NMKRV COLLEGE FOR WOMEN
(AUTONOMOUS INSTITUTION)
3rd Block, Jayanagar, Bangalore-11

CHEMISTRY SYLLABUS FOR I and II SEMESTER BSc (SEP)

Programme outcome:

By the end of the programme the students will:

1. Understand the basic principles of various branches of chemistry.
2. Demonstrate a range of practical skills to conduct and infer experiments independently and in groups.
3. Apply the key concepts and standard methodologies to solve problems related to chemistry.
4. Apply methodologies to the solution of unfamiliar types of problems.
5. Exhibit skills leading to employability in chemistry and allied industries.
6. Comprehend the fundamental aspects of research in chemistry.
7. Identify chemical formulae and solve numerical problems.
8. Possess the level of proficiency in subject required for post-graduation as well as for pursuing research in chemistry and related interdisciplinary subjects.
9. Introducing students to modern techniques, various equipments and chemical softwares.
10. Design solutions stemming from the application of chemistry to local issues.
11. Understand good laboratory practices and safety.
12. Opportunity to the students for getting job in industries besides academic and administrative works.

Program Duration:

The B.Sc. Programme with Chemistry is of three years duration. Each year is called an academic year and is divided into two semesters. Thus, there will be a total of six semesters.

Assessment: Weightage for assessments (in percentage)

Type of Course	Formative Assessment/IA	Summative Assessment Marks/ESE
Theory	20	80
Practical	10	40

The curriculum will be delivered through various methods including chalk and talk, power point presentations, audio, video tools, E-learning/E-content, virtual labs, simulations, field trips/Industry visits, seminars (talks by experts), workshops, projects, models and class discussions. The assessment broadly will comprise of Internal Assessment (Continuous Evaluation) and End Semester Examination (ESE).

COURSE PATTERN AND SCHEME OF EXAMINATION

Title of the paper	Teaching hours	Contact hours/Week	Exam. hours	IA	Marks	Total Marks	Credits
First Semester							
Chemistry-I CHE11T	56	4	3	20	80	100	4
Chemistry Practical-I CHE11P	-	3	3	10	40	50	2
Second Semester							
Chemistry-II CHE21T	56	4	3	20	80	100	4
Chemistry Practical-II CHE21P	-	3	3	10	40	50	2

Scheme of Internal Assessment Marks: Theory

Sl no.	Particulars	IA Marks
1	Attendance	05
2	Internal Tests	10
3	Assignments/Seminars	05
	Total Theory IA marks	**20**

Scheme of Internal Assessment Marks: Practicals

Sl no.	Particulars	IA Marks
1	Attendance	05
2	Practical Test (Preparatory)	05
	Total Practical IA marks	**10**

Scheme of Evaluation for Practical Examination

Sl.no.	Examination particulars	Marks allotted
1	Experimental performance	25
2	Procedure writing	05
3	Record assessment	05
4	Viva-voce	05
Total		**40**

Scheme for Summative Assessment : Theory
Question paper pattern

Sl. No	Question Paper Pattern	Marks
1	Part A (10 out of 12 questions to be answered of, 2M each)	10 x 2 = 20
2	Part B (5 out of 7 questions to be answered of, 4M each)	5 x 4 = 20
3	Part C (5 out of 7 questions to be answered of, 8M each) (5+3) pattern	5 x 8= 40
	Total	**80**

First Semester B.Sc. (Chemistry)

Title of the paper	**Chemistry-I (Theory)** CHE11T	No. of Credits	04
Total Contact hours/Sem	56 hours	Teaching Hours	4hrs/Week
Internal Assessment marks	20	Summative Assessment Marks	80

Objectives:

The objective of this course is to make the students aware about the SI Units, various analytical methods, types of errors in chemical analysis. It discusses the Periodicity in properties with reference to the *s* and *p* block, which is necessary in understanding their group chemistry, noble gases. The course is also infused with fundamentals of organic chemistry. To establish the applications on the concepts like alkanes, alkenes, alkynes and aromatic hydrocarbons are introduced. It is emphasising on the concept of gases, liquids and solutions.

Course Outcomes:

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

1. fundamentals of Analytical Chemistry
2. use of SI units and its conversion
3. concepts of titration
4. modern periodic table and periodic properties
5. knowledge and applications of noble gases
6. applications of fluorides and oxides of xenon
7. applications of some non-metals
8. basic concepts in organic chemistry
9. reactions of some organic compounds
10. concept of gases, liquids and solutions
11. transport processes of liquids and gases

Course Articulation Matrix:
Mapping of course outcome (COs) with programme outcomes (POs)

	CO1	CO2	CO3	CO4	CO5	CO6	CO7	CO8	CO9	CO10	CO11
PO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PO2	✓		✓				✓			✓	
PO3		✓						✓	✓		
PO4	✓										✓
PO5					✓	✓	✓		✓		
PO6	✓	✓							✓		
PO7		✓									
PO8	✓	✓							✓	✓	
PO9	✓										
PO10					✓						
PO11	✓		✓							✓	✓
PO12	✓		✓							✓	✓

Course Articulation Matrix relates course outcomes of course with the corresponding programme outcomes whose attainment is attempted in this course. Mark ✔ in the intersection cell if a course outcome addresses a particular programme outcome.

NMKRV COLLEGE FOR WOMEN
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3rd Block, Jayanagar, Bangalore-11

I SEMESTER: Chemistry-I: CHE11T

Contact Hours: 56 **Teaching Hours: 4 Hours/Week**
Credit Points: 4

UNIT-I

Analytical Chemistry: **6 hours**

Review*: Definitions of the Basic Units: mass, length, time, temperature, amount of substance, derived units, conversion between units.*

Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of analytical method-accuracy, precision, sensitivity, selectivity and method validation.
Errors and treatment of analytical data: Limitations of analytical methods – Errors: Determinate and in determinate errors, absolute error, relative error, minimization of errors. Statistical treatment of finite samples -mean, median, range, standard deviation and variance. Standard calibration curve - correlation coefficient (R^2). Numerical problems.

Titrimetric Analysis: **8 hours**

Acid-base titrimetry: Theory of acid-base indicators Ex: Phenolphthalein, methyl red. Titration curves for strong acid vs strong base, weak acid vs strong base and weak base vs strong acid titrations - titration curves. Quantitative applications – selecting and standardizing a titrant.
Redox titrimetry: Balancing redox equations, calculation of the equilibrium constant of redox reactions, titration curves, Theory of redox indicators, calculation of standard potentials using Nernst equation. Applications.
Precipitation titrimetry: Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences.

UNIT-II

Periodic Properties: **7 Hours**

Review: *Modern periodic table, division of elements in the long form of the periodic table into s, p, d and f-blocks. Bohr's theory,*

Quantum numbers, shapes of s, p, d orbitals, Pauli's exclusion principle, Hund's multiplicity rule, Aufbau principle, electronic configuration of elements.
Atomic and ionic radii, ionization energy, electron affinity and electronegativity- trends in the periodic table and application in predicting and explaining chemical behavior. Comparative studies of groups 1, 2, 16 and 17 with respect to electronic configuration, atomic and ionic radii, and ionization energy and

electro negativity. Comparative study of compounds-halides, oxides and carbonates of groups 1 and 2: hydrides of groups 16 and 17. Diagonal relationship between Li and Mg.

Noble gases: **3 hours**

Introduction to noble gases, general characteristics including occurrence and applications.
Preparation, properties, structures and nature of bonding of fluorides & oxides of Xenon (XeF_2, XeF_4, XeF_6, XeO_3, XeO_4).

Compounds of nonmetals: **4 hours**

Synthesis, structure and applications of compounds of the following elements;
(a) Boron-boranes (classification), diborane, borazole.
(b) Nitrogen-Hydrazine, hydroxylamine.
(c) Sulphur-thionyl chloride.

UNIT-III

Basic concepts in organic chemistry: **3 hours**

Bond cleavage – homolytic and heterolytic. Types of reagents – electrophilic and nucleophilic reagents. Reactive intermediates - generation and relative stabilities of carbocation, carbanion, carbon free radicals and carbenes –explanation for stability and reactivity based on inductive, resonance and hyperconjugation effects. Types of reactions-addition, substitution and elimination. Concept of isomerism-structural isomerism, stereoisomerism-geometrical and optical isomerism, chiral centre – definition and example.

Aliphatic Hydrocarbons: **11 hours**

Alkanes: **3 hours**

Sources, nomenclature of branched chain alkanes, preparation of symmetrical and unsymmetrical alkanes, Corey-House synthesis, Wurtz reaction and Wurtz-Fittig reaction- their merits and demerits.
Difference between conformation and configuration. Conformations of ethane, propane and butane, explanation of stability based on energy profile diagrams.
Conformation and stability of 1,2- dichloroethane, ethylene glycol and acetaldehyde.

Cycloalkanes: **2 hours**

Nomenclature. Method of formation, explanation for stability based on heat of hydrogenation data, Baeyer's strain theory and its limitation, Sachse - Mohr theory of strain-less rings; cyclopropane ring - banana bonds. Conformations of cyclohexane (chair, twist boat, boat, half-chair and envelop forms and their stability). Geometrical isomerism with examples, *cis* and *trans* isomerism in 1,2- dimethyl cyclopropane and 1,2-dimethyl cyclohexane.

Alkenes: **2 hours**

Preparation of alkenes by Wittig reaction-stereoselectivity. Addition of HX to unsymmetrical alkene - Markownikov's rule and Antimarkownikov's rule with mechanism. Reactions: Hydroboration-oxidation, reduction, oxymercuration-demercuration, epoxidation. Mechanism of oxidation with $KMnO_4$ and OsO_4. Ozonolysis- mechanism and importance.

Dienes: **2 hours**

Classification- isolated, conjugated, cumulated. Structure of allene and butadiene.1,2 addition and 1,4 addition reactions. Diels Alder reaction-1,3-butadiene with maleic anhydride.

Alkynes: **2 hours**

Preparation- Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: alkylation of terminal alkynes and conversion to higher alkynes, ozonolysis and oxidation with hot alk. $KMnO_4$.

UNIT-IV

Gaseous state: **8 hours**

Introduction**:** Maxwell-Boltzmann distribution law, mathematical expression for both mole and molecule (explanation of the terms only). Explanation of velocity distribution curves based on this law (no derivation). Mean free path, collision frequency and collision number. Definition and expressions using SI units (no derivations). Derivation of expression for most probable speed from Maxwell-Boltzmann equation. Definitions and expressions for RMS velocity, average velocity and relationships between them. Numerical problems. Andrew's isotherm on carbon di oxide and explanation of the curves (no experimental details).

Derivation of critical constants T_c,P_c and V_c from vanderWaal's equation and their experimental determination by Cagniard de La Tour method for $T_c$and P_c. Amagat's mean density method for V_c. Problems on the calculation of T_c, P_c and V_c, a and b.

Law of corresponding states-statements, reduced equation of state and explanation, Joule- Thomson effect-explanation. Joule-Thomson co-efficient, inversion temperature-definition (no derivation). The application of Joule-Thomson effect to the liquefaction of air and hydrogen by Linde's process.

Liquids and Solutions: **6 hours**

Viscosity-Definition, mathematical expression, coefficient of viscosity, effect of temperature, size, weight, shape of molecules and intermolecular forces on it.

Surface tension-Definition, mathematical expression, effect of temperature and solute on it. Completely miscible liquids: Fractional distillation, Tc curves for all the three types, azeotropic mixtures with examples. Critical solution temperature (three types), examples. Effect of addition of salt on CST of phenol-water system.

Immiscible liquids: Steam distillation and its applications.

Distribution law: Statement, partition coefficient and condition for validity of distribution law. Application-solvent extraction.

Reference books:

1. Analytical Chemistry: Basic Concepts, Priti Malhotra, Ane Books Pv tLtd,2021.
2. Advanced Inorganic Chemistry,6th Edition, F.A.Cotton, G.Wilkinson, C.A.Murillo and M.Bochmann-JohnWiley&Sons,1999.
3. Inorganic Chemistry, ELBS 2nd Edition, D. F. Shriver, P. W. Atkins and C. H. Langford, Oxford Univ. Press 2002.
4. Organic Chemistry, Morrison,R.T.& Boyd, R.N.Pearson, 2010.
5. Physical Chemistry, Castellan, G.W.4thEd.Narosa,2004.
6. Advanced Organic Chemistry, Bahl, A.& Bahl,B .S,S.Chand,2010.
7. Organic Chemistry, Graham Solomon, T.W., Fryhle,C.B.& Dnyder,S.A.JohnWiley& Sons, 2014.
8. Inorganic Chemistry,4th Edition,J.E.Huhee,E.A.Keiter and R.I.Keiter,Pearson Education Asia, 2000
9. Analytical Chemistry,Gary D.Christian,6thEdition,Wiley,2007
10. Physical Chemistry,Barrow,G.M.Tata McGraw-Hill,2007.

I Semester: Chemistry Practical I: CHE11P

Title of the paper	**Chemistry-I (Practical)** CHE11P	No. of Credits	02
Duration of the Examination	03 hours	Teaching Hours	3hrs/Week
Internal Assessment marks	10	Summative Assessment Marks	40

Course Learning Outcomes:

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

1. Understand the safety practices in the chemistry laboratory
2. Understand the calibration and handling of the glasswares
3. Develop awareness regarding toxicity of chemicals
4. Prepare standard/working solutions, standard solutions
5. Learn to carryout titrations
6. Preparation of a solution of the desired concentration and the desired volume along with calculations to be taught
7. Determination of the percentage of the chemicals in a given solution
8. Determination of the percentage of the given analyte
9. Estimation of binary mixture.

Course Articulation Matrix: Mapping of course outcome (COs) with programme outcomes

	CO1	CO2	CO3	CO4	CO5	CO6	CO7	CO8	CO9
PO1	✓	✓	✓	✓	✓	✓	✓	✓	✓
PO2	✓	✓	✓	✓	✓	✓	✓	✓	✓
PO3	✓	✓	✓	✓	✓	✓	✓	✓	✓
PO4	✓	✓	✓	✓	✓	✓	✓	✓	✓
PO5					✓	✓	✓	✓	✓
PO6	✓	✓	✓	✓	✓	✓	✓	✓	✓
PO7					✓	✓	✓	✓	✓
PO8			✓	✓	✓			✓	
PO9			✓						
PO10			✓						
PO11	✓	✓	✓						
PO12	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Articulation Matrix relates course outcomes of course with the corresponding programme outcomes whose attainment is attempted in this course. Mark ✓ in the intersection cell if a course outcome addresses a particular programme outcome.

I Semester : Chemistry Practical -I: CHE11P

List of Experiments to be conducted

1. Calibration of glasswares: pipette, burette and volumetric flask and preparation of solutions.
2. Estimation of potassium permanganate using standard sodium oxalate solution.
3. Determination of percentage of manganese di oxide from pyrolusite ore.
4. Estimation of ferrous ammonium sulphate using standard potassium dichromate solution using internal indicator.
5. Estimation of ferrous ammonium sulphate using standard potassium dichromate solution using external indicator.
6. Estimation of sodium thiosulphate using standard potassium dichromate solution.
7. Determination of the percentage of available chlorine in the given sample of commercial bleaching powder.
8. Estimation of the amount of alkali present in soaps/detergents.
9. Estimation of nitrogen in an ammonium salt using sodium hydroxide solution and standard oxalic acid.
10. Estimation of the amount of carbonate and bicarbonate in the given mixture.
11. Estimation of chloride by Mohr's method.

Second Semester B.Sc (Chemistry) as per SEP Scheme

Paper Title	**Chemistry-II (Theory) CHE21T**	No.of Credits	04
Total Contact hours/ Sem	56 hours	Teaching Hours	4hrs/Week
Internal Assessment marks	20	Summative Assessment Marks	80

Objectives:

The course reviews the structure of the atom, which is a necessary pre-requisite in understanding the nature of chemical bonding in compounds. It provides basic knowledge about ionic, covalent and metallic bonding. To establish applications of aromatic hydrocarbons, alkyl and aryl halides. Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, radial and angular distribution curves, shapes of s, p, and d orbitals. The constitution of the course strongly focuses on the colligative properties of the solutions. It helps in understanding the photophysical and photochemical processes. This course helps the students to relate the structure of an organic compound to its physical and chemical properties.

Course Learning Outcomes:

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

1. Thorough understanding of chemical bonding with special emphasis on ionic, covalent bonding
2. Approaches related with the valence bond theory and hybridization
3. Draw the plausible structures and geometries of molecules using radius ratio rules, VSEPR Theory and MO diagrams (homo-&hetero-nuclear diatomic molecules).
4. Understand and explain the differential behavior of organic compounds based on fundamental concepts learnt.
5. Understanding the mechanism of nucleophilic and electrophilic reactions
6. Deeper insight of Quantum Mechanics
7. To discuss on the postulates of quantum mechanics
8. Structure and applications of zeolites and silicates
9. Understand the laws of photochemistry and photochemical processes

10. Use the concepts learnt to predict feasibility of photochemical reactions.

11. Kinetic, optical and Electrical stability of colloids

12. Types of adsorptions and knowledge of autocatalysis

Course Articulation Matrix: Mapping of course outcome (COs)with programme outcomes

	CO1	CO2	CO3	CO4	CO5	CO6	CO7	CO8	CO9	CO10	CO11	CO12
PO1	✓		✓	✓		✓						
PO2	✓		✓	✓		✓						
PO3	✓		✓	✓		✓						
PO4	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓
PO5	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓
PO6	✓		✓	✓			✓	✓	✓			
PO7	✓		✓	✓			✓	✓	✓			
PO8	✓	✓	✓		✓				✓			✓
PO9	✓		✓			✓						
PO10	✓		✓			✓						
PO11	✓	✓	✓		✓							
PO12	✓	✓	✓		✓							

Course Articulation Matrix relates course outcomes of course with the corresponding programme outcomes whose attainment is attempted in this course. Mark ✓ in the intersection cell if a course outcome addresses a particular programme outcome.

II SEMESTER: Chemistry-II: CHE21T

UNIT-I

Chemical Bonding: **14 hours**

Ionic bond: Lattice energy, Born-Haber cycle, Born-Lande equation (No derivation), problems on it. Calculation of lattice energies of NaCl and MgO, effect of lattice energy on solubility of ionic compounds. Polarization concept, Fajan's rule, polarity and polarizability of ions.

Covalent bond: Valence bond approach; hybridization and directional characteristics of sp, sp^2, sp^3, sp^2d, sp^3d^2. Shapes of $BeCl_2$, BF_3, $SiCl_4$, PCl_5 and SF_6. VSEPR theory: shapes of CH_4, NH_3, NH_4^+,H_2O, BrF_3 and ICl_2.Molecular orbital theory: H_2,He_2^+,Be_2,N_2,O_2,O_2^-,O_2^{2-},O_2^{2+},CO and NO (bond order, stability and magnetic properties to be discussed). Bond length, bond angle and bond energy. Polar and non-polar molecules, dipole moment.

Weak interactions: i) Hydrogen bonding: Intramolecular and Intermolecular types, anomalous properties of HF, H_2O, NH_3,alcohols, carboxylic acids, nitrophenols and biomolecules. ii) van der Waals forces: Dipole-dipole, dipole- induced dipole interactions and temporarily dipole- induced dipole interactions.

Metallic bond: Band theory, electrical properties of metals, semiconductors and insulators.

UNIT-II

Aromatic hydrocarbons: **9 hours**

Nomenclature. Structure of benzene using molecular orbital theory. Criteria for aromaticity-Huckel's rule (Examples: cyclopentadienyl anion, cycloheptatrieneyl cation, benzene, naphthalene, anthracene and phenanthrene). Antiaromaticity.

General mechanism of aromatic electrophilic substitution. Mechanism of nitration of benzene including evidence for the formation of nitronium ion,energy profile diagram and isotopic effect. Orienting influence of substituents in toluene, chlorobenzene, nitrobenzene and phenol.

Aromatic nucleophilic substitution via benzyne intermediate, mechanism with evidences for the formation of benzyne by trapping with anthracene, Birch reduction. Side chain oxidation of toluene to benzaldehyde and benzoic acid. Oxidation of naphthalene, anthracene and phenanthrene. Diels-Alder reaction of anthracene with 1,2-dichloroethene.

Alkenyl benzenes: Styrene, cis-and trans-stilbenes and their preparations. Biphenyl: Preparation-Ullmann reaction.

Organic halogen compounds: **5 hours**

Alkyl halides: Nomenclature. Nucleophilic substitution reactions – S_N1 and S_N2 mechanisms with energy profile diagrams. Effect of (i) nature of alkyl groups (ii) nature of leaving groups (iii) nucleophiles and (iv) solvents on S_N1 and S_N2 mechanisms. Elimination reactions - E1 and E2 mechanisms; Hofmann and Saytzeff eliminations with mechanism.

Arylhalides: Preparation by halogenation. Relative reactivity of alkyl, allyl, vinyl, aryl and aralkyl halides towards nucleophilic substitution.

UNIT-III

Quantum Mechanics: **11 hours**

Derivation of expressions for radius, energy and ionization energies of hydrogen like atoms. Numerical Problems. Hydrogen spectrum

Limitations of classical mechanics. Wave particle duality, Uncertainty principle.

New quantum mechanics-sinusoidal wave (Explanation). Schrodinger wave equation-derivation. Postulates of quantum mechanics.

Significance of the terms; Hamiltonian operator, Eigen function; Ψ (significance of ψ and ψ^2) and Eigen values.

Application of Schrodinger equation to particle in one dimensional box (No derivation required), and to the hydrogen atom (detailed solution not required). Expressing the solution as a product of $\psi n,l,m(r,\theta,\varphi)=\psi n,l.(r)\psi l.m(\theta,\varphi)$.Explanation on quantum numbers (only qualitative). Radial and angular probability distribution. Radial and angular parts of the wave function and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (graphical representation only).

Colligative properties: **3 hours**

Liquid Mixture: *Review of Raoult's law*,

Ideal and non-ideal solutions. Dilute solutions- colligative properties and concentration terms.

Determination of molecular mass of a solute by: (i) Berkeley-Hartley's method (π); (ii) Beckmann's method (ΔT_f) and (iii) Landsberger's method. Numerical problems.

UNIT-IV

Photochemistry: **6 hours**

Introduction to photochemical reactions, Laws of photochemistry-Grotthus-Draper law, Stark-Einstein law. Differences between photophysical and photochemical processes with examples. Comparison of photochemical and thermal reactions. Quantum yield of photochemical combination of (i)H_2 and Cl_2 (ii)H_2 and Br_2 (iii) dissociation of HI (iv) dimerization of anthracene. Reasons for the high and low quantum yield. Problems based on quantum efficiency. Photosensitization and photo stationary equilibrium. Singlet and triplet states. Fluorescence, phosphorescence, luminescence, bioluminescence and chemical sensors. Jablonski diagram. Explanation of internal conversion, inter-system crossing Beer-Lambert's law and its applications. Numerical problems on absorption coefficient and molar extinction coefficient.

Colloids **3 hours**

Definition of colloids. Classification of colloids. Solids in liquids (sols): preparations and properties–Kinetic, Optical and Electrical stability of colloids.Protective action. Hardy–Schultz law and Gold number. Liquids in liquids(emulsions):Types of emulsions, preparation and emulsifier. Liquids in solids (gels): Classification, preparations and properties. General applications of colloids.

Adsorption and catalysis **5 hours**

Introduction. Types of adsorptions. Factors influencing adsorption. Freundlich adsorption isotherm. Langmuir theory of unilayer adsorption isotherm. Applications.

Catalysis –Types and theories (intermediate compound theory and adsorption theory). Heterogeneous catalysis: surface reactions, unimolecular and bi-molecular surface reactions. pH dependence of rate constant of catalyzed reactions. Autocatalysis.

Reference Books:

1. Concise Inorganic Chemistry,5thEdition, J.D.Lee, Blackwell Science,2001.
2. Principles of Inorganic Chemistry, B. R. Puri and L. R. Sharma, Jauhar S. P-S. N. Chand & Co., 1998.
3. Basic Inorganic Chemistry,3rdEdition, F.A.Cotton, G.Wilkinson , P.L.Gaus-John Wiley & Sons, 1995.
4. Fundamentals of Organic Chemistry, McMurry, J.E.,7th Edition, Cengage Learning India Edition, 2013.
5. Text Book of Physical Chemistry, K.L.Kapoor, McGraw Hill Education Private Limited, 2022.
6. Introduction to Quantum Theory and Atomic Structure, P.A.Cox, Oxford Chemistry Primers, 1996.
7. Text Book of Physical Chemistry, Soni P.L.,Dharmarha OP,Dash UN,Sultan Chand & Sons, 2023.
8. Organic Chemistry, Finar, I.L.Vol.1,6thEdition, Pearson,2002.
9. Physical Chemistry, Puri, Sharma, Pathania,48thEdition.

II Semester: Chemistry Practical II: CHE21P

Paper Title	**Chemistry-II (Practical)**	No.of Credits	02
Duration of the Examination	03hours	Teaching Hours	3hrs/Week
Internal Assessment marks	10	Summative Assessment Marks	40

Course Learning Outcomes:

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

1. Knowledge in maintaining laboratory equipments
2. Understanding of the concepts of viscosity.
3. Study of the variation of viscosity of a solute
4. Determination of the density and surface tension
5. Know the importance of surface tension
6. Study of critical solution temperature.
7. Applicability of transition temperature
8. Gain insight on the distribution coefficient, when solute undergo association or dissociation

Course Articulation Matrix:Mapping of course outcome(COs)with programme outcomes

	CO1	CO2	CO3	CO4	CO5	CO6	CO7	CO8
PO1	✓	✓	✓	✓	✓	✓	✓	✓
PO2	✓	✓	✓	✓	✓	✓	✓	✓
PO3	✓	✓	✓	✓	✓	✓	✓	✓
PO4	✓	✓	✓	✓	✓	✓	✓	✓
PO5	✓	✓	✓	✓	✓	✓	✓	□
PO6	✓	✓	✓	✓	✓	✓	✓	✓
PO7	✓	✓	✓	✓	✓	□	□	✓
PO8	□	✓	✓	✓	✓	□	□	✓
PO9	□	□	□	□	□	□	□	✓
PO10	✓	✓	✓	✓	✓	□	□	□
PO11	✓	□	□	□	□	✓	✓	□
PO12	✓	✓	✓	✓	✓	□	□	□

Course Articulation Matrix relates course outcomes of course with the corresponding programme outcomes whose attainment is attempted in this course. Mark ✓ in the intersection cell if a course outcome addresses a particular programme outcome.

Chemistry Practical II: CHE21P

List of Experiments to be conducted

1. Determination of the density using specific gravity bottle and viscosity of a liquid using Ostwald's viscometer.
2. Determination of the density using specific gravity bottle and surface tension of a liquid using Stalagmometer.
3. Determination of molar mass of an non -electrolyte by Walker-Lumsden method.
4. Determination of percentage composition of a binary mixture by viscosity method
5. Determination of molar mass of polymer by viscosity method.
6. Determination of transition temperature of a salt hydrate by thermometric method.
7. Determination of degree of dissociation of electrolyte by Walker-Lumsden method.
8. Determination of critical solution temperature of phenol water system.
9. Determination of distribution coefficient of benzoic acid between water and toluene.
10. Study of kinetics of their action between KI and $K_2S_2O_8$ by colorimetric method.

NMKRV COLLEGE

(Autonomous Institution)

3rd block Jayanagar, Bangalore-11

B.Sc. Chemistry as per SEP-2024 for III and IV Semester

COURSE PATTERN AND SCHEME OF EXAMINATION

Title and code of the paper	Teaching hours	Contact hours/Week	Exam. hours	IA	Marks	Total Marks	Credits
Third Semester							
Chemistry-III CHE31T	56	4	3	20	80	100	4
Chemistry Practical-III CHE31P		3	3	10	40	50	2
Fourth Semester							
Chemistry-IV CHE41T	56	4	3	20	80	100	4
Chemistry Practical-IV CHE41P		3	3	10	40	50	2

III Semester B.Sc. (Chemistry) Paper –III

Chemistry-III/ CHE31T

UNIT-I

Chemical Kinetics: **7 hrs**

Review of terms - Rate, Order and Molecularity.

Derivation of the expression for the rate constant of a second-order reaction with a = b and a ≠ b. Half-life period. Definition and derivation for the half-life expression of a second-order reaction with a=b. Mean life period of a reaction - definition, expression for the mean life period of a second-order reaction (a=b). Problems on rate constant (a=b); half life period, mean life period and order of reaction.

Determination of order of reaction: differential method, method of integration, method of half-life period and isolation method.

Theories of reaction rates: Effect of temperature on rate of reaction – temperature coefficient and probability distribution curve of effective molecules with rise in temperature of 10 °C; Arrhenius equation: indication of the terms involved, concept of activation energy, threshold energy definitions with energy profile diagram. Numericals on the Arrhenius equation in calculating the energy of activation and rate constants.

Simple collisions theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects. Limitations of collision theory. Steady state approximation statement and Lindemann's hypothesis-postulates. Explanation of the hypothesis using concentration dependence in deciding the order of a reaction.

Experimental determination of kinetics of (i) inversion of cane sugar by polarimetric method (ii) spectrophotometric method for the reaction between potassium per sulphate and potassium iodide.

Thermodynamics -I **7 hrs**

Review of terms.

Exact and inexact differentials, I law of Thermodynamics – statement. Mathematical expression with explanation of the terms. Derivation of expressions for work done in isothermal and adiabatic expansion and compression of an ideal gas (IUPAC sign conventions to be used). Numerical problems.

Heat capacity of a gas at constant pressure and constant volume, derivation of the relationship between Cp and Cv. The relation between P, V and T in an adiabatic process to be derived. Derivation of Kirchoff's equation. Numerical problems on Kirchoff' equation, Cp and Cv.

Spontaneous and non-spontaneous processes definitions with suitable examples.

Second law of thermodynamics: Limitations of I law of thermodynamics with illustrations. Need for II law of thermodynamics, different ways of stating II law with respect to heat and spontaneity. Other forms of II law of thermodynamics. Concept of entropy and its physical significance- illustrations with order, disorder, physical and chemical processes and probability.

Heat engine-Carnot's cycle and derivation of the expression for its efficiency based on entropy concept. Problems based on efficiency equation. II law in terms of efficiency (η). Change in entropy in reversible and irreversible processes (derivations required). Calculation of entropy changes in reversible isothermal and reversible adiabatic processes. Phase transitions in terms of Entropy (Fusion, vaporization, sublimation and polymorphic changes) in terms of entropy. Limitations of the entropy concept of spontaneity. Problems on Phase transitions.

UNIT-II

Organic and Inorganic polymers **5 hrs**

Differences between inorganic and organic polymers. Polymerization: definition. Types i**) Addition polymerization:** definition with examples: Polystyrene preparation and its partial structure **ii) Condensation polymerization:** definition with examples: Nylon-66 preparation and its partial structure.

Molecular weight of polymers: Expression for weight average and number average molecular weights. (Experimental determination is not required). Preparation, partial structure and applications of the following types of polymers: **(1) Plastics:** (i) Thermosetting plastics: phenol-formaldehyde. (ii) Thermo softening plastics: PVC. **(2) Fibres:** acrylic-polyacrylonitrile, polyamide- Nylon 6,6, polyester: types- PET and PEDT with an example each (reactions not required). **(3) Rubber:** Neoprene **(4) Fluorocarbons:** Teflon (5) **Silicones.**

Fertilizers. **2 hrs**

Introduction: (need of fertilizers), functions of essential plant nutrients (N, P, K). Classification of fertilizers -nitrogenous, phosphatic and mixed fertilizers with suitable examples. Manufacture of urea and super phosphate of lime and their uses. Fertilizer industries in India.

Nuclear chemistry **7 hrs**

Nucleus: Structure and stability, binding energy calculations. Instability of the nuclei, radioactive decay law, half life: numerical problems. Radioactive equilibrium, radioactive series. Artificial radioactivity: Nuclear reactions induced by γ-radiation, α, n, p, and d particles. Nuclear fission and fusion. Nuclear reactors, Breeder reactors, atomic energy programme in India. Isotopes- use of radio isotopes in tracer technique, agriculture, medicine, food preservation and Carbon dating-Numerical problems.

UNIT-III

Metallurgy **5 hrs**

Ellingham's diagrams: principle, salient features, Curves corresponding to formation of CO, CO_2 and oxides of Cr, Al, Mg, Ca, Hg and Ag. Applications with reference to selection of reducing agents using Carbon for ZnO and Al for Cr_2O_3. Extraction of the following metals: **(i**) Nickel from pentlandite ore **(ii)** Thorium from monazite sand **(iii)** Uranium from pitch blende **(iv)** Plutonium from nuclear waste.

Environmental Chemistry **6 hrs**

Acid-base Equalibria. Fundamentals, buffering in water systems, the carbonates and other systems of importance in water. Meaning of stratosphere. Depletion of ozone in the stratosphere causes and remedial measures. The green-house effect and its consequences. Acid rain, photochemical smog-causes, consequences and remedial measures. Treatment of sewage - primary and secondary processes. Industrial effluents from paper industry and sugar industries. Disposal of radioactive solid, liquid and gaseous wastes.

Water Technology **3 hrs**

Types of impurities present in water: Physical (suspended, colloidal), Chemical (high content of chlorine, calcium and magnesium salts) and biological (algae, fungi and bacterial). Causes for the hardness of water. Temporary hardness due to magnesium hydrogen carbonate and calcium hydrogen carbonate, permanent hardness due to calcium and magnesium sulphates. Permissible levels of ions present in water: F^-, Cl^-, NO_3^-, PO_4^{3-}, Ca^{2+}, Mg^{2+} and silicates.

Treatment of water for domestic and industrial purposes by (i) Demineralisation of water by ion exchange method: principle and process. (ii) Reverse osmosis method: principle and the process.

UNIT-IV

Alcohols and thiols **8 hrs**

Introduction and classification: monohydric, dihydric and trihydric alcohols with an example each. 1°, 2° and 3° alcohols with an example each. Methods of preparation: (i) from carbonyl compounds – by the reduction of aldehydes and ketones by reduction, Meerwin-Pondorff-Verley reaction (ii) from acids and esters (by reduction with $LiAlH_4$) (iii) hydroboration-oxidation of alkenes and (iv) hydration of alkenes. Reactions of alcohols: acidic nature-reaction with sodium, esterification, oxidation of alcohols with $KMnO_4$. Comparison of the reactivity of 1°, 2° and 3° alcohols-Lucas test and oxidation with $K_2Cr_2O_7$-with equations.

Glycols: Preparation from alkenes using OsO_4, $KMnO_4$ and from epoxides. Oxidation of glycols by periodic acid and lead tetraacetate with mechanisms. Pinacol-pinacolone re-arrangement.

Glycerol: Preparation from propene and from oils/fats. Reactions of glycerol (i) nitration (ii) action of concentrated H_2SO_4 and (iii) oxidation by periodic acid. Uses of glycerol.

Thiols: Nomenclature. Methods of preparation (Ex: methanethiol). Chemical reactions of methanethiol with (i) sodium (ii) NaOH (iii) metal oxides (iv) formation of thioesters and (v) oxidation with mild oxidising agent (H_2O_2) and strong oxidising agent (HNO_3 or HIO_4). Uses of dithanes. Introduction of umpolung character (reversal of polarity) in carbonyl compounds taking 1,3-dithane as an example.

Phenols **3 hrs**

Classification. Acidic nature - Comparison of acidic strength of phenol with alcohols and monocarboxylic acids. Effect of electron withdrawing group (NO_2) and electron donating group (CH_3) on acidity of phenols at o-,m-,p- positions. Pechmann reaction. Mechanisms of

Reimer Tiemann and Kolbe-Schmidt reactions. Industrial applications of phenols: Conversion of phenol to (i) aspirin (ii) methyl salicylate (iii) salol (iv) salicylsalicylic acid - reactions with conditions.

Ethers and Epoxides **3 hrs**

Methods of preparation - (i) dehydration of alcohols (ii) Williamson's ether synthesis with diethyl ether as an example. Reactions - Ethers as Lewis bases (complexation with metal ions), cleavage and auto-oxidation. Ziesel's method.

Epoxides: Definition, Preparation using per acids, Darzen's reaction. Reactions of mono and 1,2-disubstituted epoxides with (i) carbon nucleophiles (Ex: CH_3MgI) (ii) nitrogen nucleophiles (Ex: NH_3) (iii) reduction with $LiAlH_4$.

III Semester: Practical - III (Organic Chemistry)

Title of the Course: Chemistry Practical- III / CHE31P

(Preparation, recrystallization and melting point determination of the recrystallized sample.)

1. Purification of solid organic compounds by sublimation.
2. Purification of solid organic compounds by Recrystallization.
3. Determination of the melting point of a pure substance.
4. Purification of liquid organic compounds by distillation.
5. Preparation of m-dinitrobenzene from nitrobenzene.
6. Preparation of aspirin from salicylic acid.
7. Preparation of benzoic acid from benzaldehyde.
8. Preparation of p-nitroaniline from acetanilide.
9. Preparation of p-bromo aniline from acetanilide.
10. Extraction of eucalyptus oil/lemon grass oil from their leaves.

Reference Books:

1. Advanced Inorganic Chemistry, 6th Edition, F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann-John Wiley & Sons, 1999.
2. Inorganic Chemistry, ELBS 2nd Edition, D. F. Shriver, P. W. Atkins and C. H. Langford, Oxford Univ. Press 2002.
3. Physical Chemistry, Castellan, G.W. 4th Ed. Narosa, 2004.
4. Advanced Organic Chemistry, Bahl, A. & Bahl, B.S, S. Chand, 2010.
5. Shriver D. E., Atkins P. W., Inorganic Chemistry, Oxford University Press, 5th Edn..
6. Das Asim K. and Das Mahua , Environment Chemistry with Green Chemistry, Books and Allied (P) Ltd. 2010.
7. Kapoor, K. L., Text Book of Physical Chemistry, McGraw Hill, Vol. II, IV, 2008.
8. Hari Jeevan Arnikar, Essentials of Nuclear Chemistry, Revised 4th Ed., New Age International Publishing, 1995.

IV Semester B.Sc. (Chemistry) Paper –IV
Chemistry-IV/ CHE41T

UNIT-I

Phase Equilibria **7 hrs**

Statement and explanation of the terms with examples for phase (P), component (C) and degree of freedom (F), Definition and significance of phase rule. Derivation of phase rule. Application of phase rule to one component systems-water and sulphur, -modified form of phase rule to two component systems. Lead-silver systems. Eutectic mixtures and their applications (examples: freezing mixtures, desilverisation of lead by Patterson's method).

Thermodynamics II **7 hrs**

Gibb's free energy: Work function, chemical potential. Definition and relationship between free energy and work function. Criteria for equilibrium and spontaneous processes. Gibb's-Helmholtz equation - Derivation. Change of free energy with respect to temperature and pressure. Mention of temperature coefficient, van't Hoff isotherm (derivations included), $\Delta G^\circ = -RT \ln K_p$. Problems. Derivation of van't Hoff reaction isochore and Clausius-Clapeyron equation. Its applications to ΔT_b and ΔT_f determination (thermodynamic derivation not required). Qualitative treatment of Nernst heat theorem and III law of thermodynamics-statement only. Elementary concept of residual entropy.

UNIT-II

Solid state chemistry **7 hrs**

Crystalline state, Laws of crystallography. Symmetry elements in crystals, crystal systems. Weiss and Miller indices. X-ray diffraction of crystals-derivation of Bragg's equation, numerical Problems. Coordination number in ionic solids, Defects in solids (Schottky and Frenkel defects). Liquid crystals-Types with examples. Applications Superconducting Solids-High temperature superconductors. Applications.

Steel **5 hrs**

Iron-Carbon Phase diagram, Austenite, Ferrite, Cementite and Pearlite phases. Alloy steels: Influence of Si, Mn, Cr, Ni, Ti and W on the properties of Steel. Ferro alloys: Production of ferro chrome, ferro manganese, and ferro silicon and their applications. Carbon steel: classification. Heat treatment: hardening, case hardening, carbiding, nitriding, tempering and annealing.

Powder metallurgy **2 hrs**

Advantages of powder metallurgy and its applications. Methods of production of metal powders. production of Tungsten powder from Wulframite.

UNIT-III

General study of d and f block elements **8 hrs**

Transition elements: electronic configuration, atomic and ionic radii, ionisation energy, oxidation states, redox potentials, spectral and magnetic properties, catalytic activity, interstitial compound formation.

Lanthanides and Actinides: Electronic configuration, atomic and ionic sizes, lanthanide contraction and its consequences. Oxidation states, spectral and magnetic properties, comparison of oxidation states, complex formation and magnetic properties of d and f block elements. Ion exchange method for separation of Lanthanides.

Chromatography **4 hrs**

Introduction, classification of chromatography. Principles and applications of paper, TLC and Column chromatography.

Ion exchange chromatography: Resins, types with examples- cation exchange and anion exchange resins, mechanism of cation and anion exchange.

Silicates **2hrs**

Structure of SiO_4^{4-}, Classification of silicates based on the structure. Zeolites: their structure and applications.

UNIT-IV

Aldehydes and Ketones **6 hrs**

Nomenclature. Preparation of aldehydes: from acid chlorides (Rosenmund reaction), Gattermann-Koch aldehyde synthesis. Preparation of Ketones: From nitriles, from carboxylic acids with alkyl lithium, from acid chlorides with metal alkyls. Mechanisms of Aldol condensation, Perkin condensation and Knoevenagel condensation. Reactions of Benzoin condensation and Acetal formation. General mechanism of condensation with ammonia and its derivatives ($NH_2{-}R$; R = $-NH_2$, $-OH$, $-NH-CO-NH_2$). Reduction: Reduction by $LiAlH_4$ and $NaBH_4$. Mannich and WolffKishner reduction (only reaction). Mechanisms of Clemmensen reductions.

Carboxylic acids and their derivatives. **6 hrs**

Nomenclature. Preparation: Acid hydrolysis of nitriles with mechanism. Acidic strength (pKa values) - Effect of substituents on the strength of aliphatic and aromatic carboxylic acids. (Comparison of acidic strength of formic and acetic acids; acetic acid and monochloro, dichloro, trichloro acetic acids; benzoic and p-nitrobenzoic acid; benzoic acid and p-aminobenzoic acid) Reactions: Formation of esters, acid chlorides, amides and anhydrides. Hell-Vollhard-Zelinsky reaction, Decarboxylation and reduction (using $LiAlH_4$). (already included under preparation of alcohols from acid)

Di and tri carboxylic acids: Action of heat on dicarboxylic acids (Oxalic to Adipic acids) Reactions of tartaric acid and citric acid. (action of heat, reduction with HI). Reactions of acid chlorides (hydrolysis, reaction with alcohol,). Acid anhydrides (hydrolysis, reaction with alcohol). Esters (alkaline hydrolysis, alcoholysis).Amides (hydrolysis, reduction, Hoffmann rearrangement).

Organometallic compounds **2 hours**

Preparation and synthetic applications of Grignard reagents, Organolithium compounds and lithium dialkylcuprates.

IV Semester: Practical – IV (Inorganic Chemistry)

Title of the Course: Chemistry Practical- IV/ CHE41P

1. Systematic semi-micro qualitative analysis of a mixture of two simple salts (with no interfering radicals).
2. Separation of Organic pigment present in spinach leaves and calculation of R_f value.
3. Separation of a mixture of two organic compounds by TLC.
4. Separation of Mg(II) and Fe(II) by ion exchange method.

Reference Books :

1. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co, 47th Edn., 2017.
1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications, 2008.
2. Khosla, B. D.; Garg, V. C. & Gulati, A. Practical Physical Chemistry, R. Chand & Co., New Delhi, 2011.
3. Peter Atkins and Julio de Paula, Atkin's Physical Chemistry 9th Ed., Oxford University Press 2006.
4. Gurdeep Raj, Advanced Physical Chemistry, 35th Edition, Goel Publishing House, Meerut, 2009.
5. Irving M. Klotz and Robert M. Rosenberg, Chemical Thermodynamics, John Wiley and sons, Inc. 1994.
6. Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.
7. Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry 4th Ed., Pearson, 2010.
8. Arun Bahl and Bahl, B.S. Advanced Organic Chemistry, S. Chand & Co. Ltd., 2012.
9. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons, 2014.

NMKRV COLLEGE

(Autonomous Institution)

3rd block Jayanagar, Bangalore-11

Chemistry Open Elective Syllabus

III/IV Semester:

COSMETIC SCIENCE

Contact Hours: 42 **Work load: 3 Hours/Week.**

Credit Points: 2

Evaluation: Continuous Internal Assesment-50 Marks

Course Objectives:

The objective of this course is to make students aware of the chemistry behind Cosmetics, contents of personal care products, uses, harmful effects and caution about overuse of cosmetics.

Course Specific Outcomes: On completion of this course, students will be able to

1. Understand the meaning of the term 'Cosmetics'.
2. Gain knowledge about the variety of cosmetic products and chemistry behind them.
3. Learn the chemistry employed in personal care products and major constituents in cosmetics.
4. Classify the cosmetic products into different categories.
5. Explain Harmful side effects of cosmetics and their cautious and judicious usage in daily life.
6. Identify the quality of cosmetic products by learning testing, packaging and labelling.
7. Gain knowledge about regulatory bodies and rules governing personal care products.
8. Understand the importance and health benefits of essential oils in cosmetic industries.

UNIT-I

Introduction to Cosmetics **14 hrs**

History of cosmetics, product types - aerosol, emulsion, gel, non-aerosol, solution and stick. Quality control: Testing-clinical testing, consumer testing, Draize test, efficacy testing, RIPT, salon testing. Cosmetic packaging and labelling - how to read PCP (Personal Care Product) label. Cosmetic regulations and laws - Food, Drug and Cosmetic Act (FD&C Act), Fair Packaging and Labeling Act (FPLA).

Colour Cosmetics: Pigments and dyes in cosmetics. Constituents, manufacturing methods and formulation of lipstick, nail polish and face powder,harmful effects of colour cosmetics.

UNIT-II

Hair care products **14 hrs**

Hair care and nutrition, shampoo – major constituents, thickeners, foam stabilizers, perfumes, preservatives and conditioning agents. Anti-dandruff shampoo. Hair cream – composition, hair gels, and hair dyes – types and constituents.

Skin care products : skin cleansers, face wash, toner, cold cream, cleansing milk , moisturizer , hand and body lotion - skin tan, sun screen lotion – constituents, tattoos and tattoo ink - How safe are they?

UNIT-III

Perfumes **14 hrs**

History of perfumes –types of perfumes, raw materials in perfumery, production of natural perfumes, flower perfumes. Deodorant-types, major constituents.Essential oils and their importance in Cosmetic Industry**:** limonene, eugenol, geraniol, α– santalol, rose oxide, menthol, citronellol, linolool, citral and health benefits of essential oils.

Dental Products : Dental hygiene, dental caries, oral care product - product categories – tooth paste , tooth powder , oral rinses – mouth washes ,dental sealants, dental floss, tooth whiteners, comparison between synthetic and herbal oral products.

REFERENCES

1. *Modern Technology of Cosmetics*, Asia Pacific Press Inc, New Delhi, 2004
2. E. Stocchi*: Industrial Chemistry*, Vol 1, Ellis Horwood Ltd. UK, 1990.
3. P.C Jain, M. Jain: *Engineering Chemistry*, 16th edition, Dhanpat Rai & Sons, Delhi, 2015.
4. Sharma B.K & Gaur H, *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

NMKRV COLLEGE FOR WOMEN
(AUTONOMOUS INSTITUTION)
3rd Block, Jayanagar, Bangalore-11

CHEMISTRY SYLLABUS FOR V SEMESTER BSc (NEP)

DSCHE51-Organic and Physical Chemistry- III

Number of hours -60 **Credit points-4**
Number of hours/week-4

COURSE OBJECTIVES

The course objective enables the students to,

1. Recognize and classify alcohols, thiols and phenols based on their structural characteristics.
2. Explore the reactivity of alcohols, thiols and phenols, including their reactions with various reagents and different conditions.
3. Explore the reactivity of aldehydes and ketones, including their reactions with various reagents.
4. Learn methods for the synthesis of carboxylic acids, including laboratory techniques and industrial processes.
5. Introduce students to various spectroscopic techniques and their applications.
6. Know different types of electrochemical cells, types of electrodes and electrode potential.
7. Understand about hydrolysis of various types of salts, buffers and their applications.

COURSE SPECIFIC OUTCOMES

After the completion of this course, the students would be able to,

1. Demonstrate a solid understanding of the properties, structures, and nomenclature of alcohols, thiols, and phenols.
2. Evaluate the suitability of different synthetic methods and reagents for specific applications involving aldehydes and ketones.
3. Understand and appreciate the practical applications of aldehyde, ketones, carboxylic acids and amines in various industries, research, and in daily life.
4. Predict the spectroscopic technique and understand its role in the structural elucidation based on its interaction with electromagnetic radiation.
5. Determine the degree of hydrolysis, pH of salt solution and buffer solution and calculation of solubility product of sparingly soluble salts.
6. Determine the electrode potential of a half cell, identify different types of electrodes, construct cells and demonstrate its application.

UNIT-I

Chapter 1: Alcohols and Thiols (10 Hours)

Alcohols- Nomenclature, isomerism and classification. Methods of preparation- reduction of aldehydes, ketones (by Meerwein-Pondorff-Verley reaction), acids and esters, hydroboration – oxidation and hydration of alkenes.

Reactions of alcohols- acidic nature (reaction with sodium metal and formation of alkoxides), esterification, oxidation with $KMnO_4$.

Comparison of reactivity of 1^0, 2^0 and 3^0 alcohols using oxidation with $K_2Cr_2O_7$, Lucas reagent and Victor-Mayer's method.

Glycols: Preparation of glycols from alkenes using osmium tetraoxide and potassium permanganate and from epoxides. Oxidation of glycols by per-iodic acid and lead tetra acetate.

Glycerol: Manufacture of glycerol from propene, oils and fats. Reactions of glycerol- nitration, action of concentrated sulphuric acid and oxidation by periodicacid. Uses.

Thiols- Nomenclature. Methods of preparation from alkyl halides and alkenes. Reactions of thiols- with sodium, sodium hydroxide, metal oxides, formation of thioesters and oxidation with mild oxidizing agent-H_2O_2 and strong oxidizing agent- nitric acid. Uses of dithianes. Introduction of umpolung character (reversal of polarity) in carbonyl compounds.

Chapter 2: Phenols (5 Hours)

Definition, classification with examples. Methods of preparation-Cumene process. Acidity of phenols, effect of substituents (electron withdrawing and electron releasing groups) on acidity of phenols, comparison with alcohols and carboxylic acids. Mechanisms of Reimer – Tiemann, Kolbe and Schmidt reactions. Industrial applications of phenols-conversion of phenol to aspirin, methyl salicylate, salol, salicylic acid.

UNIT-II

Chapter 3: Aldehydes and Ketones (5 Hours)

Nomenclature, synthesis of aldehydes from acid chlorides, synthesis of ketones from nitriles and carboxylic acids. Polarity of the carbonyl group, aldol condensation, Perkin condensation, Knoevenagel condensation, benzoin condensation, condensation with NH_3, NH_2NH_2 and its derivatives. Mechanisms of aldol condensation, Cannizzaro's reaction, benzoin condensation and acetal formation. Reduction- Clemmensen and Wolff-Kishner reduction, diimide reduction, reduction by $LiAlH_4$ and $NaBH_4$.

Chapter 4: Carboxylic Acids (5 Hours)

Classification and nomenclature. Acidic strength – pKa values. Effect of substituents on the strength of aliphatic and aromatic acids – comparison of acid strength of formic and acetic acid, acetic acid and monochloro, dichloro, trichloro acetic acids, benzoic and p-nitrobenzoic acid,

p-amino benzoic acid, explanation. Preparation- oxidation of alcohols and carbonyl compounds and hydrolysis of nitriles.

Reactions- formation of esters, acid chlorides, amides and anhydrides, Hell-Volhard-Zelinski reaction, decarboxylation and reduction.

Di and tri carboxylic acids: Action of heat on dicarboxylic acids. Reactions of tartaric acid and citric acid- action of heat and reduction with HI. Reactions of acid chlorides, acid anhydrides, esters and amides (hydrolysis, reaction with alcohol and ammonia)

Chapter 5: Amines **(5 Hours)**

Classification. Preparation of alkyl and aryl amines- reductive amination of carbonyl compounds, Gabriel-phthalimide synthesis. Basicity of amines in aqueous solution:inductive, resonance, steric and solvation effects on the basicity of amines. Reaction of amines as nucleophiles– methylation, quaternary salts, Hoffmann elimination with mechanism. Distinguishing reactions of primary, secondary and tertiary amines (carbylamine reaction, action with Hinsberg's reagent, reaction with nitrous acid).

Diazotization and synthetic applications of diazonium salts. Sandmeyer's reaction (conversion to chlorobenzene, bromobenzene and benzonitrile), hydrolysis, reduction (to phenyl hydrazine and aniline), coupling reactions to give azodyes (*p*-hydroxyazobenzene and 1- phenylazo-2-naphthol).

UNIT III

Chapter 6: Molecular Spectroscopy **(15 hours)**

Polarization and orientation of dipoles in an electric field. Dipole moment. Induced dipole moment (experimental determination of dipole moment not included). Clausius-Mossotti equation (no derivation). Dipole moment and structure of molecules (planar and non-planar). **(3 Hours)**

The interaction of radiation with matter. Regions of electromagnetic spectrum and associated spectroscopic techniques. Origin of molecular spectra: Born-Oppenheimer approximation. Rotational spectra of diatomic molecules: Relationship between internuclear distance and moment of inertia. Expression for rotational energy. Numerical problems. Criterion for absorption of radiation-selection rule. **(3 Hours)**

Vibrational spectroscopy: Hooke's law- Expression for the frequency of SHO-force constant and its significance. Expression for vibrational energy levels of SHO. Zero point energy, numerical problems. Degree of freedom of polyatomic molecules– modes of vibration for CO_2 and H_2O molecules. **(3 Hours)**

Raman spectroscopy: Concept of polarisability. Pure rotational and vibrational spectra. Stokes and anti-Stoke's lines-selection rules. Advantages of Raman spectroscopy over IR spectroscopy.

(3 Hours)

Electronic spectroscopy: Potential energy curves for bonding and antibonding molecular orbitals. Electronic transitions –qualitative description of non-bonding orbitals and transitions between them. Selection rules and Franck-Condon principle. **(3 Hours)**

UNIT-IV

Chapter 7: **Ionic equilibria** **(7 hours)**

Hydrolysis of salts: Salts of (i) strong acid and strong base (ii) weak acid and strong base (iii) strong acid and weak base (iv) weak acid and weak base, relationship between K_h , K_w , K_a , K_b, degree of hydrolysis and its relationship with K_h , pH of salt solutions- problems. Effect of temperature and dilution on degree of hydrolysis, Common-ion effect, solubility and solubility product, application of solubility product in qualitative analysis. Buffers: mechanism of buffer action-weak acid and its salt, weak base and its salt. pH of buffers - problems, buffer capacity, importance of buffer solutions.

Chapter 8: Electrochemistry **(8 hours)**

Galvanic cell: conventions of representing galvanic cells-reversible and irreversible cells, derivation of Nernst equation for single electrode potential (free energy concept).Weston-cadmium cell: determination of EMF of a cell by compensation method. Determination of E_o of Zn/Zn^{2+} and Cu/Cu^{2+}electrodes.

Liquid junction potentials, elimination of liquid junction potential.

Types of electrodes: Metal and gas electrodes (chlorine), metal/metal insoluble salt electrodes, redox electrodes. Reference electrodes-standard hydrogen electrode, calomel electrode, quinhydrone electrode and glass electrode. Determination of pH using these electrodes(glass electrode and quinhydrone electrode). Numerical problems. Concentration cells: (i) EMF of concentration cells (ii) determination of solubility of sparingly soluble salts and numerical problems. Redox electrodes, EMF of redox electrodes.

PRACTICALS

DSCHE51P: Organic and Physical Chemistry-III

Number of hours/week-4 **Credit points-2**

List of experiments to be conducted,

Part-A: Organic Chemistry

1. Preparation of m-dinitrobenzene from nitrobenzene.
2. Preparation of aspirin from salicylic acid.
3. Preparation of p-nitroaniline from acetanilide.
4. Preparation of anthranilic acid from phthalic anhydride.
5. Preparation of m-nitrobenzoic acid from methyl benzoate.
6. Preparation of benzilic acid form benzoine.
7. Microwave assisted solvent-free green synthesis of an organic compound.

Part-B: Physical chemistry

1. Determination of the critical solution temperature of phenol and water by determining their mutual solubility.
2. Determination of percentage composition of sodium chloride by miscibility temperature method.
3. Determination of transition temperature of a salt hydrate.
4. Potentiometric titration of potassium dichromate with ferrous ammonium sulphate.
5. Conductometric titration of $LiSO_4$ Vs $BaCl_2$.
6. Determination of solubility of silver halide by setting up concentration cell.
7. Estimation of Fe^{2+} ion concentration in the given solution by titration of FAS versus $KMnO_4$ by colorimetric method.

REFERENCES:

1. Advanced Organic Chemistry.Arun Bahl and B.S Bahl.
2. Organic Chemistry,Volumes I and II,ILFinar,Longman, (1999).
3. Organic Natural products.Gurudeep and Chatwal.
4. Chemistry of Natural products 1 &2.O P Agarwal
5. Organic Chemistry, R T Morrison and R N Boyd, Prence-Hall,(1998).
6. Organic reactions and their mechanisms .Kalsi.P.S
7. A text book of Organic Chemistry.O P Agarwal
8. Reactions and Reagents in Organic Chemistry.O P Agarwal
9. Spectroscopy of Organic compounds.Kalsi.P.S.
10. Spectroscopic identification of organic compounds.Silverstien &Weber.
11. Physical Chemistry,P.W.Atkins,Juliode Paula,ELBS,7th edison,(2002).
12. Physical Chemistry:A Molecular Approach,Mc Quarie and Simon,Viva, NewDelhi,(2001).
13. Findlays practical physical chemistry revised by P. B. Levi. Z, Longman's London(1966).
14. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw HillInternaBonalEdn. (1966)
15. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut(1988)
16. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987)
17. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
18. Practical Physical Chemistry by A.M James and P. E. Pritchard, Longman's Group Ltd(1968)
19. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, NewDelhi (1983)
20. Physical Chemistry Laboratory Principles and Experiments by H. W. Salberg J. I.Morrow, S. R. Cohen an Green Macmillan publishing Co.,.New York (1994).
21. Textbook of Practical Organic Chemistry- A. I. Vogel, (1996).
22. Textbook of Quantitative Organic Analysis- A. I. Vogel, (1996).

DSCHE52-Inorganic Chemistry-III and Biological Chemistry- I

Contact hours-60 **Credit points-4**
No of hours/ week-4

COURSE OBJECTIVES

The course objective enables students to,

1. Learn the concept of nomenclature of coordination compounds, geometry (e.g., octahedral, tetrahedral, square planar), and the factors that influence the geometry of coordination complexes by taking various examples.
2. Understand how coordination chemistry interfaces with other branches of chemistry and related fields, such as bioinorganic chemistry and organometallic chemistry.
3. Understand the principles of heat treatment, including annealing, quenching, and tempering, and their effects on the structure and mechanical properties of metals.
4. Know requisite background knowledge in the field of Biochemistry.
5. Have thorough knowledge about the structure, chemistry and functions of biomolecules like carbohydrates, lipids and proteins.
6. Understand the salient features of nucleic acids.
7. Understand the basic characteristics of enzyme and its classification, mechanism o f enzyme action, enzyme kinetics, enzyme inhibition and co-enzyme.

COURSE SPECIFIC OUTCOMES

After the completion of this course, the students would be able to,

1. Define and explain what coordination compounds are, including their structure, bonding and properties.
2. Understand the practical applications of coordination compounds in various fields, such as catalysis, medicinal chemistry, and material science.
3. Gain knowledge about the manufacturing and processing methods for various industrial materials.
4. Have a strong theoretical and practical background in fundamental concepts of biochemistry.
5. Correlate structure and functions of biomolecules like carbohydrates, lipids and proteins.

UNIT-I

Chapter 1: Coordination chemistry (10 hours)

Coordination compounds, ligands and their classification (mono, bi, tri, tetra, penta and hexa dentate ligands) and ambidentate ligands, coordination number, nomenclature of coordination compounds. Theories of structure and bonding (explanation for the formation of complexes by Werner's theory and its limitations). EAN rule, Valence bond theory- postulates, low spin and high spin complexes with examples, limitations of VBT. Crystal field theory (octahedral, tetrahedral and square planar complexes). Crystal field splitting and crystal field stabilization energies, limitations of CFT. Magnetic properties of $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$, $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$. Spectral properties of $[Ti(H_2O)_6]^{3+}$, $[Co(H_2O)_6]^{3+}$, $[CoCl_4]^{2-}$. Isomerism-structural,ionization, linkage, hydrate and coordination isomerism with examples. Stereoisomerism-geometrical and optical isomerism with examples.

Chapter 2: Organometallic compounds (5 hours)

Ligands, classification (hapticity). Synthesis and structure of $K[PtCl_3(\eta^2\text{-}C_2H_4)]$ and $[Fe(\eta^5 - C_5H_5)_2]$.

Metal carbonyls – $Cr(CO)_6$, $Co_2(CO)_8$, $Mn_2(CO)_{10}$; eighteen electron rule and its deviations with examples.

Applications of coordination/organometallic compounds: *cis*-platin in cancer therapy, $Na_2CaEDTA$ in the treatment of heavy metals (Pb, Hg) poisoning, Wilkinson's Catalyst in alkene hydrogenation, Monsanto acetic acid process.

UNIT-II

Chapter 3: Industrial Materials (15 hours)

Refractories: Properties- determination of PCE values, classification **(1 hour)**

Abrasives: classification, application, hardness, Moh's scale, manufacture and importance of carborundum and tungsten carbide. **(1 hour)**

Glass: **(2 hours)**

Properties, types, manufacture of soda glass. Composition and applications of borosilicate, metallic glass, optical glasses and polycarbonate glasses, safety glass, fire and bullet proof glasses.

Cement: **(2 hours)**

Raw materials, grades, manufacture of Portland cement (by wet process), setting of cement.

Paints and Varnishes: **(1 hours)**

Constituents of oil and emulsion paints and their role, constituents of varnishes.

Steel **(5 hours)**

Iron-Carbon phase diagram, Austenite, Ferrite, Cementite and Pearlite phases.
Alloy steels: Influence of Si, Mn, Cr, Ni, Ti and W on the properties of steel.
Ferro alloys: Production of ferrochrome, ferromanganese, and ferrosilicon and their applications. Carbon steel: classification. Heat treatment: hardening, case hardening, carbiding, nitriding, tempering and annealing.

Silicates **(3 hours)**

Classification and structures, isomorphous replacement, pyroxenes, layered and vitreous silicates, silica gel, zeolites-molecular sieves and applications.

UNIT-III

Chapter 4: Introduction to biological chemistry **(2 hours)**

Contributions of Lavosier, Wohler, Emil Fischer, Louis Pasteur, Hans Kreb, Michaelis and Menton, Watson and Crick, Chargaff, H.G. Khorana, Knoop, Pauling, Hopkins and Miescher in the field of biochemistry. Elemental and biochemical composition of living organisms. Role of water in biochemical systems (mention the properties of water which makes water a solvent of life). Importance of water in biological system with special reference to the maintenance of the native structure of biological molecules. Types of bonding in biological molecules. Biological relevance of pH and pKa of functional groups in biopolymers, proteins and nucleic acids.

Chapter 5: Carbohydrates **(8 hours)**

Introduction and classification. Monosaccharides: Structure of glucose, galactose, fructose, mannose and ribose (α and β forms). Glucose: properties, open- chain and ring structure. Determination of ring size, anomers and epimers. Structure and biological importance of derivatives of Monosaccharides: Amino sugars: β-D-glucosamine, β-D-galactosamine and their acetaylated forms. N-acetyl muramic acid (NAMA), N-acetyl neuraminic acid (NANA). Sugar acids: D- gluconic acid, D-glucuronic acid and D- glucaric acid. Sugar phosphates- Glucose 6-phosphate,

Fructose-6-phosphate, Fructose-1,6-diphosphate, β-D-Ribose-5-phosphate, β-D-deoxyribose-5-phosphate. Structure and functions of deoxyribose. Oligosaccharides: Structure and biological importance of isomaltose, cellobiose and trehalose. Polysaccharides: Source, partial structure and biological functions of starch, cellulose, chitin, heparin and insulin.

Chapter 6: Lipids **(5 hours)**

Introduction and classification into simple, compound and derived lipids. Fatty acids : definition and classification- i) saturated and unsaturated with examples and structure of palmitic, stearic, linoleic, linolenic and arachidonic acid. ii) Essential and non-essential fatty acids with examples. Triglycerides–Structure of simple and mixed glycerides, properties of triglycerides- acid and alkali hydrolysis, saponification number and its significance, iodine number and its significance, rancidity (oxidative and hydrolytic), biological importance of triglycerides. Phosphoglycerides – general structure of 3-Sn–phosphatidic acid, lipid bilayer (as in cell membrane), micelles, liposomes and its applications, structure and biological importance of lecithin, cephalin, phosphatidylserine, phosphatidylinositol. Cholesterol – definition, types (HDL, LDL and VLDL).

UNIT-IV

Chapter 7: Proteins **(6 hours)**

α-amino acids-general structure, classification based on the polarity of side chain groups. Reactions of amino acids- reaction with alcohols, ninhydrin, Sanger's reagent ,Edman's reagent, carbon dioxide, nitrous acid. Zwitter ionic structure and isoelectric point taking glycine as an example. Aminoacids as precursors for specialised molecules ex:neurotransmitters(GABA), Importance of serotonin**.** Peptide bond –characteristics. Biological importance of proteins. Classification of proteins based on composition and solubility with suitable examples. Structural organization of proteins-primary (example of insulin, sickle cell anemia) secondary, brief description of α-helix, β-pleated structure (keratin and silk fibroin), tertiary (ribonuclease) and quaternary structure of proteins(ex: Hemoglobin).

Chapter 8: Enzymes **(6 hours)**

General characteristics of enzymes. Classification according to IUB with examples (EC number not required).Active site, enzyme specificity, mechanism of enzyme action. Enzyme kinetics- effect of enzyme and substrate concentration on rate of reaction, M-M equation (derivation not required), significance of Km and Vmax, effect of pH and temperature on rate of enzyme catalyzed reaction. Enzyme inhibition –competitive and noncompetitive with their significance. Clinical and industrial applications of enzymes (Creatine kinase, Lactate dehydrogenase, alkaline phosphatase)

Chapter 9: Nucleic acids **(3 hours)**

Types–Components of nucleic acids, bases, nucleosides and nucleotides with structures. Partial structure of polynucleotide. Structure of DNA (Watson - Crick model) and RNA. Biological roles of DNA and RNA. Protein-nucleic acid interaction- chromatin and viral nuclear capsid.

PRACTICALS

DSCHE52P: Inorganic-III and Biological Chemistry -I

Number of hours/week-4 **Credit points-2**

List of experiments to be conducted,

Part-A: Inorganic chemistry

1. Estimation of zinc using EDTA.
2. Estimation of nickel using EDTA and standard zinc sulphate.
3. Estimation of Ca^{2+} and Mg^{2+} ions in hard water using Patton- Reeder's indicator.
4. Estimation of copper in brass.
5. Estimation of calcium in limestone by permanganometric method.
6. Estimation of percentage of iron in Haematite ore using barium diphenylamine sulphonate as an internal indicator.

Part-B: Biological chemistry

1. Preparation of buffers and determination of their pH values.
2. Estimation of creatinine by Jaffe's method.
3. Estimation of reducing sugars by DNS method.
4. Estimation of protein by Biuret method.
5. Estimation of Lactose in milk by Somogy's method.
6. Isolation of DNA from onions.

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NMKRV COLLEGE FOR WOMEN
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CHEMISTRY SYLLABUS FOR VI SEMESTER BSc (NEP)

DSCHE61-Organic and Physical Chemistry- IV

Contact hours-60 **Credit points-4**
Number of hours/week-4

COURSE OBJECTIVES

The course objective enables the students to,

1. Recognize and classify heterocyclic compounds based on their ring structures and heteroatoms.
2. Understand the principles and strategies involved in the total synthesis of complex natural products.
3. Learn the applications of organic chemistry in the field of medicine.
4. Learn various spectroscopic techniques, including IR, NMR, Mass and their applications.
5. Understand retrosynthetic analysis in the field of industry.
6. Learn the basics of voltammetry as an electro analytical techniques.
7. Learn the concepts of photochemistry and study Beer- Lambert's law.
8. Understand the photochemical and photophysical processes and their quantum yield expressions.
9. Develop expertise on the fundamental concepts of quantum mechanics and its application in chemistry.

COURSE SPECIFIC OUTCOMES

After the completion of this course, the students would be able to,

1. Apply knowledge to solve problems related to the synthesis and reactions of heterocyclic compounds.
2. Recognize the importance of natural products in drug discovery, agriculture, and other applied fields.
3. Use spectroscopic data to deduce the structure and connectivity of organic compounds.
4. Explain the Beer-Lambert's law, the laws of photochemistry, photochemical and photophysical processes as well as to calculate the quantum yield of photochemical combinations.
5. Explain the fundamental concepts of quantum mechanics and its application in chemistry.
6. Demonstrate skills to explain the principles of DME and experimental set up for cyclic voltammetry.

UNIT-I

Chapter 1: Heterocyclic compounds (5 hours)

Structure, resonance and aromatic character of Furan, Pyrrole, Thiophene and Pyridine. Methods of preparation and reaction of Furan, Pyrrole, Thiophene, and Pyridine. Mechanism of electrophilic substitution reaction; comparison of basicity of pyridine, piperidine and pyrrole. Structures of fused ring systems eg: Indole, Quinoline and Isoquinoline.

Chapter 2: Chemistry of Natural Products (4 hours)

Terpenoids: **(2 Hrs):** Occurance, classification, isoprene rule; structural elucidation and synthesis of citral. Structure of menthol, camphor, limonene and β-carotene and their uses.

Alkaloids: (2 Hrs): Classification, general characteristics, structural elucidation and synthesis of nicotine. Uses of quinine, morphine, cocaine, atropine, and caffeine.

Chapter 3: Medicinal Chemistry (3 hours)

Introduction and classification of drugs, their action and discovery. Sources of drugs and lead compounds. Methods and routes of administration. A brief introduction to drug action: the pharmacokinetic phase (ADME), the pharmacodynamic phase. Synthesis and uses of paracetamol, chloramphenicol, penthothal, sulphanilamide and Ibuprofen (green synthesis).

Chapter 4: Rearrangement reactions (3 hours)

Introduction, classification, mechanisms of Pinacol-Pinacalone, Fries, Beckmann, Schmidt, Wolff and Claisen rearrangement.

UNIT-II

Chapter 5: Spectroscopy of Organic Compounds (12 hours)

IR Spectroscopy: (3 Hrs): Vibrational transition; stretching and bending modes of vibration; influence of force constants and atomic weight on IR absorption position; identification of common functional groups; fingerprint region.Ex: 2- hexanol, 2- hexanone, 2- hexanoic acid, hexane.

NMR Spectroscopy: (6 Hrs): Basic principles of proton magnetic resonance; chemical shift, factors influencing chemical shift, equivalent and non-equivalent protons, shielding and deshielding effect, Splitting of the signals Coupling constant(J). Application in structural identification of simple organic molecules such as methane, methyl chloride, ethyl chloride, ethyl alcohol, propane, chloroform, benzene, toluene and benzyl alcohol .

Mass Spectroscopy: (3 Hrs): Basic principles of mass spectrum, molecular peak, base peak, isotopic peak, metastable peak and their uses, fragmentation- by direct electron impact, Nitrogen rule. Ex: 1^0, 2^0, 3^0 alcohol, triethyl amine. Application of all the above spectra in determining the structure of a compound Ex: methyl ethyl ketone.

Chapter 6: Retrosynthetic Analysis (3 hours)

Introduction to synthons and synthetic equivalents, Target molecule, Disconnection approach. Basic principles and terminologies used in disconnection approach. Functional group inter conversion i) Halides to alcohols ii) carbonyl groups to 1^0,2^0 and 3^0 alcohols iii) Nitro groups to Amines.

Synthesis of Toluene, Acetophenone, Benzaldehyde, Benzoic acid, Benzyl alcohol through disconnection approach.

UNIT-III

Chapter 7: Quantum Mechanics (9 hours)

Concepts of operators: Laplacian, Hamiltonian, Linear and Hermitian operators. Angular momentum operators and their properties. Ladder operator method for angular momentum.

Schrödinger equation to hydrogen atom in spherical polar co-ordinates. List of wave functions for few initial states of hydrogen like atoms. Electron spin (Stern-Gerlach experiment), spin-orbital, anti-symmetry , Slater determinants, coupling of angular momenta. Russell-Saunders and JJ-coupling, term symbols. Spin-orbital interaction and explanation of term multiplicities (Na-D doublet). Zeeman effect. Approximate methods: need for approximate methods. Perturbation method. Rayleigh Schrödinger perturbation theory for time-independent non-degenerate system.

Chapter 8: Electroanalytical Methods: (6 hours)

Voltammetry at a dropping mercury electrodes (DME)-Types of current obtained at DME. Ilkovic equation and its applications. Current –potential relation for a cathodic process – halfwave potential. Cyclic voltammetry-Principles-Experimental set up-quantitative analysis, determination of diffusion coefficients. Residual current, diffusion current

UNIT-IV

Chapter 9: Photochemistry (7 hours)

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients.

Laws of photochemistry. Grotthus-Draper law, Stark-Einstein law – statements, differences between photophysical and photochemical processes-any four differences with examples.

Comparison of photochemical and thermal reactions with an example. Quantum yield-definition, magnitude of quantum yield for photochemical combination of (i) H_2 and Cl_2 (ii) H_2 and Br_2 (iii) dissociation of HI (iv) dimerisation of anthracene: reason for low, high and medium quantum yields.

Photosensitization-definition with example, photostationary equilibrium – definition and example. Singlet and triplet states – definitions. Fluorescence, phosphorescence, luminescence, bioluminescence and chemical sensors – definitions of all these with suitable examples.

Chapter 10: Phase rule **(7 hours)**

Significance of phase rule. Statement of phase rule and explanation of the terms with examples for phase(P), component (C) and degrees of freedom (F).

One component systems-water, Two-component systems – sulphur, water- potassium iodide and lead –silver systems.

Eutectic mixtures and their applications (freezing mixtures). Desilverisation of lead by Pattinson's method).

PRACTICALS

DSCHE61P: Organic and Physical Chemistry-IV

Number of hours/week-4 **Credit points-2**

List of experiments to be conducted,

PART-A: Organic Chemistry

1. Estimation of nitrogen by Kjeldhal's method.
2. Estimation of molecular weight of an acid.
3. Determination of saponification value of oil or fat.
4. Extraction of lemon grass or eucalyptus oil.
5. Determination of iodine value of vegetable oil.
6. Estimation of amino acid.

PART B: Physical chemistry

1. Conductometric titration of weak acid versus weak base.
2. Estimation of Fe^{2+} ion concentration using EDTA by colorimetric method.
3. Determination of single electrode potential of Cu^{2+}/Cu and estimation of the given unknown concentration using potentiometric titration.
4. Determination of single electrode potential of $Zn^{2+/}Zn$ and estimation of the given unknown concentration using potentiometric titration.
5. Titration of weak acid against a strong base using quinhydrone electrode and calculation of pKa and Ka of the weak acid.
6. Determination of oxidation and reduction potential of $K_4[Fe(CN)_6]/K_3[Fe(CN)_6]$ system by cyclic voltammeter.

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DSCHE62- Inorganic Chemistry-IV and Biological Chemistry- II

Contact hours-60 **Credit points-4**

No of hours/week-4

COURSE OBJECTIVES

The course objective enables students to,

1. Explore research and innovation in materials science, exploring new materials, applications, and sustainable practices.
2. Develop the ability to select appropriate materials for specific engineering applications based on their properties, performance requirements, and cost considerations.
3. Understand the role of transition metals as catalysts in various chemical reactions.
4. Identify practical applications of conducting polymers in electronics, sensors, and energy storage devices.
5. Understand the mechanism of DNA Replication, Transcription, Genetic code and Translation Process
6. Understand and know more about Vitamins and hormones.
7. Analyse the principle and the applications of Blotting and Electrophoretic techniques

COURSE SPECIFIC OUTCOMES

After the completion of this course, the students would be able to

1. Apply metallurgical principles to the production, processing, and selection of materials in various industries.
2. Understand the fundamentals of powder metallurgy and its advantages.
3. Recognize the importance of transition metals in various chemical processes and industries.
4. Apply knowledge of doping and processing to tailor the performance of conducting polymers.

UNIT-I.

Chapter 1: Metallurgy (5 hours)

Ellingham's diagrams: Salient features. Selection of reducing agents using Ellingham's diagrams. Extraction of the following metals.

i) Nickel from sulphide ore

ii) Thorium from Monazite sand

iii) Uranium from Pitch blende

iv) Plutonium from Nuclear waste

Chapter 2: Powder metallurgy (2 hours)

Advantages of powder metallurgy and its applications. Methods of production of metal powders. production of Tungsten powder from Wulframite.

Chapter 3: Nuclear and Radiochemistry (8 hours)

Nucleus-structure and stability, binding energy calculations. Instability of the nuclei, radioactive decay law, half life: numerical problems. Radioactive equilibrium, radioactive series. Artificial radioactivity: Nuclear reactions induced by γ-radiation,α, n and p particles. Nuclear fission and fusion. Nuclear reactors, atomic energy programme in India. Isotopes- use of radio isotopes in tracer technique, agriculture, medicine, food preservation and Carbon dating-numerical problems.

UNIT-II

Chapter 4: General study of d and f block elements (6 hours)

Transition elements: electronic configuration, atomic and ionic radii, ionisation energy, oxidation states, redox potentials, spectral and magnetic properties, catalytic activity, interstitial compound formation.

Lanthanides and Actinides: Electronic configuration, atomic and ionic sizes, lanthanide contraction and its consequences. Oxidation states, spectral and magnetic properties, comparison of oxidation states, complex formation and magnetic properties of d and f block elements. Ion exchange method for separation of Lanthanides.

Chapter 5: Chemistry of Newer materials **(5 hours)**

Conducting polymers **(3 hours)**

Introduction, definition, and examples-polyaniline, polyacetylene. Mechanism of conduction. Qualitative treatment of doping, properties: elasticity with high electrical conductivities, engineering and biological applications.

Nanomaterials (**2 hours)**

Introduction, definition, and electronic structure. Different methods of production: Sol gel synthesis, inert gas condensation, mechanical alloying (ball milling), plasma synthesis, electrodeposition, and general applications.

Chapter 6: Water Technology **(4 hours)**

Types of impurities present in water. Causes for the hardness of water. Permissible levels of ions present in water. Treatment of water for domestic and Industrial purposes by the following methods.

i) Demineralization of water by Ion exchange method.

ii) By reverse Osmosis method.

UNIT -III

Chapter 7: Biological oxidation **(7 hours)**

Bioenergetics- Introduction-stages of energy transformation. Exergonic and endergonic reactions. Relationship between G and Keq. High energy phosphates–definition, examples, structural features of ATP that makes ATP a high energy phosphate (electro static repulsion, opposing resonance, solvation of ATP). Examples of high energy phosphates other than ATP. Energy coupling in biological reactions (explain the concept with suitable examples). Biological oxidation – comparison of oxidation with combustion using glucose as an example. Redox potentials of some biological important half reactions. Calculation of energy yield from biological redox reaction (oxidation of NADH by oxygen, reduction of acetaldehyde by NADH). Mitochondrial electron transport chain, oxidative phosphorylation. Substrate level phosphorylation.

Chapter 8: Metabolism **(8 hours)**

Catabolism and anabolism (explanation with an example) – Carbohydrate metabolism, glycolysis, fate of pyruvate. TCA cycle, energetics. Gluconeogenesis–definition, synthesis of glucose from lactate. Fatty acid metabolism–activation of fatty acids, role of carnitine, β oxidation pathway, energetics.

Protein metabolism–general aspects of amino acid degradation –transamination, deamination and decarboxylation. Urea cycle.

UNIT - IV

Chapter 9: Molecular biology (5 hours)

Central dogma of molecular biology–semi conservative replication and mechanism of DNA replication, transcription, translation. DNA finger printing – definition and its applications.

Chapter 10: Vitamins (5 hours)

Classification and nomenclature of vitamins. Fat soluble and water-soluble vitamins sources, deficiency diseases, Vitamin B complex and Vitamins of E group. Structure of Vitamin A1 and A2, mechanism of vision, structures of Vitamin B1, Vitamin C, Vitamin D, Vitamin E and Vitamin K1

Chapter 11: Hormones (3 hours)

Definition. Classification - a) amino acid derivatives (epinephrine and thyroxine); b) peptide (oxytocin and vasopressin) and polypeptide hormones (insulin and glucagon); c) Steroid hormones (progesterone, testosterone) with functions. Role of insulin and glucagon in glucose homeostasis.

Chapter 12: Biochemical techniques (2 hours)

Principle and applications Electrophoresis–cellulose acetate membrane electrophoresis and PAGE. Blotting techniques- Basic principle, types and application.

PRACTICALS

DSCHE62P: Inorganic-IV and Biological Chemistry -II

Number of hours/week-4 **Credit points-2**

List of experiments to be conducted,

Part-A: Inorganic chemistry

1. Preparation of cis-potassium dioxalato diaqua chromate (III) complex
2. Preparation of cuprammoium sulphate.
3. Preparation of tri-oxalato ferrate(III).
4. Preparation of hexaammine cobalt (III) chloride.
5. Preparation of pentaammine cobalt (III) chloride.
6. Preparation of hexaammine nickel (II) chloride.

Part-B: Biological chemistry

1. Estimation of α-amino acids using Ninhydrin by colorimetric method.
2. Estimation of reducing sugars by Hegdorn-Jensen method
3. Isolation of Lactose and casein from milk and estimation of lactose by colorimetric method.
4. Estimation of Fructose by Seliwanoff's method.
5. Qualitative analysis of carbohydrates.
6. Separation of amino acids by circular paper chromatography.

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