's constants.

Problems based on kinetic gas equation.*

UNIT - IV

Ethers-IUPAC nomenclature, preparation- dehydration of alcohols and Williamson synthesis. Chemical properties - formation of oxonium salts, etherate and peroxides, cleavage by acids and halogenation. Determination of alkoxy group by Ziesel's method. Crown ethers – 12 crown 4, and 15 crown 5.

Epoxides- Preparation,chemical reactions – acid hydrolysis, HBr, C_2H_5OH/ C_2H_5ONa, RNH_2 and RMgX.

Thioethers - IUPAC nomenclature, preparation- from alkyl halide, mercaptans and alkenes. Chemical reactions– metal salts, alkyl halides, oxidation, hydrolysis and halogenation.

Preparation, properties and uses of anisole.Orientation of epoxides in ring opening.*

UNIT - V

p-Block Elements: General characteristic of 13 & 14 group elements. Comparison of carbon and silicon. Diagonal relationship between boron and silicon. Chemistry ofdiborane, boron nitride, borazine, boron trioxide, boric acid, carbon disulfide, fullerenes, carbides and fluorocarbons.

Various types of silicates.*

****Self-study***

Books for study:

1. M. K. Jain and S. C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co., 1st Edition, Reprint 2020.
2. R. L. Madan, *Chemistry of Degree students*, S. Chand & Company, 2nd Edition, Reprint 2014.
3. ArunBahl, B. S. Bahl and G. D.Tuli, *Essentials of Physical Chemistry*, S. Chand & Company 28th Edition, 2020.

Books for reference:

1. R. D. Madan, *Modern Inorganic Chemistry*, S. Chand Publishing, 3rd Edition, 2019.
2. B. R. Puri, L. R. Sharma and Madan S. Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., 47th Edition, 2016.

E-resources:

1. https://www.youtube.com/watch?v=YMi6GT2ELbQ
2. https://www.youtube.com/watch?v=sAtAqsrala0
3. https://www.khanacademy.org/science/chemistry/gases-and-kinetic-molecular-theory
4. https://www.khanacademy.org/science/organic-chemistry/alcohols-ethers-epoxides-sulfides
5. https://www.youtube.com/watch?v=XS4SRZ2eMwg

Course Title	**:**	**Core Practical-1:** Inorganic Qualitative Analysis	**Course Code**	**:**	**20UCH2CP1**
Year	**:**	**I**	**Semester**	**:**	**I &II**
Hours/Week	**:**	**4**	**Credit**	**:**	**4**

COURSE OBJECTIVES

1. To admit the skills on identifying the anions and cations in a mixture.
2. To convey the skills on diagnosing and eliminating the interfering anions.
3. To administer competence on the preparation of inorganic complexes.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Identify the anions and cations in a mixture.	K1,K2,K3&K4
CO2	Diagnose and eliminate the interfering anions.	K1,K2,K3&K4
CO3	Synthesise inorganic complexes.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S
CO3	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

A. QUALITATIVE INORGANIC ANALYSIS

1. Semi micro method of analysis of a mixture containing two cations and two anions of which one may be an interfering acid radical requiring elimination during the analysis of basic radical.
2. Radicals for the reactions

Basic radicals - Lead, copper, zinc, bismuth, cadmium, tin, iron,aluminium,manganese, magnesium, cobalt, nickel, calcium, barium, strontium, ammonium

Acid radicals - Sulphate, carbonate, nitrate, chloride, bromide, iodide, oxalate, arsenite,arsenate, phosphate, borate and chromate

B. PREPARATION OF INORGANIC COMPLEXES

Preparation of any four of the following complexes:

Prussian Blue, Tetramminecopper(II)sulphate tetrahydate, Tris(thiourea)copper(II)sulphate dehydrate, Potassiumtrioxalatochromate(III), Potassiumtrioxalato ferrate(III), Hexamminecobalt(III)chloride and Ammonium hexachlorostannate(III)

Book for study:

V. Venkateswaran, R. Veeraswamyand A. R. Kulandaivelu, *Basic Principles of Practical Chemistry*, S. Chand & Sons 2nd Edition, Reprint 2017.

Course Title	**:**	**Core: Inorganic, Organic and Analytical Chemistry**	**Course Code**	**:**	**20UCH3C05**
Year	**:**	**II**	**Semester**	**:**	**III**
Hours/Week	**:**	**6**	**Credit**	**:**	**6**

COURSE OBJECTIVES:

1. To impart skills on volumetric analysis.
2. To provide the chemistry of p-block elements.
3. To facilitate employability in the field of metallurgy.
4. To indulge the knowledge on the trends in properties and reactivity of d-block elements and chemistry of its compounds.
5. To teach the chemistry of alcohols and thiols.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Analyse the given solution quantitatively by volumetric analysis.	K1&K4
CO2	Know the chemistry of p-block elements.	K1&K2
CO3	Fetch employability in the field of metallurgy.	K3&K4
CO4	Perceive knowledge on the trends in properties and reactivity of d-block elements and chemistry of its compounds.	K2
CO5	Apply the chemistry of alcohols and thiols in various fields.	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	M	L		S	S	S	L	M
CO3	S	S	S	S	S		S	S	S	M	M
CO4	S	S	S	S	M		S	S	S	M	M
CO5	S	S	S	S	M		S	S	S	M	M

S – Strong; M – Medium; L Low

UNIT – I

Theory of Volumetric analysis-Classification, standard solution, primary and secondary standards, concentration units – percentage (W/V & V/V), molarity, molality and normality. Acid-base titrations - choice of indicators and theory of acid base indicators. Redox titrations-self indicators and external indicators. Principles and applications of iodimetry, iodometry and dichrometry. Precipitation titrations–estimation of halides and thiocyanates.

EDTAcomplexometrictitration.*

UNIT – II

Group 15 (Nitrogen family): Properties, structure and uses of Hydrides – N_2H_4, N_2H_4OH, HN_3, and PH_3; Halides – NF_3, PCl_3, and PCl_5. Oxides – N_2O_4, N_2O_5, P_2O_3, P_2O_5; Oxoacids of nitrogen and phosphorus: Oxidation state and structure; Preparation and properties of nitric acid and phosphoric acid.

Group 16 (Oxygen family): Oxidation state and Structure of oxides and oxoacids of sulphur; Preparation and properties of H_2SO_3, and H_2SO_4.

Preparation and properties of Caro's and Marshall's acid.*

UNIT – III

Metallurgy: Methods of concentration of ores - gravity separation, froth flotation, magnetic separation and chemical separation. Extraction –roasting, calcination and smelting. Purification of metals: electrolysis, zone-refining and VanArkel method. Ellingham diagram - reduction of metal oxides using carbon and carbon monoxide.

Group 17 (Halogen family): A comparative study on oxides and oxyacids of halogens with respect to oxidation state, oxidizing power, acidic nature and structure.

Structure and properties of pseudo halides - cyanide, thiocyanateand azide.*

UNIT- IV

Transition elements- General characteristics, position in the periodic table, general trends with reference to electronic configuration, variable valency, colour, magnetic, catalytic properties, complex formation and stability of various oxidation states (Latimer diagrams ofMn, Fe and Cu).

Occurrence, extraction, properties and uses of titanium and vanadium. Chemistry of titanium dioxide, vanadium pentoxide, ammonium molybdate, potassium permanganate and potassium dichromate.

Chemistry of titanium tetrachloride and tungstic acid.*

UNIT-V

Alcohols: Classification and nomenclature, monohydric alcohols. Preparation –hydroboration, reduction of carbonyl compounds, epoxidation and Grignard method. Properties - boiling point, solubility and acidic nature. Chemical reactions of alcohols. Preparation, properties and uses of ethylene glycol and glycerol. Interconversion of alcohols (primary to secondary, Primary to tertiary, secondary to tertiary).Breathalyzer Test.

Thiols: Introduction, nomenclature, preparation, physical and chemical properties and uses.

Distinction between alcohols (Lucas, Victor-Meyer and dichromate test).*

****Self-study***

Books for study:

1. B.R. Puri, L. R. Sharma and K. C. Kalia, *Principles of Inorganic chemistry*, Milestone Publishers, 33rdEdition, 2016.
2. P. L. Soni, Katyal Mohan, *Text Book of Inorganic Chemistry*, S Chand & Sons 2017.
3. ArunBahland B. S. Bahl, A *Textbook of Organic Chemistry*, S Chand & Company 22nd Edition, 2016.
4. R. Gopalan, P.S. Subramanian, K. Rengarajan,*Elements of Analytical Chemistry*, Sultan Chand & Sons, 3rd Edition, 2004.
5. V. Venkateswaran, R. Veeraswamyand A. R. Kulandaivelu, *Basic Principles of Practical Chemistry*, S. Chand & Sons 2nd Edition, Reprint 2017.

Books for reference:

1. J. Huheey, E. Keiter, R. Keiterand O. Medhi,*Inorganic Chemistry*, 4th Edition,Pearson Education India,2009.
2. J.D. Lee, *Concise Inorganic Chemistry*,Wiley India, 5th Edition, 2015.

E-resources:

1. https://www.khanacademy.org/science/ap-chemistry-beta/x2eef969c74e0d802:chemical-reactions/x2eef969c74e0d802:introduction-to-titration/v/titration-introduction
2. https://www.youtube.com/watch?v=JBgbUI3pxV0
3. https://www.youtube.com/watch?v=TXJ0ffXyLq0&list=PLaySzQJTCO1mBSvv9MFtYVavsyw68nXMF

Course Title	**:**	**Core:** Physical, Organic and Analytical Chemistry	**Course Code**	**:**	**20UCH4C06**
Year	**:**	**II**	**Semester**	**:**	**IV**
Hours/Week	**:**	**6**	**Credit**	**:**	**6**

COURSE OBJECTIVES:

1. To facilitate employability by inculcating the basic principles and applications of gravimetric analysis.
2. To impart problem solving skills in the field of Thermodynamics.
3. To provide the significance of thermochemistry.
4. To deliver the concepts of chemical equilibrium.
5. To give the chemistry of phenols.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Earn employability in industries using the principles and applications of gravimetric analysis.	K3&K4
CO2	Solve problems in the field of thermodynamics.	K3&K4
CO3	Equip with the significance of thermochemistry.	K2
CO4	Know the concepts of chemical equilibrium.	K1
CO5	Analyse the chemistry of phenols.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	L		S	S	S	M	S
CO3	S	S	S	S	S		S	S	S	M	M
CO4	S	S	S	M	M		S	S	S	L	M
CO5	S	S	S	S	M		S	S	S	M	M

S – Strong; M – Medium; L - Low

UNIT-I

Theory of gravimetric analysis-methods &conditions of precipitation and choice of precipitants. Types of organic precipitants and sequestering agents.Solubility product and precipitation. Factors affecting the solubility of precipitates, co-precipitation and post precipitation. Procedure to minimise co-precipitation and post-precipitation. Precipitation from homogeneous solution. Types of crucibles - sintered, silica and porcelain.

Washing and drying of precipitates.*

UNIT-II

Thermodynamics-Introduction, terminology, thermodynamic equilibrium, nature of work and heat. First law-statement and significances, internal energy and enthalpy. Heat capacity-correlation between Cp and Cv. Workdone, enthalpy and internal energy change during isothermal and adiabatic processes.Joule-Thomson effect and coefficient in real and ideal gases.

Statement and significance of zeroth law.*

UNIT-III

Thermochemistry-Exothermic and endothermic reactions, relation between heat and energy, Kirchoff's equations, Hess's law and its applications. Second law of thermodynamics–need, statements, cyclic process and Carnot's cycle. Efficiency of heat engine andCarnot theorem. Entropy – definition andphysical significance. Entropy changes in reversible and irreversible processes. Work and free energy functions, variation of free energy changes with temperature and pressure. Maxwell's relations.

Derivation of Gibbs-Helmholtz equation.*

UNIT-IV

Nernst heat theorem andThird law of thermodynamics – need and statement.

Partial molar properties- chemical potential and its significances, derivation of Gibb's-Duhem and Clausius-Clapeyron equation.

Chemical equilibrium- introduction, law of mass action, Van't Hoff reaction isotherm and relation between K_p and K_c. Determination of K_p for dissociation of $N_2O_4$and $CaCO_3$.van'tHoff equation. Le Chatelier's principle and applications.

Determination of K_p for dissociation of PCl_5.*

UNIT-V

Phenol - preparation, resonance structures, acidity of phenol and substituted phenols. Bromination, nitration, oxidation, reduction, Schotten-Baumann, phthalein fusion and coupling reactions. Mechanisms of Reimer-Tiemann and Kolbe-Schmidt reactions. Tests for phenol. Preparation and properties of o-cresol, catechol, resorcinol, pyrogallol, phloroglucinol, and quinol. **Benzenesulphonicacid** - preparation and properties. Bacterostatic action of sulphanilamide.

Preparation and properties of benzene suphanilicacid.*

Self-study

Books for study:

1. ArunBahl, B. S. Bahl and G. D.Tuli, *Essentials of Physical Chemistry*, S. Chand & Company 28th Edition, 2020.
2. M. K. Jain and S. C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co., 1st Edition, Reprint 2020.
3. R. D. Madan, *Modern Inorganic Chemistry*, S. Chand Publishing, 3rd Edition, 2019.

Books for reference:

1. B.R. Puri, L. R. Sharma and K. C. Kalia, *Principles of Inorganic chemistry*, Milestone Publishers, 33rdEdition, 2016.
2. B. R. Puri, L. R. Sharma and Madan S. Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., 47th Edition, 2016.

E-resources:

1. https://www.khanacademy.org/science/ap-chemistry/stoichiometry-and-molecular-composition-ap/limiting-reagent-stoichiometry-ap/a/gravimetric-analysis-and-precipitation-gravimetry
2. https://www.khanacademy.org/science/chemistry/thermodynamics-chemistry
3. https://www.youtube.com/watch?v=h-dXz6E-kBw

Course Title	**:**	**Core Practical -2:** Volumetric and Organic Qualitative Analysis	**Course Code**	**:**	**20UCH4CP2**
Year	**:**	**II**	**Semester**	**:**	**III & IV**
Hours/Week	**:**	**4**	**Credit**	**:**	**4**

COURSE OBJECTIVES:

1. To enhance the skills in volumetric analysis.
2. To inculcate the skills of organic qualitative analysis.
3. To provide competence on the preparation and recrystallization of organic compounds.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Enhance their skills in volumetric analysis.	K1,K2,K3&K4
CO2	Perform organic qualitative analysis.	K1,K2,K3&K4
CO3	Prepare and produce fine crystals of organic compounds.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S
CO3	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

A- VOLUMETRIC ANALYSIS

Acidimetry and Alkalimetry

1. Estimation of sodium carbonate using link hydrochloric acid and standard sodium carbonate.
2. Estimation of hydrochloric acid using link sodium hydroxide and standard oxalic acid.
3. Estimation of carbonate and bicarbonate in a mixture by Warder's method.

Permanganometry

4. Estimation of ferrous iron using link $KMnO_4$ and standard oxalic acid.
5. Estimation of oxalic acid using link $KMnO_4$ and standard ferrous ammonium sulphate.
6. Estimation of calcium using link $KMnO_4$ and standard oxalic acid.

Dichrometry

7. Estimation of ferric iron using standard $K_2Cr_2O_7$ and external indicator potassium ferricyanide.
8. Estimation of ferric iron using standard $K_2Cr_2O_7$ and internal indicator diphenylamine.
9. Estimation of $K_2Cr_2O_7$ using link sodium thiosulphate and standard potassium dichromate.

Iodometry and iodimetry

10. Estimation of copper using link sodium thiosulphate and standardpotassium dichromate.
11. Estimation of arseneous oxide using link iodine and standardarseneous oxide.

Argentometry (demonstration)

12. Estimation of chloride using link silver nitrate and standard sodium chloride.
13. Estimation of hardness of water by EDTA method.

B -ORGANIC CHEMISTRY PRACTICALS

Qualitative analysis of monofunctional groups:

Organic compounds containing any one of the following functional groups/compounds may be given for analysis: Carboxylic acids, Esters, Aldehydes, Ketones, Nitrocompounds, Amines, Carbohydrates, Amides, Phenols/Naphthols, Dihydric phenols, Urea and Thiourea.

C -ORGANIC PREPARATIONS

1. Preparation of acetanilide from aniline.
2. Preparation of benzanilide from aniline.
3. Benzoic acid from ethylbenzoate.
4. *p*-bromoacetanilide from acetanilide.
5. Preparation of Aspirin.
6. Preparation of nitrobenzene.
7. Preparation of glucosazone.
8. Salicylic acid from methyl salicylate.

Books for reference:

1. Brain S. Furniss*et. al.,Vogel's Textbook of Practical Organic Chemistry*, 5th Edition, Pearson Education India, 2005.
2. V. Venkateswaran, R. Veeraswamyand A. R. Kulandaivelu, *Basic Principles of Practical Chemistry*, S. Chand & Sons, 2nd Edition, Reprint 2017.
3. A. Thomas, *Practical Chemistry*, Scientific Book Centre, Cannanore, Kerala, 2003.

Course Title	**:**	**Core: Coordination Chemistry**	**Course Code**	**:**	**20UCH5C07**
Year	**:**	**III**	**Semester**	**:**	**V**
Hours/Week	**:**	**5**	**Credit**	**:**	**5**

COURSE OBJECTIVES:

1. To introduce the basics of coordination compounds.
2. To enrich problem solving skills in the theories of coordination chemistry.
3. To give the application of coordination complexes.
4. To admit the fundamentals of organometallic chemistry and chemistry of metal-carbonyls.
5. To furnish the importance and role of metal ions in biological systems.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Gain the basics of coordination compounds.	K1
CO2	Solve problems in theories of coordination chemistry.	K2&K3
CO3	Know the applications of coordination complexes.	K3
CO4	Popularize with the fundamentals of organometallic chemistry and chemistry of metal-carbonyls.	K1
CO5	Acquaint the importance and role of metal ions in biological systems.	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	L		S	S	S	L	M
CO2	S	S	S	S	L		S	S	S	L	M
CO3	S	S	S	L	L		S	S	S	L	M
CO4	S	S	S	L	L		S	S	S	L	M
CO5	S	S	S	S	M		S	S	S	M	M

S – Strong; M – Medium; L – Low

UNIT-I

Introduction- Terminology, classification of ligands and IUPAC nomenclature of mononuclear and dinuclearcomplexes.Werner's theory - postulates and its experimental evidences.

Isomerism - structural isomerism -ionization, hydrate, linkage, coordination and ligandisomerisms. Stereo isomerism -geometrical isomerism of square planar and octahedral complexes of $[Ma_2b_2]$, $[Ma_2bc]$, $M(AB)_2$, Ma_4b_2, Ma_3b_3, $M(AB)_3$, and $Ma_2b_2c_2$ types. Optical isomerism in octahedral complexes ofMa_4b_2, Ma_3b_3, $Ma_2b_2c_2$ and $M(AA)_2a_2$ types.

Distinction between cis- and trans- isomers.*

UNIT-II

Theories of Metal-Ligand bonding- Sidgwick'stheory and EAN rule. Valence bond theory – postulates, applications of VBT to tetrahedral, square planar, and octahedral complexes – limitations. Crystal field theory – splitting of *d* orbitals in octahedral and tetrahedral complexes. Factors affecting the magnitude of crystal field splitting. Effect of crystal field splitting –highspin and lowspin complexes -spectrochemical series - applications of CFT to magnetic property and colour of complexes - limitations.

Calculation of Crystal field stabilization energy.*

UNIT-III

Magnetic properties-types of magnetic behaviour, spin-only formula, calculation of magnetic moment, experimental determination of magnetic susceptibility – Gouy method.
Applications- complexometric titrations – principle and applications. Qualitative separation of silver and mercury, copper and cadmium ions.Gravimetric estimation of nickel using DMG and aluminium using oxine. Estimation of hardness of water using EDTA.
Qualitative analysis of Cobalt, Zinc and Iron.*

UNIT-IV

Organometallic compounds-introduction - definition and classification of organometallic compounds based on bond type.Nature of Metal-Carbon bond. Metal carbonyls - 18 electron rule, electron count of mononuclear and binuclear complexes of 3*d* series. General methods of preparation, properties and structure of $Ni(CO)_4$, $Mn_2(CO)_9$, $Fe(CO)_5$, $Co_2(CO)_8$.

Preparation, properties and uses of Zeise's salt and Ziegler-Natta Catalyst.*

UNIT-V

Bio-Inorganic chemistry: Biological functions and toxicity of trace elements: Cr, Mn, Cu, Ar, Hg, Cd, Fe, Mo. Se. Zn, I, Pb. Role of Na^+, K^+, Mg^{2+}, and Ca^{2+}in biological system. Structure and functions ofhemoglobin and chlorophyll. Structure and functions of carbonic anhydrase.Nitrogen fixation in atmosphere.

Structure and functions of myoglobin and Carboxypeptidase.*

****Self-study***

Books forstudy:

1. Ajai Kumar, *Coordination Chemistry*, Aaryush education, 7th Edition, 2021.
2. R. Gopalan and V Ramalingam, *Concise Coordination Chemistry*, Vikas Publishing,1stEdition, 2018.
3. B.R. Puri, L. R. Sharma and K. C. Kalia, *Principles of Inorganic chemistry*, Milestone Publishers, 33rd Edition, 2016.

Books for reference:

1. D.F. Shriver, P.W. Atkins, *Inorganic Chemistry*, Oxford University Press, 5th Edition, 2010.
2. F.A. Cotton, andG. Wilkinson, *Basic Inorganic Chemistry*, Wiley, 3rd Edition 1996.
3. J. Huheey, E. Keiter, R. Keiterand O. Medhi, *Inorganic Chemistry*, 4th Edition, Pearson Education India, 2009.

E-resource:

https://www.youtube.com/watch?v=BZ_tY88o0oI&list=PLbMVogVj5nJTWU1tCPCtLBaiWNsJRAiZZ

Course Title	**:**	**Core: Organic Chemistry**	**Course Code**	**:**	**20UCH5C08**
Year	**:**	**III**	**Semester**	**:**	**V**
Hours/Week	**:**	**5**	**Credit**	**:**	**5**

COURSE OBJECTIVES

1. To deliver the chemistry of phenols and aromatic acid derivatives.
2. To enrich the knowledge on the mechanisms of organic reactions.
3. To explain the reactivity and basicity of aliphatic and aromatic amines.
4. To employ the significance of heterocyclic compounds and natural products.
5. To enhance the knowledge on the applications of molecular rearrangement reactions.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Know the chemistry of phenols and aromatic acid derivatives.	K1
CO2	Analyse the mechanisms of organic reactions.	K3&K4
CO3	Compare the reactivity and basicity of aliphatic and aromatic amines.	K4
CO4	Realise the significance of heterocyclic compounds and natural products.	K2
CO5	To enhance the knowledge on the applications of molecular rearrangement reactions.	K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	L		S	S	S	L	M
CO2	S	S	S	S	L		S	S	S	L	M
CO3	S	S	S	M	L		S	S	S	M	M
CO4	S	S	S	S	S		S	S	S	S	S
CO5	S	S	S	S	M		S	S	S	M	M

S – Strong; M – Medium; L – Low

UNIT-I

Aliphatic and Aromatic Aldehydes & Ketones–structure, reactivity and preparation. Mechanism of nucleophilic addition reaction - ammonia and its derivatives. Mechanisms of aldol (Simple & Cross), benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro, Wittig and haloform reactions. Oxidation with Ag_2O, $KMnO_4$, PCC, and PDC. Reduction with $LiAlH_4$, and $NaBH_4$. Michael addition. Tautomerism of ethyl acetoacetate.

Reduction with $NaCNBH_3$ and oxidation with pyridine-N-oxide.*

UNIT-II

Carboxylic acids- preparation and properties of formic, acetic, benzoic, oxalic, malonic and succinic acids. Relative acidity of carboxylic acids. Action of heat on formic, acetic, oxalic, malonic and succinic acids. Mechanism of hydrolysis of esters by $B_{AC}2$ and $A_{AC}2$. **Diethyl malonate** – preparation. Synthesis of acetic acid, adipic acid, cinnamic acid, glycine and malonyl urea from

diethyl malonate. **Ethylacetoacetate**– preparation. Synthesis of succinic acid, crotonic acid, butanone, 4-methyl uracil and antipyrine from ethyl acetoacetate.

Preparation and properties of maleic and fumaricacids.*

UNIT-III

Nitrobenzene – preparation, reduction (acidic, neutral, alkaline and electrolytic).**Amines** – preparation, separation (Hinsberg method), properties of aliphatic primary, secondary and tertiary amines. Aniline - preparation and reactions. Basicity of aliphatic and aromatic amines. **Benzene diazonium chloride** – preparation, and coupling reaction with aniline. Synthesis of phenol, benzene, benzoic acid, halo benzenes and nitrobenzene from benzene diazonium chloride.

Separation of amines by Hoffmann method.*

UNIT-IV

Heterocyclic compounds– preparation, basicity, electrophilic & nucleophilic substitution, oxidation and reduction reactions of pyrrole, furan, thiophene and pyridine. Synthesis of quinoline (Skraup), isoquinoline (Bischler-Napieralski) and Indole (Fischer-Indole) – electrophilic and nucleophilic reactions.**Terpenoids**-isolation and isoprene rule. Structural elucidation and synthesis of α-terpeniol.

Structural elucidation and synthesis of geraniol.*

UNIT-V

Alkaloids–isolation, structural elucidation and synthesis of coniine.**Molecular rearrangements**-mechanisms of pinacol-pinacolone, Beckmann,benzidine, Hoffmann, Curtius, Schmidt, benzil-benzilic acid, Claisen, Fries, and Wolf rearrangements.

Structural elucidation and synthesis of nicotine.*

Self-study

Books for study:

1. B. S. Bahl and ArunBahl, *Advanced Organic Chemistry*, S Chand & Company, 5thEdition, 2012.
2. O. P. Agarwal, *Organic Chemistry Reactions and Reagents*, Krishna Prakashan Media (P) Ltd, 56th Edition, 2017.
3. M. K. Jain and S. C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co., 1st Edition, Reprint 2020.

Books for reference:

1. T.W. Solomons, G. Fryhle, B. Craig. *Organic Chemistry*, John Wiley & Sons, 10th Edition, 2012.
2. P. Sykes, *A Guide Book to Mechanism in Organic Chemistry*, Pearson Education India, 6thEdition, 2003.
3. R.T. Morrison and R. N. Boyd, *Organic Chemistry*, 6thEdition,Pearson Education India, 2016.

E-resources:

1. https://www.youtube.com/watch?v=L1J-KJiD_Ug

2. https://www.khanacademy.org/science/organic-chemistry/aromatic-compounds/aromatic-stability/v/aromatic-heterocycles-i
3. https://www.youtube.com/watch?v=h1Z1iwhbtBo
4. https://www.youtube.com/watch?v=OxQzr6tXYFQ

Course Title	**:**	**Core: Electrochemistry**	**Course Code**	**:**	**20UCH5C09**
Year	**:**	**III**	**Semester**	**:**	**V**
Hours/Week	**:**	**5**	**Credit**	**:**	**5**

COURSE OBJECTIVES

1. To enhance the knowledge on electrolytes.
2. To administer the significance of pH and buffer solutions.
3. To afford ideas on EMF.
4. To give basic skills on potentiometry.
5. To facilitate the progression in the area of electrochemistry.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Have knowledge on electrolytes.	K1
CO2	Understand the significance of pH and buffer solutions.	K2
CO3	Fetch ideas on EMF.	K1&K2
CO4	Acquire skills on potentiometry.	K2
CO5	Progress in the area of electrochemistry.	K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	L		S	S	S	L	M
CO2	S	S	S	M	L		S	S	S	L	M
CO3	S	S	S	M	L		S	S	S	L	M
CO4	S	S	S	S	S		S	S	S	M	S
CO5	S	S	S	S	M		S	S	S	M	M

S – Strong; M – Medium; L – Low

UNIT – I

Ionic mobility - Ohm's law and electrical units. Arrhenius theory of electrolytic dissociation and its limitations.Electrolysis – Faraday's laws of electrolysis. Conductance of electrolytes.Variation of specific and molar conductances with dilution. Ionic mobility – abnormal mobilities of hydrogen & hydroxyl ions and Walden's rule.Transport number- determination by Hittorf's and moving boundary methods. Kohlrausch's law and its applications.Applications of conductance measurements - determination of solubility product, degree of dissociation, ionic product of water and conductometric titrations – acid-base and precipitation.

Types of electrolytes, Ostwald's dilution law and its limitations.*

UNIT – II

Inter-ionic effects - Debye-Huckel theory of strong electrolytes. Debye-Falkenhagenand Wein effects.Activity and activity coefficient of strong electrolytes (definition only).**Dissociation of weak acids and bases** – relative strengths.pH and pH scale, common ion effect and solubility product - applications of solubility product principle. **Buffer solutions** - types of buffers and buffer action -

Henderson's equation. **Hydrolysis of salts** - hydrolysis constant and degree of hydrolysis of salts of weak acids& strong bases and weak acids & weak bases.

Hydrolysis of salts - hydrolysis constant and degree of hydrolysis of salts ofstrong acids &weak bases.*

UNIT – III

Electromotive force - electrochemical cells - galvanic cells - cell terminology - representation of cell - calculation of EMF of the cell.Reversible and irreversible cells. Types of electrodes –metal-metal ion electrode, gas electrode- standard hydrogen electrode, amalgam electrode, metal-insoluble salt electrode-calomel and Ag/AgCl, oxidation-reduction electrodes. Single electrode potential - determination. Nernst equation for electrode and cell potentials. Electrochemical series and its applications. Thermodynamic concept of electrode potential.Relation between EMF and thermodynamic quantities ΔG, ΔH, ΔS and their significance.

Weston standard cell.*

UNIT – IV

Concentration cells - types - derivation of EMF of concentration cells with and without transference. Liquid Junction potential - definition (derivation not necessary) and its elimination. Application of EMF measurements - potentiometric titrations - acid base, precipitation and redox titrations – determination of solubility of a sparingly soluble salt,determination of pH using glass, quinhydrone electrode.

Determination of pH using hydrogen electrodes.*

UNIT – V

Metallic coating – introduction, anodic and cathode coatings. Coating processes – metal cladding and hot dipping – galvanishing, tinning, electroless plating. Electroplating and its applications. **Corrosion** – electrochemical principle of rusting of iron, prevention of corrosion-barrier, sacrificial and cathodic protections. Passivity of metals.**Commercial cells** – Acid storage battery. Rechargeable cells – nickel cadmium and lithium ion cells. Fuel cells – Hydrogen-oxygen fuel cell.

Hydrocarbon-oxygen fuel cell.*

****Self-study***

Books for study:

1. B. R. Puri, L. R. Sharma and Madan S. Pathania, *Principles of Physical Chemistry*,Vishal Publishing Co., 47th Edition, 2016.
2. ArunBahl, B. S. Bahl and G. D.Tuli, *Essentials of Physical Chemistry*,S. Chand & Company, 28th Edition, 2020
3. P. L. Soni, D. P. Dharmarha and U. N. Dash,*Text Book of Physical Chemistry*, Sultan Chand & Sons, 23rd Edition, 2016.
4. B.K. Sharma, *Industrial Chemistry*, KrishanPrakashan Media (P) Ltd., 17th Edition, 2014.

Book for reference:

1. S. Glasstone, *An Introduction to Electrochemistry*, Maurice Press, 2011.

E-resource:

https://www.youtube.com/watch?v=PH1DR0c-jqw

Course Title	**:**	**Core: Spectroscopy**	**Course Code**	**:**	**20UCH5C10**
Year	**:**	**III**	**Semester**	**:**	**V**
Hours/Week	**:**	**5**	**Credit**	**:**	**5**

COURSE OBJECTIVES

1. To provide the fundamental concepts of electromagnetic spectrum.
2. To train in analysing the compounds through IR spectroscopy.
3. To teach the applications of electronic spectroscopy.
4. To impart knowledge on NMR spectroscopy.
5. To inculcate the significance of Mass spectrometry.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Know the fundamental concepts of electromagnetic spectrum.	K1
CO2	Analyse the compounds through IR spectroscopy.	K3&K4
CO3	Characterise the compounds using electronic spectroscopy.	K3&K4
CO4	Have knowledge on NMR spectroscopy.	K3&K4
CO5	Recognise the significance of Mass spectrometry.	K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	L		S	S	S	L	M
CO2	S	S	S	M	L		S	S	S	L	M
CO3	S	S	S	M	L		S	S	S	L	M
CO4	S	S	S	S	S		S	S	S	S	S
CO5	S	S	S	S	M		S	S	S	M	M

S – Strong; M – Medium; L – Low

UNIT- I

Atomic and molecular spectroscopy-absorption and emission spectra. Spectroscopy, spectrometry and spectrum. Electromagnetic radiation, wavelength, wave number, frequency and energy. Regions of electromagnetic spectrum and absorption of radiation by organic molecules. Different types of molecular energies. **Microwave spectroscopy**-principle and theory. Diatomic molecule as a rigid rotor-selection rule-instrumentation. Applications of rotational spectroscopy-structures of xenon oxyfluoride and benzonitrile.

Different types of molecular spectroscopy.*

UNIT- II

IR Spectroscopy - theory-molecular vibrations-vibrational frequency-force constant vibrational energy-zero point energy- vibrational degrees of freedom for liner and nonliner molecules and selection rules. Factor affecting Vibrational frequencies-coupled vibration, Fermi resonance and electronic effects. Instrumentation (block diagram only). Finger print region, overtones, combination and difference frequencies. Applications of IR spectroscopy-qualitative analysis (determination of functional groups).

Distinction betweentwo types of hydrogen bonding and study of keto-enol tautomerism.*

UNIT- III

Electronic Spectroscopy - Beer's and Lambert's law. Theory of electronic spectroscopy-types of electronic transitions. Franck-Condon principle, Chromophores and auxochormes. Absorption and intensity shifts-bathochromic, hypsochromic, hyperchromic, and hypochromic shifts. Types of absorption bands. Instrumentation (block diagram only). Woodward-Fieser rules for calculating λ_{max} in conjugated dienes.

Applications togeometrical isomers.*

UNIT- IV

NMR Spectroscopy - theory- number of signals-equivalent and non-equivalent protons. Instrumentation (block diagram only). Chemical shift and reference standard. Factors affecting chemical shift-shielding and deshielding-anisotropy with reference to ethylene, acetylene and benzene. Spin – Spin Coupling. Rules of splittingsignals-splitting of signals with reference to 1,1,2-tribromoethane, ethanol andacetaldehyde. Coupling constant (elementary idea only) NMR spectra of ethyl bromide, 2-chloropropane andacetamide.

Coupling constant (elementary idea only) NMR spectra of toluene and 1,4-dioxane.*

UNIT- V

Mass Spectrometry- basic principles and theory. Instrumentation - single focusing mass analyser-presentation of mass spectrum. Nitrogen rule-isotopic peaks, metastable ions and peak, molecular ion peak and base peak. McLafferty rearrangement and Retero Diels – Alder reaction.Fragmentation of ethanol and isopropanol.

Fragmentation of* t*-butanol.*

****Self-study:***

Books for study:

1. Y. R. Sharma,*Elementary organic Spectroscopy*,S. Chand & Company, 5th Edition, 2013.

2.Jag Mohan, *Organic Spectroscopy Principles and Applications*,Narosa Publishing House, 2nd Edition, 2009.

Book for reference:

P.S. Kalsi,*Spectroscopy of Organic Compounds*, New Age International, 18th Edition,2020.

E-resource:

https://www.youtube.com/watch?v=QSztChmDY44

Course Title	**:**	**Core: Conceptual Aspects of Chemistry**	**Course Code**	**:**	**20UCH5C11**
Year	**:**	**III**	**Semester**	**:**	**V**
Hours/Week	**:**	**Self-Study**	**Credit**	**:**	**2**

COURSE OBJECTIVES

1. To train for competitive examinations
2. To develop problem solving competency

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Take competitive examinations easily	K1,K2,K3&K4
CO2	Have problem solving competency	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

Basic concepts in

Atomic structure, chemical bonding, periodic properties, s and p block elements, transition elements, coordination compounds and nuclear chemistry.

Gaseous state, solid state, thermodynamics, chemical equilibrium, chemical kinetics, catalysis, colloids and electrochemistry.

Isomerism, hydrocarbons, halogen compounds, hydroxyl derivatives, carbonyl compounds, ethers, carboxylic acids, nitro compounds, amines and diazonium salts.

Course Title	**:**	**Elective Practical - 1: Industrial Chemical Analysis**	**Course Code**	**:**	**20UCH5EP1**
Year	**:**	**III**	**Semester**	**:**	**V**
Hours/Week	**:**	**3**	**Credit**	**:**	**2**

COURSE OBJECTIVES

1. To provide necessary skills required in water analysis.
2. To enhance the employability skills.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Have necessary skills required in water analysis.	K1,K2,K3&K4
CO2	Fetch employability.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

Water Analysis

1. Estimation of permanent hardness
2. Estimation of temporary hardness
3. Estimation of total hardness by EDTA method
4. Determination of drinking water quality using water analysis kit
5. Estimation of calcium, magnesium, chloride and dissolved oxygen using water analysis kit (i.e., demonstration only)
6. Estimation of total solids
7. Estimation of total suspended solids
8. Estimation of total dissolved solids (Gravimetric method)
9. Determination of dissolved oxygen
10. Determination of chemical oxygen demand

Books for reference:

1. O. P. Vermani and A. K. Narula, *Applied Chemistry Theory and Practice*, New Age International, 2nd Edition, 2017.
2. J. Bassett, R. C. Denney, G. H. Jeffery, J. Mendham, *Vogel's Text Book of Quantitative Inorganic Analysis*, John Wiley & Sons, 5th Edition,1989.

Course Title	**:**	**Core: Inorganic Chemistry**	**Course Code**	**:**	**20UCH6C12**
Year	**:**	**III**	**Semester**	**:**	**VI**
Hours/Week	**:**	**5**	**Credit**	**:**	**5**

COURSE OBJECTIVES

1. To impart the basic aspects of oxidation number and its calculations.
2. To deliver the chemistry of noble gases and inter-halogen compounds.
3. To convey the concepts of acid-base theory.
4. To create awareness on nuclear reactions.
5. To drop idea on the chemistry of*f*-block elements.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Calculate the oxidation number of elements in various compounds.	K1&K2
CO2	Acquire knowledge on chemistry of noble gases and inter-halogen compounds.	K1&K2
CO3	Analyse the concepts of acid-base theory.	K3&K4
CO4	Have awareness on nuclear reactions.	K1&K2
CO5	Know the chemistry of f-block elements.	K1&K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	L		S	S	S	L	M
CO2	S	S	S	M	L		S	S	S	L	M
CO3	S	S	S	M	L		S	S	S	L	M
CO4	S	S	S	S	S		S	S	S	S	S
CO5	S	S	S	M	L		S	S	S	M	M

S – Strong; M – Medium; L – Low

UNIT – I

Oxidation number - covalency and oxidation number, difference between oxidation number and valency. Rules for calculating oxidation number. Oxidation and reduction, common oxidizing agents and reducing agents. Balancing redox equations using oxidation number method.

Oxides: Classification based on oxygen content and chemical behaviour. H_2O_2: preparation, structure, andproperties.

Calculation of volume strength and uses of H_2O_2.*

UNIT –II

Noble gases – occurrence, isolation, inertness and uses. Clathrate compounds.Preparation, structure and properties of XeF_2, XeF_4, XeF_6, XeO_3 and $XeOF_4$.

Interhalogen compounds - preparation, structure, properties and uses of ICl, IBr, ICl_3, IF_5, and IF_7.

Preparation, properties, uses and structures of ClF, and ClF_3.*

UNIT –III

Acids and Bases - Arrhenius concept, Lowry - Bronsted concept - conjugate acid - base pair, Lewis concept. Relative strength of acids and bases-effect of solvent, levelling effect-polarity and dielectric constant. Hard and Soft Acids, Bases (HSAB) principle, and their applications.

Non-aqueous solvents-classification of solvents, characteristic properties of a solvent. Physical properties, chemical reactions, advantages and limitations of liquid ammonia, and liquid sulphur dioxide.

Relative strength of acids and bases –effect of electron releasing and electron withdrawingsubstituents, oxidation number of central atom and resonance effect.*

UNIT-IV

Nuclear Chemistry - composition of nucleus, properties of α, β and γ rays, nuclear forces (meson theory) - nuclear stability- mass defect, binding energy, packing fraction, n/p ratio and magic numbers. Isotopes, isobars, isotones, isomers, and mirror nuclei (basic idea only). Detection of isotopes by Aston's mass spectrograph method. Radioactive disintegration- modes of decay, rate of disintegration, half-life period, average life and radioactive disintegration series. Nuclear fission- atom bomb, nuclear power generator, nuclear fusion - hydrogen bomb and stellar energy.

Uses of radioactive isotopes- in medicine, analytical chemistry and carbon dating.*

UNIT-V

***f*-Blockelements** -position in the periodic table, lanthanides - electronic configuration, oxidation states, lanthanide contraction - cause and consequences, complex formation, occurrence and extraction from monazite, separation of monazite by ion exchange method. Compounds of lanthanum - oxides and halides, uses of lanthanides. Actinides: general features of actinides - electronic configuration, oxidation states, ionic radius, actinide contraction, colour of ions and formation of complexes. Separation of Np, Pu and Am from uranium, and trans uranic elements.

Similarities and differences between lanthanide and actinides.*

Self-Study:

Books for study:

1. R. D. Madan, *Modern Inorganic Chemistry*, S. Chand Publishing, 3rd Edition, 2019.
2. B.R. Puri, L. R. Sharma and K. C. Kalia, *Principles of Inorganic chemistry*, Vishal Publishing Co., 33rdEdition, 2020.
3. P. L. Soni, Katyal Mohan, *Text Book of Inorganic Chemistry*, S Chand & Sons 2017.

Books for reference:

1. J. Huheey, E. Keiter, R. Keiterand O. Medhi, *Inorganic Chemistry*, 4th Edition, Pearson Education India, 2009.
2. J.D. Lee, *Concise Inorganic Chemistry*,Wiley India, 5th Edition, 2015.
3. James E. House, *Inorganic Chemistry*, Reed Elsevier India Pvt.Ltd, 1st Edition, 2010.

E-resources:

1. https://www.youtube.com/watch?v=DvYs1HILq1g
2. https://www.youtube.com/watch?v=FM2MpMbV0rw
3. https://www.youtube.com/watch?v=hFG8-ukxIQE
4. https://www.youtube.com/watch?v=zm6u-XW_Qso

Course Title	**:**	**Core: Stereochemistry, Free Radicals and Biomolecules**	**Course Code**	**:**	**20UCH6C13**
Year	**:**	**III**	**Semester**	**:**	**VI**
Hours/Week	**:**	**5**	**Credit**	**:**	**5**

COURSE OBJECTIVES

1. To transmit knowledge on stereoisomerism.
2. To teach the conformations of organic molecules.
3. To make awareness on free radicals.
4. To generate familiarity with addition reactions of alkenes.
5. To inculcate the significance of biomolecules.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Gain comprehensive knowledge on optical and geometrical isomerism.	K1&K2
CO2	Know about various conformations of organic molecules.	K2
CO3	Have awareness on free radicals and their reactions.	K1&K2
CO4	Familiarise with addition reactions of alkenes.	K1&K2
CO5	Understand the significance of biomolecules.	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	L		S	S	S	L	M
CO2	S	S	S	M	L		S	S	S	L	M
CO3	S	S	S	M	L		S	S	S	L	M
CO4	S	S	S	S	S		S	S	S	S	S
CO5	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

UNIT-I

Isomerism-concept and types. Optical isomerism-elements of symmetry, plane polarized light, molecular chirality, dissymmetric, asymmetric, chiral and achiral molecules with two stereogeniccentres. Enantiomers and diastereomers,anomers, epimers and meso compounds. Racemization - resolution, mechanism of racemization. Epimerization. Walden inversion, retention and asymmetric synthesis. Relative and absolute configuration. Sequence rules–R/S nomenclature. Geometrical isomerism, E/Z nomenclature.

Determination of configuration of geometrical isomers by physical and chemical methods.*

UNIT-II

Conformational analysis-distinction between conformation and configuration, Conformational analysis of ethane, n-butane and cyclohexane. Axial–equatorial inter conversion-conformation and

stabilities of methyl cyclohexane,1,2–dimethyl cyclohexane,1,3–dimethyl cyclohexane and 1,4–dimethyl cyclohexane. Conformations in cyclohexanol, cyclohexane-1,3- diol and cyclohexane-1,4,-diol.

Cis-trans isomerism in substituted cycloalkanes.*

UNIT-III

Reaction intermediates -free radicals - classification, generation, detection, and configuration. Relative stabilities of alkyl and triphenylmethyl free radicals. Reactions - polymerization, allylic brominationby NBS, autoxidation, Sandmeyer, Gomberg and Ullmannreactions. Generation of carbenes and nitrenes.

Reactions involving carbene and nitrene-Reimer Tiemann reaction and Hoffmann rearrangement.*

UNIT-IV

Carbohydrates – classification, preparation and properties of glucose and fructose. Cyclic structures - pyranose and furanose forms. Mutarotation and its mechanism. Configuration of monosaccharides, epimerisation, chain lengthening and chain shortening of aldoses. Inter conversions of glucose and fructose. Disaccharides – reactions and structure elucidation of sucrose.

Polysaccharides-structure of starch and cellulose, industrial uses of cellulose.*

UNIT-V

Amino acids -classification, essential and non-essential amino acids, preparation and properties of α-amino acids. Synthesis of peptides, end-group analysis.

Proteins – classification, primary and secondary structures.

Nucleic acids – DNA and RNA-composition, structure of DNA and its role in heredity and DNA replication.

Denaturation and renaturation of proteins, colour test for proteins.*

****Self-study***

Books for study:

1. ArunBahl and B. S. Bahl, *Advanced Organic Chemistry*, S. Chand & Co. 1st Edition, 2017.
2. O. P. Agarwal, *Organic Chemistry Reactions and Reagents*, Krishna Prakashan Media (P) Ltd, 56th Edition, 2017.
3. M. K. Jain and S. C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co., 1st Edition, Reprint 2020.

Books for reference:

1. I. L. Finar, Volume –I & II, *Organic Chemistry*, Pearson India Education Services Pvt.Ltd, 6th Edition, 2014.
2. P. S. Kalsi,*Stereochemistry of Organic Compounds*, New Age International,18thEdition, 2020.

E-resource:

https://www.youtube.com/watch?v=yZ8JDDnyxC4&list=PLaySzQJTCO1nsM3ItT8irQ650tYgjHk6i

Course Title	**:**	**Core: Physical Chemistry**	**Course Code**	**:**	**20UCH6C14**
Year	**:**	**III**	**Semester**	**:**	**VI**
Hours/Week	**:**	**5**	**Credit**	**:**	**5**

COURSE OBJECTIVES

1. To disseminate knowledge on phase diagram.
2. To enhance the problem solving capacity on chemical kinetics.
3. To give ideas on the applications of catalysis.
4. To transmit ideas on surface chemistry.
5. To translate basic knowledge on photochemistry and group theory.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Apply the phase rule to various systems.	K1,K2&K3
CO2	Solve problems on chemical kinetics.	K3
CO3	Apply the concept of catalysis in various industries.	K3&K4
CO4	Have knowledge on surface chemistry.	K1&K2
CO5	Acquire basic knowledge on photochemistry and group theory.	K1&K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	L		S	S	S	L	M
CO2	S	S	S	S	L		S	S	S	L	M
CO3	S	S	S	S	S		S	S	S	M	M
CO4	S	S	S	M	L		S	S	S	L	M
CO5	S	S	S	M	L		S	S	S	L	M

S – Strong; M – Medium; L – Low

UNIT – I

Phase rule – definition of phase, component and degrees of freedom. Derivation of phase rule.Application to one-component systems – H_2O, CO_2 and sulphur. Application to two component systems – lead-silver and zinc-magnesium. Two component liquid systems - Phenol-water, triethylamine-water and nicotine-water.Distillation of immiscible liquids-steam distillation.

Phase diagrams of Bi-Cd and KI-H_2O systems.*

UNIT – II

Chemical Kinetics - definition of rate and rate constant dimensions of rate and rate constant. Order and molecularity – differences. Derivation of rate constants and half-life of zero, first and second order reactions. Pseudo first-order reaction – acidcatalyzed ester hydrolysis. Examples for fractional and higher order reactions. Various methods of determining order of a reaction. Arrhenius equation – calculation of energy of activation. Complex reactions - consecutive, reversible, parallel and chain reactions – definition and examples.

Effect of temperature on reaction rate.*

UNIT – III

Simple collision theory – its limitations and modifications. ARRT of bimolecular reactions, Comparison of collision theory with ARRT. Lindemann theory of unimolecular reactions. **Catalysis** – typesand characteristics of catalyst. Energy of activation and catalysis. Theories of catalysis. Enzyme catalysis, lock and key mechanism. Derivation of Michaleis–Menton equation.

Types of catalyst.*

UNIT – IV

Surface chemistry - absorption and adsorption – physisorption and chemisorption – difference.Adsorption isotherms – theory and derivation of Frendulich and Langmuir isotherms. Ion exchange adsorption – cationic exchange and anionic exchange. Nernst distribution law and its applications.

Applications of ion exchange adsorption – water softening and deionization of water.*

UNIT – V

Photochemical reactions -difference between photochemical and thermochemical reactions. Laws of photochemistry – Lambert Beer's, Grotthus Draper, and Stark Einstein's laws. Quantum yield – definition and types. Photochemical reactions of low and high quantum yields.Kinetics of hydrogen-chlorine and hydrogen-bromine reactions. Basic idea on fluorescence, phosphorescence, chemiluminescence and bioluminescence.

Group theory - Symmetry elements and symmetry operation. Group-requirements, types-abelian, and non-abelian. Point group of water and ammonia. Group multiplication table of C_{2V} point group.

Group multiplication table of C_{3V} point group.*

****Self-study***

Books for study:

1. B. R. Puri, L. R. Sharma and Madan S. Pathania, *Principles of Physical Chemistry*,Vishal Publishing Co., 47th Edition, 2016.
2. ArunBahl, B. S. Bahl and G. D.Tuli, *Essentials of Physical Chemistry*,S. Chand & Company 28th Edition, 2020.
3. P. L. Soni, D. P. Dharmarha and U. N. Dash,*Text Book of Physical Chemistry*, Sultan Chand & Sons, 23rd Edition, 2016.
4. Gurdeep Raj, *Advanced Physical Chemistry*, KrishanPrakashan media (P) Ltd., 39th Edition, 2014.
5. K. Veera Reddy, *Symmetry and Spectroscopy of molecules*, New Age International (P) ltd. 2nd Edition, 2020.

Books for reference:

1. P. Atkins, J. Paula, and J. Keeler, *Atkins' Physical Chemistry*, Oxford University Press, 11th Edition, 2018.
2. K.J. Laidler, *Chemical Kinetics*, Pearson India Education Services Pvt. Ltd, 3rd Edition, 2018.

E-resources:

1. https://www.youtube.com/watch?v=syhwfcv3Qhc&list=PLCvpYrhOPdiU2J7gtzn9jON53XM2GZjTL
2. https://www.khanacademy.org/science/high-school-biology/hs-energy-and-transport/hs-enzymes/v/introduction-to-kinetics
3. https://www.youtube.com/watch?v=dkrWtP_8aHk

Course Title	**:**	**Core: Conceptual Aspects of Practical Chemistry**	**Course Code**	**:**	**20UCH6C15**
Year	**:**	**III**	**Semester**	**:**	**VI**
Hours/Week	**:**	**Self-study**	**Credit**	**:**	**2**

COURSE OBJECTIVES:

1. To train for competitive examinations
2. To develop problem solving competency

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Take competitive examinations easily	K1,K2,K3&K4
CO2	Have problem solving competency	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

Fundamental aspects of

1. Inorganic qualitative analysis
2. Organic qualitative analysis
3. Inorganic quantitative analysis including volumetric and gravimetric analyses
4. Physical chemistry practicals
5. Inorganic and organic preparations

Books for reference:

1. V. Venkateswaran, R. Veeraswamyand A. R. Kulandaivelu, *Basic Principles of Practical Chemistry*, S. Chand & Sons 2nd Edition, Reprint 2017.

2.A. Thomas, *Practical Chemistry*, Scientific Book Centre, Cannanore, Kerala, 2003.

Course Title	**:**	**Core Practical -3:** Gravimetric and Physical Chemistry Experiments	**Course Code**	**:**	**20UCH6CP3**
Year	**:**	**III**	**Semester**	**:**	**V & VI**
Hours/Week	**:**	**5**	**Credit**	**:**	**5**

COURSE OBJECTIVES:

1. To give skills on gravimetric analysis.
2. To impart skills on physical chemistry experiments.
3. To demonstrate the determination of polarity.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Analyze the substance gravimetrically.	K1,K2,K3&K4
CO2	Work on physical chemistry experiments.	K1,K2,K3&K4
CO3	Determine polarity of organic compounds.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S
CO3	S	S	S	S	S		S	S	S	S	S

S – Strong;M – Medium;L – Low

A. Gravimetric Analysis

1. Lead as lead chromate
2. Barium as barium chromate
3. Calcium as calcium oxalate monohydrate
4. Nickel as nickel dimethyl glyoxime complex
5. Magnesium as magnesium oxinate
6. Barium as barium sulphate (by insineration)
7. Lead as lead sulphate

B. Physical Chemistry Experiments

1. Determination of transition temperature of a hydrated salt
2. Determination of partition coefficient of Iodine between CCl_4 and H_2O
3. Determination of equilibrium constant for the reaction $KI + I_2 \rightleftharpoons KI_3$
4. Determination of critical solution temperature of phenol-water system
5. Determination of effectof impurity (NaCl) on CST of phenol-water system

6. Determination of effectof impurity (Succinic acid) on CST of phenol-water system
7. Determination of molecular weight by Rast's macro method
8. Phase diagram- simple eutectic system
9. Determination of rate constant of acid catalyzed hydrolysis of an ester
10. Kinetics of persulphate- Iodide reaction

Electrochemistry Experiments

1. Determination of cell constant
2. Determination of equivalent conductance of a strongelectrolyte.
3. Conductometric titration- strong acidvs strong base
4. Conductometric titration- weak acidvs strong base
5. Potentiometric titration- Redox reaction [$KMnO_4$ vs Fe(II)]
6. Potentiometric titration- acid-base titration [HClvs NaOH]

C. Demonstration Experiments

1. Polarimetry- Inversion of cane sugar

Books for reference:

1. V. Venkateswaran, R. Veeraswamyand A. R. Kulandaivelu, *Basic Principles of Practical Chemistry*, S. Chand & Sons 2nd Edition, Reprint 2017.
2. A. Thomas, *Practical Chemistry*, Scientific Book Centre, Cannanore, Kerala, 2003

Course Title	**:**	**Elective Practical - 2: Application Oriented Practical**	**Course Code**	**:**	**20UCH6EP2**
Year	**:**	**III**	**Semester**	**:**	**VI**
Hours/Week	**:**	**3**	**Credit**	**:**	**2**

COURSE OBJECTIVES

- To educate the necessary skills required in industrial chemical analysis.
- To facilitate employability and entrepreneurial skills.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Acquire necessary skills required in industrial chemical analysis.	K1,K2,K3&K4
CO2	Get employability in various industries and become entrepreneur.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

Industrial Analysis

1. Estimation of hydrogen peroxide
2. Estimation of saponification value of oil
3. Estimation of iodine value of oil
4. Estimation of manganese dioxide in pyrolusite
5. Determination of percentage of copper in brass
6. Determination of percentage of CaO in cement
7. Determination of ferrous iron in cement
8. Determination of percentage of iron in haematite ore using external indicator
9. Determination of available chlorine in bleaching powder

Books for reference:

1. O. P. Vermani and A. K. Narula, *Applied Chemistry Theory and Practice*, New Age International, 2nd Edition, 2017.
2. J. Bassett, R. C. Denney, G. H. Jeffery, J. Mendham, *Vogel's Text Book of Quantitative Inorganic Analysis*, John Wiley & Sons, 5th Edition,1989.

Course Title	**:**	**Project Work**	**Course Code**	**:**	**20UCH6CPR**
Year	**:**	**III**	**Semester**	**:**	**VI**
Hours/Week	**:**	**5**	**Credit**	**:**	**5**

Course Objectives:

Enable the students to

1. Understand the importance of literature survey, experimental analysis, and scientific approach in solving problems of chemistry.
2. Write the scientific reports.

Course Outcomes

After learning the course, the students will be able to

CO1	identify a research problem and plan suitable research strategy and design the experimental setup for the problem,	K3& K4
CO2	interpret the experimental data, analyse the result and based on the experimental data provide solution for the problem.	K3& K4
CO3	apply the problem-solving skill, demonstrative skill, analytical skill.	K3& K4

K1- Remember, K2- Understand, K3- Apply, K4- Analyse

CO/ PSO	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	M	S		M	S	S	M	S
CO2	M	S	S	M	S		M	S	S	M	S
CO3	M	S	S	M	S		M	S	S	M	S

S-Strong, M-Medium, L-Low

LIST OF ELECTIVE COURSES – GROUP I

Course Title	**:**	**Elective : Industrial Chemistry**	**Course Code**	**:**	**20UCH5EA1**
Year	**:**	**III**	**Semester**	**:**	**V**
Hours/Week	**:**	**2**	**Credit**	**:**	**2**

COURSE OBJECTIVES:

1. To employ in various chemicals industries.
2. To make aware on the chemistry behind various industries.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Fetch employability in various chemicals industries.	K1,K2,K3&K4
CO2	Have awareness on the chemistry behind various industries.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 –Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S

S – Strong;M – Medium;L – Low

UNIT – I

Pulp and Paper -introduction, manufacture of sulphite pulp, soda pulp and rag pulp. Beating, refining, filling, sizing and colouring. Manufacture of paper – calendaring.

Ecological problems in pulp and paper industry*

UNIT – II

Sugar - introduction – manufacture of cane sugar, extraction and purification of juice – defection, sulphitation and carbonation, concentration, crystallization, separation of crystals, drying, refining and grades. Recovery of sugar from molasses. Testing of sugar.

Manufacture of sucrose from beet-root.*

UNIT – III

Synthetic Fibres - introduction – requirements of a fibre – difference between natural fibres and synthetic fibres. Properties and preparation of synthetic fibres-terylene, orlon, vinyon and teflon. Methods of spinning. Artificial silk – Preparation of rayon by cuprammonium& viscose processes and properties rayon.

Manufacture of nylon 66*

Self-study

Books for reference:

1. B. K. Sharma, *Industrial Chemistry*, Geol Publishing House, 15th Edition, 2006.
2. O. P. Vermani and A. K. Narula, *Applied Chemistry Theory and Practice*, New Age International, 2nd Edition, 2017.

E-resources:

1. https://www.youtube.com/watch?v=E4C3X26dxbM
2. https://www.youtube.com/watch?v=P9ctNiJZFTY
3. https://www.youtube.com/watch?v=B5Ge3xSRrKA

Course Title	**:**	**Elective : Environmental Chemistry**	**Course Code**	**:**	**20UCH5EB1**
Year	**:**	**III**	**Semester**	**:**	**V**
Hours/Week	**:**	**2**	**Credit**	**:**	**2**

COURSE OBJECTIVES

1. To create awareness on the environment pollution
2. To inculcate the knowledge of chemistry in environment

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Have awareness on the environment pollution	K1,K2,K3&K4
CO2	Know the chemistry in environment	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

UNIT-I

Environment: Composition of atmosphere, temperature variation of earth atmospheric system (temperature vs. altitude curve), biogeochemical cycles of C, N, P, S and O system.

Hydrological cycle*

UNIT-II

Atmosphere: Chemical composition–particles, ions and radicals in their formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S,O and their effect, pollution by chemicals, CFC, green house effect and acid rain.

Effects and control of air pollution*

UNIT-III

Aquatic chemistry: Water and its necessities, various water quality parameters (DO, BOD, COD, conductivity, pH, alkalinity, hardness) and its determination. Industrial, municipal water treatment processes and solid waste treatment.

Primary, secondary and tertiary methods of waste water treatment*

Text Books:

1. A. K. De, *Environmental Chemistry*, New Age International Publishers, 8th Edition, 2016.
2. B. K. Sharma, *Environmental Chemistry*, KrishanPrakashan, 2nd Edition, 2014.

E-resources:

https://www.youtube.com/watch?v=oq2K1IvRf8M

Course Title	**:**	**Elective: Polymer Chemistry**	**Course Code**	**:**	**20UCH5EC1**
Year	**:**	**III**	**Semester**	**:**	**V**
Hours/Week	**:**	**2**	**Credit**	**:**	**2**

COURSE OBJECTIVES

1. To give knowledge on the mechanism of polymer formation
2. To kindle the entrepreneurial skills

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Know the mechanism of polymer formation.	K1,K2,K3&K4
CO2	Become entrepreneurs.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

UNIT-I

Introduction: Polymer, monomer, biopolymers, classification, polymerization process, degree of polymerization, condensation and addition polymers. Polymeric structure and property relationship. Structure of polymers - Linear, branched, cross-linked and network polymers. Molecular weight (number average, weight average, viscosity average) and distribution of molecular weight, polydispersity index, crystallinity in polymer and melting temperature.

Glass transition temperature*

UNIT-II

Polymerization Chemistry: Industrial methods of polymerization-bulk, solution, emulsion and suspension. Stereochemistry of polymers and stereo-specific polymerization, Catalysts-their utility in polymer manufacture and stereo-specific polymerizations.

Ziegler-Natta polymerization*

UNIT-III

Determination of molecular weight: Light Scattering, osmometry, end-group analysis, viscosity and gel permeation chromatography.

Identification of polymers by FTIR, UV-visible and NMR spectroscopy

Identification of polymers by mass spectroscopy*

Self-study*

Text Books:

1. W. Billmeyer, *Text book of polymer science*, 3rd Edition, 2007, Wiley.
2. V. R. Gowariker, N.V. Viswanathan and JayadevSreedhar, *Polymer Science*, New Age International Publishers, 3rd Edition, 2019.

E-resources:

https://www.youtube.com/watch?v=jSNlmOwpxYg&list=PLbMVogVj5nJT0slH3tuas5BIp1DG8ZpMj

LIST OF ELECTIVE COURSES – GROUP II

Course Title	**:**	**Elective: Dye Chemistry**	**Course Code**	**:**	**20UCH6EA2**
Year	**:**	**III**	**Semester**	**:**	**VI**
Hours/Week	**:**	**2**	**Credit**	**:**	**2**

COURSE OBJECTIVES

1. To impart the knowledge on chemistry behind dyeing
2. To give training for employability

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Have knowledge on chemistry behind dyeing.	K1,K2,K3&K4
CO2	Get job in dyeing industries.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

UNIT-I

Introduction -Relationship of colour observed and wavelength absorbed.Relationship between colour and chemical constitution – Witts theory of chromophores &auxochromes and modern theory. Application of dyes to textile fibres – cellulose acetate, polyamide, polyester, polyacrylonitrile and polypropylene.

***Application of dyes to cotton, wool, silk**.**

UNIT-II

Classification – Based on application - acidic, basic, direct, mordant, vat, ingrain, dispersive and reactive dyes. Based on chemical structure - nitro, nitroso, azo, triphenylmethane, xanthene, anthraquinone and indigoid dyes.Preparation and uses of methyl orange, fluorescein, and alizarin.

***Preparation and uses of indigo and malachite green dyes**.**

UNIT-III

Methods of dyeing – direct, vat, mordant, substantive and disperse. Formation of dye on the fibre - dyeing with reactive dyes.

***Dyeing of wool with acid dyes**.**

Self-study*

Books for Study:

1. D.W. Rangnekar, P.P.Singh,*An Introduction to synthetic dyes*,Himalaya Publishing House, 1980.
2. V.A.Shenai, *Chemistry of Dyes and Principles of Dyeing*, Sevak Publications, Bombay, 2nd Edition, 1983.

E-resources:

1. https://www.youtube.com/watch?v=2sHlLNzTpUU
2. https://www.youtube.com/watch?v=e06-glNxOTE

Course Title	**:**	**Elective: Biochemistry**	**Course Code**	**:**	**20UCH6EB2**
Year	**:**	**III**	**Semester**	**:**	**VI**
Hours/Week	**:**	**2**	**Credit**	**:**	**2**

COURSE OBJECTIVES

1. To provide the basic concepts of biochemistry
2. To give training for employability

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Learn the basic concepts of biochemistry	K1,K2,K3&K4
CO2	Seek employability biochemical laboratories	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

UNIT-I

Carbohydrates: Biological importance of carbohydrates, metabolism, cellular currency of energy (ATP), glycolysis, alcoholic and lactic acid fermentations. Krebs cycle.

Proteins: Classification, biological importance; primary and secondary structures of proteins.

Denaturation of proteins*

UNIT-II

Enzymes: Nomenclature, characteristics (mention of Ribozymes), classification, active site, mechanism of enzyme action, stereo-specificity of enzymes, enzyme inhibitors, biocatalysis in green chemistry and chemical industry.

Coenzymes and cofactors*

UNIT-III

Lipids: Biological importance of triglycerides, phosphoglycerides, cholesterol, lipid membrane, liposomes and their biological functions and underlying applications.

Structure of DNA/RNA: Structure of DNA (Watson-Crick model) and RNA, genetic code, biological roles of DNA and RNA.

Introduction to Gene therapy*

Self-study*

Books for Study:

1. J. M. Berg, J. L. Tymoczko, and L. Stryer, *Biochemistry*, W.H. Freeman and Co, 5th Edition, 2006.
2. D. L. Nelson, M. M. Cox and A. L. Lehninger, *Principles of Biochemistry*, 4th Edition, W.H. Freeman and Co.,2009.

E-resources:

https://www.youtube.com/watch?v=rrSew8JNFHw

Course Title	**:**	**Elective: Introduction to Nanochemistry & Applications**	**Course Code**	**:**	**20UCH6EC2**
Year	**:**	**III**	**Semester**	**:**	**VI**
Hours/Week	**:**	**2**	**Credit**	**:**	**2**

COURSE OBJECTIVES

1. To create awareness on nanoscience.
2. To impart the applications of Nanomaterials

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Have awareness on nanoscience.	K1,K2,K3&K4
CO2	Know the applications of Nanomaterials and develop new nanomaterials.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S

S – Strong;M – Medium;L – Low

UNIT-I

Nanoscience: Introduction, nanostructure and nanotechnology (basic idea), Classification of nanoparticles, calculation of percentage of surface atom and surface to volume ratio of spherical, wire, rod, and disc shapes nanoparticles.

Properties: Electrical, optical (surface plasmon resonance), variation in colors (blue shift & red shift) and magnetic properties.

Thermal and catalytic properties*

UNIT-II

Synthesis of nanomaterials: Brief introduction about top-down and bottom-up approaches & self-assembly techniques of nanoparticles synthesis. solvothermal process, preparation of gold and silver metallic nanoparticles. Control of nanoarchitecture and one-dimensional control.

Carbon nanotubes and nanowires*

UNIT-III

Material characterization techniques: Electron microscopic technique, diffraction technique, zeta-potential measurement. Use of nanomaterials in environmental remediation and biology (few practical examples of use of materials can be discussed).

Photoelectron spectroscopy*

Self-study*

Books for Study:

1. C. N. R. Rao, A. Muller and A. K. Cheetam, *The Chemistry of Nanomaterials: Synthesis, Properties and Applications*, Willey-VCH Verlag, Germany, 2005.
2. G. Cao, *Nanostructures and Nanomaterials: Synthesis, Properties and Applications*,World Scientific Publishing Company, 2011.

E-resources:

1. https://www.youtube.com/watch?v=0MzIh7wkgMs
2. https://www.youtube.com/watch?v=jDuzWlz9BaY

Course Title	**:**	**Modular Course: Chemistry for Entrepreneurship**	**Course Code**	**:**	**20UCH6MC1**
Year	**:**	**III**	**Semester**	**:**	**VI**
Hours/Week	**:**	**Self-study**	**Credit**	**:**	**2**

COURSE OBJECTIVE

To enable entrepreneurial skills.

COURSE OUTCOME

After learning the course, the students will be able to

CO1	Become entrepreneur.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

1. Separation of individual organic compounds in plant extract using thin layer and column chromatography
2. Soil Analysis
3. Food additives and adulteration testing
4. Household things preparations
   i. Cosmetics
   ii. Hand sanitizer
   iii. Ink
   iv. Agarbathi
   v. Candle
   vi. Toiletries

Book for reference:

J. Bassett, R. C. Denney, G. H. Jeffery, J. Mendham, *Vogel's Text Book of Quantitative Inorganic Analysis*, John Wiley & Sons, 5th Edition,1989.

Programme	**:**	**B.Sc. Physics**			
Course Title	**:**	**Allied: Chemistry – I**	**Course Code**	**:**	**20UPH3AL3**
Year	**:**	**II**	**Semester**	**:**	**III**
Hours/Week	**:**	**4**	**Credit**	**:**	**4**

COURSE OBJECTIVES:

1. To provide the basic knowledge on various fields of Chemistry.
2. To enhance the interdisciplinary knowledge.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Have basic knowledge on various fields of Chemistry.	K1,K2,K3&K4
CO2	Enhance their interdisciplinary knowledge.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M		S	S	S	S	M
CO2	S	S	S	S	S		S	S	S	S	M

S – Strong;M – Medium;L – Low

UNIT - I

Shapes of s and p orbitals, hybridization of carbon atom in CH_4, C_2H_4 and C_2H_2.

Polar effects -Inductive effect, Electromeric effect, Resonance effect, Hyperconjugative effect and steric effect. Cis-Trans isomerism - inter-conversion of Maleic and Fumaric acids, Optical isomerism - Optical activity, Optical isomerism in Lactic acid andTartaric acid.

UNIT - II

Molecular orbital theory - postulates, applications of Molecular Orbital theory to H_2, He_2, N_2 and O_2 molecules.

Interhalogen compounds - Preparation, properties, structure and uses of ICl, BrF_3 and IF_5. Diborane- preparation, properties and structure.

UNIT- III

Synthetic dyes- classification based on chemical constitution, preparation of methyl orange and malachite green.

Chemotherapy - preparation and uses of sulpha drugs-prontosil, sulphadiazine and sulphafurazole. Structure and uses of Penicillin and Chloromycetin.

Vitamins - Sources and deficiency diseases.

Hormones - definition, classification - biological functions of oxytocin and insulin.

UNIT IV

Solutions -types,Raoult's law, deviation from ideal behaviour, binary liquid mixture, fractional distillation.

Chemical Kinetics - order and molecularity, determination of order of a reaction, effect of temperature on reaction rate, activation energy.

Concept of chromatography - principles and applications of thin layer, column and paper chromatography.

UNIT V

Silicones - synthesis, properties and uses.

Fuel gases - natural gas, water gas, semi-water gas, producer gas, oil gas and gobar gas.

Fertilizers - Preparation and uses of ammonium sulphate, urea, superphosphate of lime and triple super phosphate.

Pollution - air, water and soil pollutions, sources and their control - acid rain, ozone layer depletion and greenhouse effect.

Book for study:

V. Veeraiyan&A.N.S.Vasudevan,*Allied Chemistry*,Volume I & II, HighmountPublishing House, 2nd Edition, 2005.

Programme	**:**	**B.Sc. Physics**			
Course Title	**:**	**Allied: Chemistry – II**	**Course Code**	**:**	**20UPH4AL4**
Year	**:**	**II**	**Semester**	**:**	**IV**
Hours/Week	**:**	**4**	**Credit**	**:**	**4**

COURSE OBJECTIVES:

1. To make aware of the applications of Chemistry in the field of Physics.
2. To increase the inter-disciplinary competency.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Have awareness in the applications of Chemistry in the field of Physics.	K1,K2,K3&K4
CO2	Increase the inter-disciplinary competency.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M		S	S	S	S	M
CO2	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

UNIT I

Coordination chemistry - Nomenclature of mono-nuclear complexes, Werner's theory, Sidgwick's EAN rule, Pauling's theory applied to $K_4[Fe(CN)_6]$, $K_3[CoF_6]$, $[Ni(CO)_4]$ and $K_2[Ni(CN)_4]$. Chelation and industrial applications of EDTA. Biological role of hemoglobin and chlorophyll.

Metals - Ore dressing, reduction to free metals, refining of crude metals. Furnaces - kilns, Muffle furnace, blast furnace, electric furnace and reverberatory furnace. Metallurgy of copper.

UNIT II

Aromatic compounds - Aromaticity, Aromatic electrophilic substitution reactions - halogenation, nitration, alkylation, acylation and sulphonation.Isolation, preparation, properties and structural elucidation of naphthalene.Preparation and properties of pyrrole, furan and thiophene.

UNIT III

Amino acids – classification, preparation and properties.Bergmann synthesis of polypeptides.

Proteins – classification, properties and biological functions.

Carbohydrates -Classification, preparation and properties of glucose and fructose.

UNIT IV

Energetics – Types of systems and processes. Statement of the first law of thermodynamics and need for the second law. Carnot cycle and efficiency of a heat engine.Joule-Thomson effect, Enthalpy and free energy relationships.

Phase equilibria-definition of phase, component and degrees of freedom. Phase rule (derivation notnecessary). Phase diagrams- water system and lead-silver system.

UNIT V

Electrochemistry - conductance-definition, Kohlrausch law and its application, conductometric titrations, electroplating.

Galvanic cells - EMF, standard electrode potential, hydrogen electrode, calomel electrode and glass electrode. pH definition and its determination by EMF method.

Buffer solution - definition, buffer action, buffer solutions in biological systems.

Book for study:

1. V. Veeraiyan&A.N.S.Vasudevan,*Allied Chemistry*,Volume I & II, HighmountPublishing House, 2nd Edition, 2005.

Programme	**:**	**B.Sc. Physics**			
Course Title	**:**	**Allied Practical: Chemistry**	**Course Code**	**:**	**20UPH4AP1**
Year	**:**	**II**	**Semester**	**:**	**III**
Hours/Week	**:**	**2**	**Credit**	**:**	**2**

COURSE OBJECTIVES:

1. To provide the skills in volumetric analysis.
2. To give the significance of physical and applied chemistry experiments.

COURSE OUTCOMES

After learning the course, the students will be able to

CO1	Gain the skills in volumetric analysis.	K1,K2,K3&K4
CO2	Know the significance of physical and applied chemistry experiments.	K1,K2,K3&K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	S	S	S
CO2	S	S	S	S	S		S	S	S	S	S

S – Strong; M – Medium; L – Low

A. VOLUMETRIC ANALYSIS

Acidimetry&Alkalimetry

1. Estimation of Sodium Carbonate
2. Estimation of Sodium hydroxide
3. Estimation of Sodium Carbonate and sodium bicarbonate in a mixture - Warder's method
4. Estimation of Oxalic acid
5. Estimation of Hydrochloric acid
6. Determination of hardness of water

Permanganometry

1. Estimation of Mohr's salt
2. Estimation of Ferrous sulphate
3. Estimation of Oxalic acid
4. Estimation of Hydrogen peroxide

Dichrometry

1. Estimation of Potassium dichromate
2. Estimation of Potassium permanganate

B. PHYSICAL CHEMISTRY EXPERIMENTS

Conductometric Titrations

1. Strong Acid Vs Strong base
2. Weak Acid Vs Strong base

Potentiometric Titrations

1. Strong Acid Vs Strong base
2. Weak Acid Vs Strong base
3. Ferrous sulphate Vs Potassium dichromate
4. Dissociation constant of Weak acid

C. APPLIED CHEMISTRY EXPERIMENTS

1. Determination of pH of water
2. Determination of Electrical Conductivity of water
3. Determination of Dissolved Oxygen in water
4. Determination of Total Dissolved Solids in water
5. Determination of Calcium and Magnesium in water

Book for study:

V. Venkateswaran, R. Veeraswamyand A. R. Kulandaivelu, *Basic Principles of Practical Chemistry*, S. Chand & Sons 2nd Edition, Reprint 2017.

Programme: B.Sc., Physics Course code: **20UPH3NM1**

Course Title: **NME: Solid-state chemistry**

PART-IV Year: II Semester: III Credits: 2 Total Hours: 2x15 = 30

Course Objectives:

- To learn the characteristics of crystalline and amorphous solids.
- To know the determination of crystal structures by X-ray diffraction studies.
- To study about the various stoichiometric and non-stochiometric defects and their consequences.
- To learn the classification and applications of liquid crystals.
- To understand the magnetic and electrical properties of crystals

Unit I:

Characteristics of solids - difference between crystalline and amorphous solids-crystal lattice-unit cells-seven crystal systems, Bravais lattices - Weiss and Miller indices. Derivation of Bragg's law - determination of crystal structure by rotating crystal method using X ray diffraction. Types of crystals-ionic, covalent, molecular and metallic crystals.

Unit II:

Defects in crystalline solids- stoichiometric and non-stoichiometric defects-Schottky, Frenkel, metal deficiency and metal excess defects and their consequences. Structure of AX type ionic solids-sodium chloride, Zinc blende and Wurtzite structure. Liquid crystals-smetic, nematic and choleric liquid crystals. Applications of liquid crystals.

Unit III:

Electrical properties of crystals ferroelectricity, pyroelectrocity and anti-ferroelectricity. Magnetic properties of crystals- magnetic moment, magnetic susceptibility and its measurement by Guoy's method. Intrinsic and extrinsic semiconductors-Applications of band theory to conductors, insulators, p-type and n-type semiconductors. Applications of semiconductors.

References:

1. B. R. Puri, L. R. Sharma, and K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publications (2014).

2. B. R. Puri and L.R. Sharma, Principles of Physical Chemistry, Vishal Publications(2011).

3. P. L. Soni, O. P. Dharmarha and U. N Dash. Text Book of Physical Chemistry, Sultan Chand & Sons,(2009).

Course Outcomes:

The students will be able to

- Understand the properties of crystalline and amorphous solids.
- Execute the Bragg's law in the determination of crystal structure using X-Ray diffraction technique.
- Assimilate the concepts of stoichiometric and non-stoichiometric defects in crystals.
- Acquire the knowledge about the magnetic and electrical properties of crystals.

Programme: BA/B.Sc., (For All II-UG Programmes) Course code: **20UCH4NM2**

Course Title: **NME: Health Awareness and Management**

PART-IV Year: II Semester: III Credits: 2 Total Hours: 2x15 = 30

Course Objectives:

- To study basic human anatomy and physiology.
- To understand the aspects of diet management.
- To understand principles and methods of diagnosis.
- To understand physiological and biochemical parameters in blood and urine.
- To be aware of public health and hygiene.

Unit I: (Human Anatomy and Physiology - Elementary level)

Definition of anatomy and physiology. Functions of various systems-skeletal, muscular, nervous, endocrine, cardiovascular, respiratory, digestive, urinary, lymphatic and circulatory systems.

Unit II:

Food and Nutrients: Food and nutrients-b**alanced diet, and food pyramid. F**unctions, sources, deficiency and excess of proteins, carbohydrates, fats, minerals (iodine, iron, calcium, phosphorous, potassium & sodium), vitamins (water-soluble and fat-soluble), water and fiber.

Diet in management: Diet for obesity, underweight, hypertension, diabetes, heart disease, gastro-intestinal diseases and urological disorders.

Diagnosis and screening: Normal range of physiological and biochemical parameters in blood and urine for good health. Blood glucose, lipid and kidney profile. BP, CBC, BMI, body temperature. Basic understanding of X-ray, CT scan, MRI, endoscopy, laparoscopy, biopsy and autopsy.

Unit III:

Diseases and health disorders: Communicable disease- non-communicable disease. **Symptoms and causes of some common diseases:** dengue, swine-flu, chikungunya, malaria, chicken pox, tuberculosis, thyroid disease, diabetes, kidney stones, obesity, hypertension, Alzheimer's disease and ulcer.

Life style health disorders**:** Aids, smoking, depression, drug and alcohol abuse.

Public health awareness and hygiene: Personal hygiene, vaccination, women and childcare, environmental cleanliness, solid-waste management, health insurance, first-aid and emergency medical care.

References:

1. Principles of Anatomy and Physiology, Gerard J. Tortora and Sandra Reynolds, 10th Ed., John Wiley & Sons.
2. Modern Nutrition in Health and Disease, A. Catharine and Benjamine Caballero, 11thEd. LWW publications.
3. Fundamentals of Clinical Trials, Lawrence and M. Friedman, 4thEd. Springer publications.
4. NCERT resources: http://ncert.nic.in/ebooks.html

Course Outcomes:

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

- ❖ Acquire the knowledge on the functioning of various organs of our body
- ❖ Apply food and nutritional aspects in life.
- ❖ Understand the importance of Diet management
- ❖ Realize the importance of healthy life style