JSS COLLEGE FOR WOMEN (Autonomous)

Saraswathipuram, Mysuru- 570 009

CHOICE BASED CREDIT SYSTEM(CBCS) SYLLABUS

CHEMISTRY

FOR B.Sc. DEGREE PROGRAMME
(I & II SEMESTER)-Revised NEP

2024-25 (Batch onwards)

B.Sc.CHEMISTRY SYLLABUS

FIRST SEMESTER

Paper: Chemistry-I **Code:CHDSC-1**

Contact Hours/ Week	Credits	Scheme of Evaluation: Max. Marks: 100		
		Continuous Internal Assessment		Semester End Examination(SEE)
		C_1	C_2	C_3
03	03	10 Marks	10 Marks	80 Marks

Unit-I **Inorganic Chemistry** **[15 Hours]**

Atomic Structure: deBroglie matter waves-dual nature of electron.Heisenberg'suncertainty principle and its significance. Schrodinger wave equation-explanation of the terms involved (noderivation).Significanceofψandψ^2.Atomicorbitals,shapes of s,p and d orbitals. Quantum numbers and its significance. (n+l) rule, Aufbau Principle, Pauli's exclusion principle and Hund's rule of maximum multiplicity, electronic configuration of elements (up toZ = 30). Explanation for the stability of completely-filled and half-filled orbitals based on the concepts of pairing energy,promotional energy and symmetric charge distribution. Effective nuclear charge, screening effect- based on Slater's rules (problems to be solved). [**07 Hours**]

Periodic properties: Classification of elements in to s, p, d, and f blocks. Atomic radii**,** covalent, ionic and van derWaal's (explanation with examples). Additive nature of covalent radii. Variation of covalent radii down a group and across a period-explanation for the observed trends, isoelectronicions,variationofionicradiiinisoelectronicions.Determinationofionicradiiby Pauling's method. Comparison of the size of atoms with corresponding anions and cations.

Ionization enthalpy: Explanation, successive ionization enthalpy, factors affecting ionization enthalpy, applications of ionization enthalpy. Variation down a group and across a period, explanation for the observed trends.

Electron gain enthalpy: Definition, successive electron gain enthalpy, variation of electron gain enthalpy across a period and down a group, explanation for the observed trends.

Electronegativity: Explanation, Variation of electronegativity in a group and in a period-explanation for the observed trends. Factors determining electro negativity (charge on the atom and hybridization). Pauling, Mulliken and Allred-Rochow scale of electronegativity (problems to be solved). Applications of electronegativity. [**08 Hours**]

Unit-II **Organic Chemistry** **[15 Hours]**

BasicConcepts: Arrownotations and their significance, bond cleavage,types of reagents-electrophiles and nucleophiles.Reactionintermediates-generation,stabilities,andreactionsinvolving carbocations, carbanions, carbon free radicals, nitrenes and carbenes.

Electronic displacement effects: Inductive effect, electromeric effect, resonance, hyperconjugation and their significance. Strengths of organic acids and bases: Comparative study withemphasisonfactorseffectingpKvalues.Relativestrengthofcarboxylicacids(formicacid, acetic acid, chloroacetic acid, trichloroacetic acid, propionic acid, benzoic acid, *o*-nitrobenzoic acid, *m*-nitrobenzoic acid, *p*-nitrobenzoic acid, *o*-toluic acid, *m*-toluic acid and *p*-toluic acid. Relative strength of organic bases (methylamine, ethylamine, dimethylamine, trimethylamine, aniline, diphenylamine, triphenylamine, *o*-nitroaniline, *m*-nitroaniline, *p*-nitroaniline, *o*-toluidine, *m*-toluidine, and *p*-toluidine. [**07 Hours**]

Alkanes: Preparation (Corey-House, Wurtz method), Mechanism of free radical substitution of methane.

Alkenes: Preparation (Wittig's reaction), Reactions of ethylene and propene (reduction, hydroboration, epoxidation, oxidation with $KMnO_4$and $OsO_4$and ozonolysis). Mechanism of addition of HBr to ethylene and propene (Markovnikoff rule, and peroxide effect).

Dienes: Definition, types with examples. Conjugated dienes: 1,3 butadiene – preparation, 1,2 and 1,4-addition reactions with HX and X_2, Diel's Alder reaction with an example.

Alkynes: Methods of preparation (Dehydrohalogenation), reactions (with HCN, H_2, HX, and H_2O). Acidic character of terminal alkynes.

Alkyl halides: Elimination reactions (Mechanism of E1, E2, and E1cb reactions). Saytzeff and Hoffmann's elimination. Substitution reactions (S_N1 and S_N2 reactions with energy profile diagram). Effect of nature of alkyl groups, leaving groups, nucleophiles, and solvents on substitution reactions. [**08 hours**]

Unit-III Physical Chemistry [15 Hours]

GaseousState: Elementar aspects of kinetic theory of gases,ideal and realgases(Noderivation).

MolecularVelocities: Distribution of molecular velocities and molecular energies(graphical representation-derivation not required) and their importance. Effect of temperature on distribution of molecular velocities using distribution curve. Energy distribution as a function of temperature. Types of MolecularVelocities-Most probable, average, and root mean square velocities definition and equation (no derivation) and their relationship. Law of equiportion of energy.

Behaviorofrealgases: Deviation from ideal gas behavior,compressibility factor(Z)andits variation with pressure. Causes of deviation from ideal behavior. [**04 Hours**]

CriticalPhenomenon:Andrews experiments on CO_2.Critical constants:-critical temperature (T_c), critical pressure (P_c) and critical volume (V_c) – definitions. Experimental determination of $T_C$and $P_C$using Cagniard-de-laTours apparatus. Determination of critical volume (Vc) by Cailletet and Mathias method. Relationship of vander- Waals constant (a and b) with critical constants Tc, PcandVc(derived using isotherm of CO_2),Law of corresponding stateand reduced equation state. Numerical problems on Tc, Pc and Vc vander Waals constant (a and b). [**04 Hours**]

Liquification of gases: Intermolecular forces,Vander-waal's forces of attraction,brief account of dipole-dipole, dipole-induced dipole, induced dipole-induced dipole interactions (London forces). Principle underlying liquefaction of gases-JouleThomson effect,Joule Thomson experiments, show

that joule Thomson effect is an iso-enthalpic process($\Delta H=0$),Joule-Thomson coefficient, inversion temperature definition and its relation between Van der Waal's constants a and b.numerical problems. [**04 Hours**]

Adsorption: Introduction, principle involved, sorption, absorption, and adsorption (definition, examples and differences). Types of adsorptions - Physical and Chemical adsorption ((definition, examples and differences). Adsorption of gases on solids- Factors which influence the adsorption on solids, adsorption isotherms, mathematical expression for Frieundlich and Langmuir adsorption isotherms (to be derived), mention application of adsorption. [**03 Hours**]

Paper:ChemistryPracticals-I **Code:CHDSCP-1**

ContactHours/ Week	Credits	SchemeofEvaluation:Max.Marks:50		
		ContinuousInternalAssessment		SemesterEndExamination(SEE)
		C_1	C_2	C_3
04	02	05 Marks	05 Marks	40 Marks

LIST OFEXPERIMENTS

PartA:VolumetricAnalysis

1. Preparation of standard sodium carbonate solution, standardization of hydrochloric acid solution, and estimation of sodium hydroxide present in the given solution.
2. Preparation of standard oxalic acid solution, standardization of sodium hydroxide solution, and estimation of sulphuric acid present in the given solution.
3. Preparation of standard potassium biphthalate solution, standardization of sodium hydroxide solution, and estimation of oxalic acid present in the given solution.
4. Preparation of standard oxalic acid solution, standardization of potassium permanganate solution, and estimation of ferrous ammonium sulphate present in the given solution.
5. Preparation of standard ferrous ammonium sulphate solution, standardization of potassium permanganate solution, and estimation of hydrogen peroxide present in the solution.
6. Preparation of standard potassium dichromate solution, and estimation of ferrous and ferric iron in the given solution mixture.
7. Preparation of standard potassium dichromate solution, and estimation of ferrous ammonium sulphate present in the given solution (potassium ferrocyanide as an external indicator).
8. Preparation of standard sodium carbonate solution, standardization of hydrochloric acid solution, and estimation of sodium hydroxide and sodium carbonate in a mixture(or caustic soda) by double indicator method.

PartB

1. Demonstration of laboratory practices [safety, glassware/chemicals handling, chemical nature understanding, chemical/glassware waste management, error analysis], calibration of laboratory glassware [pipettes and burettes].

2. Practical concept of Molarity, Molality, Normality, Weight %. Preparation of standard solutions, normal solutions, dilution of stock solutions (0.1M) to different concentrations.
3. Separationofpigmentsinleaves/flowersbythinlayerchromatography(Demonstration).
4. Separation of *o*- and *p*-nitroanilines in a mixture by column chromatography (Demonstration).
5. Estimationofcalciumcontentinchalkascalciumoxalateusingdecinormalpotassium permanganate solution.
6. Estimation of ammonium chloride using 0.05N sodium hydroxide and 0.1N hydrochloric acid solutions (back titration).
7. Estimationofsulphuricacidandoxalicacidinthegivenmixtureusingstandardsodium hydroxide and standard potassium permanganate solutions.
8. Estimation of carbonate and bicarbonate in the given mixture by double indicator method.

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SECOND SEMESTER

Paper: Chemistry-II **Code:CHDSC-2**

Contact Hours/ Week	Credits	Scheme of Evaluation :Max .Marks: 100		
		Continuous Internal Assessment		Semester End Examination(SEE)
		C_1	C_2	C_3
03	03	10 Marks	10 Marks	80 Marks

Unit-I **Inorganic Chemistry** **[15 Hours]**

Chemical bonding-I: Ionic bond: General characteristics of ionic compounds, radius ratio and crystal coordination number, limitations of radius ratio rule. Lattice energy and Born-Haber cycle, setting up of Born-Habercycle,numerical calculations of Lattice energy and electron affinity based on Born-Haber cycle for 1:1 ionic solids, Theoretical calculation of lattice energy by Born- Lande equation (no derivation). Role of lattice energy and hydration energy in solubility of ionic solids. Polarization of ions, Fajan's rules. [**05 Hours**] **Covalent bond:** Factors favoring the formation of covalent bond(ionization energy,electron affinity, electronegativity, nuclear charge, inter nuclear distance and number of valence electrons). Valence bond approach– explanation with examples (H_2, F_2, HF, $O_2$and N_2) to illustrate valence bonda pproach.Sigma and Pibonds– explanation by taking H_2,$O_2$and N_2as examples.Bond length, bond order, bond energy and their significance, polarity of covalent bonds, polar and non- polar molecules, Dipole moment and polarity of molecules to be explained by taking HCl, CO_2,CCl_4 and H_2O as examples. [**04 Hours**]

Chemical bonding-II: Hybridization-directional property and geometry of sp, sp^2, sp^3, sp^3d and sp^3d^2 hybrid orbitals taking $BeCl_2$, C_2H_2 BF_3, C_2H_4, $SiCl_4$, CH_4 $PCl_5$and SF_6as examples. VSEPR theory- postulates with SO_2, NH_3, H_2O, SF_4, $ClF_3$and ICl^{2-} as examples.

Molecular Orbital Theory: An elementary account of MOT, linear combination of atomic

orbitals (no mathematical approach). Bonding and antibonding molecular orbitals, conditions for the combination,energy levels of molecular orbitals. Molecular orbital structures and bond orders of species like H_2, He_2, He_2^+, N_2, O_2,F_2,HF, LiH, NO and CO. Prediction of magnetic properties of these species. [**06 Hours**]

Unit-II Organic Chemistry [15 Hours]

Cycloalkanes: Nomenclature of cycloalkanes, Synthesis of cycloalkanes(From calcium salts of dicarboxylic acids).Reactions of cycloalkanes(withCl_2, H_2,andHBr).Sachse-Mohr theory of strainlessrings.Conformation of cyclohexanes and their stabilities(mono and disubstituted). Conformational analysis of ethane and butane and their energy profile diagrams.

Aromatic hydrocarbons: Concept of aromaticity, Huckel rule with respect to benzenoids, (benzene, naphthalene, anthracene and phenanthracene), heterocycles (pyrrole, furan, thiphene, pyridine, quinoline, isoquinoline, indole), and non-benzenoid compounds (cyclopentadiene, cyclopentadienyl anion, cycloheptadienyl cation). Annulenes (10 to 18 carbon atoms) and their aromaticity. [**07 Hours**]

Reaction of aromatic compounds

Electrophilic substitution: Mechanisms of nitration, sulphonation, halogenation, Friedel-Crafts alkylation, and acylation reactions of benzene. Electronic interpretation of orientating influence of electron donating groups (-CH_3, -Cl, -$NH_2$and -OH groups) and electron withdrawing groups (-NO_2, -CHO, -COOH and –SO_3H groups) on further electrophilic substitution reactions. **Nucleophilic substitution**:Benzyne mechanism. **Oxidation:** Toluene to benzaldehyde and benzoic acid, naphthalene to benzoquinone, anthracene to anthraquinone. **Reduction:** Benzene to cyclohexane, β-naphthol to tetrahydro-β-naphthol. Naphthalene to cis and trans decalin,anthracene to 9,10-dihydroanthracene and perhydroanthracene, phenanthracene to 9,10-dihydrophenanthracene, and Birch reduction. [**08 Hours**]

Unit-III Physical Chemistry [15 Hours]

Liquid State - Surface tension- definition and its explanation, determination of surface tension using stalagmometer,effect of temperature and soluteon surfacetension.Viscosity-definition, coefficient of viscosity,determination of viscosity using Ostwald viscometer,effect of temperature, size, weight, shape of molecules and inter molecular forces. [**03 Hours**] **Solid state**: Introduction-amorphous and Crystaline solids and their differences.Laws of crystallography:(i) Law of constancy of interfacial angles (ii) Law of rotational indices- Weiss and Miller indices,unit cell,Lattice point,Lattice planes in cubic crystals.Laws of symmetry- Symmetry elements – plane, axis and center of symmetry, element of symmetry in cubic crystal.Crystalsystem,BraviasLattices– types cubic lattices and identification of lattice planes.X-ray diffraction by crystals - Braggs law, derivation of Braggs equation, determination of structure of single crystal by rotating crystal method,and powder method. Defects in solids. Numerical problems. [**06 Hours**]

Distribution law: Nernst distribution law - Statement and its derivation, distribution constant, factors affecting distribution constant, validity of distribution law, limitations of distribution law, verification of distribution law taking distribution of I_2 in H_2O and CCl_4. Modification of

distribution law when molecules undergoa ssociation and dissociation.Application of distribution law in solvent extraction process and Parke's process (de-silverisation of lead). Numerical problems.

Catalysis: Definition, general characteristics, action of catalytic promoters and inhibitors. Homogeneous catalysis (definition and examples), Heterogeneous catalysis- definition and examples, mechanism of heterogeneous catalysis based on adsorption theory. Enzyme catalysis-definition and example, lock and key mechanism of enzyme catalyzed reaction. Mechalis-Menten equation (to be derived), Mechalis-Menten constant and its significance. [**06 Hours**]

Paper:ChemistryPracticals-II **Code:CHDSCP-2**

ContactHours/ Week	Credits	SchemeofEvaluation:Max.Marks:50		
		ContinuousInternalAssessment		SemesterEndExamination(SEE)
		C_1	C_2	C_3
04	02	05 Marks	05 Marks	40 Marks

LIST OFEXPERIMENTS

PartA:Qualitative analysis of organic compounds

The following classes of organic compounds(atleast one compound from each class)be given for systematic analysis.

Carbohydrates: Glucose, sucrose; Amides: Urea, thiourea; Amines: Aniline, *N*-Methylaniline,*N*,*N*-Dimethylaniline,*p*-toluidine;Carboxylicacids:Benzoicacid,cinnamicacid;Phenols:phenol, *p*-cresol, β-napthlol; Aldehydes: Benzaldehyde; Ketones: Benzophenone, acetophenone; Hydrocarbons: Naphthalene, biphenyl; Halogenated hydrocarbons: Chlorobenzene, dichlorobenzene; Nitro compounds: Nitrobenzene, *m*-dinitrobenzene; Anilides: Acetanilide; Bifunctional compounds: Salicylic acid. Nitro aniline.

PartB:Organicpreparations:

1. Preparation of acetanilide from aniline (Acetylation).
2. Preparation of benzoic acid from benzaldehyde(Oxidation).
3. Preparation of osazone from glucose(Condensation).
4. Preparation of *p*-cresylbenzoate from *p*-cresol(Esterification).
5. Preparation of *p*-bromoacetanilide from acetanilide (Bromination).
6. Preparation of benzoic acid from ethylbenzoate (Hydrolysis).
7. Preparation 2,4-dinitrophenylhydrazone of benzaldehyde (Condensation).

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QUESTIONPAPER:THEORY EXAMINATION

(Applicableto**DSC-1**and**DSC-2**)

Time:03 Hours **Max.Marks:80**

Instructions:Draw a neat labeled diagrams wherever necessary.

PART-A

Answer all of the following 8X 1=08

1 a)
b)
c)
d)
e)
f)
g)
h)

PART-B:Inorganic Chemistry

Answer any three of the following 3X 8=24

2
3
4
5

PART-C:Organic Chemistry

Answer any three of the following 3X 8=24

6
7
8
9

PART-D:PhysicalChemistry

Answer any three of thefollowing 3X 8=24

10
11
12
13

The sub-questions inQ2-Q13shal be of(3+3+2)or(5+3)or(4+4)Marks

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SCHEMEOFVALUATION
DSCP-1:CHEMISTRY-1(PRACTICALS):

Time:03Hours **Max.Marks:40**

Note: Duly certified practical record shall be submitted at the examination for evaluation.

Distribution of Marks

Record	5 Marks
Part A	25Marks
Part B	10 Marks

Part A

Experiments (**1,2, 3,4,5**)	Preparation of standard solution and calculation of its normality		04Marks
	Titration values		
	Discrepancy	Standardization	Estimation
	± 0.2cm^3	08Marks	10Marks
	± 0.3cm^3	06Marks	08Marks
	±0.4cm^3	04Marks	06Marks
	Any other value	02Mark	03 Marks
	Calculation	Normality of link solution=01Mark Normality of given solution=01Mark Weight/dm^3or 250cm^3= 01 Mark	

Experiments **6, 7**	Preparation of standard solution and calculation Of its normality		03Marks
	Titration values		
	Discrepancy	First titration	Second titration
	± 0.2cm^3	09Marks	09Marks
	± 0.3cm^3	07Marks	07Marks
	±0.4cm^3	05Marks	05Marks
	Any other value	02 Marks	02Marks
	Calculation	02Marks	02Marks

Experiment (**8**)	Preparation of standard solution and calculation of its normality			03Marks
	Titration values			
	Discrepancy	Standardization	First titration	Second titration
	± 0.2cm^3	03Marks	07 Marks	07Marks
	± 0.3cm^3	02Marks	05 Marks	05Marks
	Any other value	01Mark	02 Marks	02Marks
	Calculation	Normality of link solution = 01 Mark Normality of given solution=01+01Mark Weight/dm^3or250cm^3=01+01Mark		

PartB

Procedure writing from the experiments listed in part B	04 Marks

Three questions/problems be given on the concept of laboratory practices, calibration, error analysis, molarity, molality, normality, weight %, preparation of standard solutions, normal solutions, dilution of stock solutions (0.1M) to different concentrations.	3 X 2 =06 Marks

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DSCP-2:CHEMISTRY-2(PRACTICALS)

Time:03Hours **Max.Marks:40**

Note: Duly certified practical record shall be submitted at the examination for evaluation.

Distribution of Marks

Record	5 Marks
PartA	25Marks

PartB	10 Marks

Part A: Organic Analysis		**Part B:Organicpreparations**	
Preliminary Examinations	04Marks	Equation	02 Marks
Physical Constant	02Marks	Preparation	05Marks
Elemental Analysis including procedure For preparation of sodium fusion extract	04Marks	Yield	01Mark
Solubility(Complete chart)	04Marks	Recrystallization	01Mark
Functional group analysis (minimum of two tests)	06Marks	Melting point	01 Mark
Naming and structure	03Marks		
Solid Derivative	02Marks		
Total	**25Marks**	**Total**	**10Marks**

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JSS COLLEGE FOR WOMEN (Autonomous)

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REVISED NATIONAL EDUCATION POLICY (REVISED NEP)

CHEMISTRY

FOR B.Sc DEGREE PROGRAMME

III & IV SEMESTER

2024-25 (Batch onwards)

B.Sc. CHEMISTRY SYLLABUS THIRD

SEMESTER

Paper: Chemistry-III **Code: CHSDSC-III**

Contact Hours/Week	Credits	Scheme of Evaluation: Max. Marks: 100		
		Continuous Internal Assessment (CIA)		Semester End Examination(SEE)
		C1	C2	C3
03	03	10 Marks	10 Marks	80 Marks

PAPER:Chemistry-III **[48 Hours]**

UNIT-I:Inorganic Chemistry **[16 Hrs]**

p- Block Elements

Boron: Boron hydrides – Classification with examples. Diborane- preparation, structure, and nature of bonding in diborane.

Interhalogen Compounds: Definition,types with examples, general methods of preparation(by direct combination of halogen, from lower inter halogens) and properties (physical state, thermal stability, reactivity, and hydrolysis), Applications.

Noble gases: Separation of nobel gases by Dewar's method,Chemical properties and applications of noble gases, chemistry of xenon. preparation, and structure of xenon compounds (XeF_2, XeF_4, XeF_6, $XeO_3$and XeO_4). [**06Hrs**]

Chemistry of transition elements: Position in the periodic table, general characteristics, electronic configuration, atomic and ionic radii, ionization energy, variable oxidation states, spectral properties, redox potentials, colour and magnetic properties, catalytic activity and complex formation. [**05 Hrs**]

Chemistry of Lanthanides and actinides: Electronic configuration, oxidation states, colour, spectral, magnetic properties,catalytic activity and complex formation. Lanthanide contraction-Causesand consequences. Separation of Lanthanides by ion exchange method.

General features and chemistry of Actinides, principles of separation of Neptunium, and Plutonium from uranium. Trans uranium elements-definition and examples. [**05 Hrs**]

UNIT-II:Organic Chemistry **[16Hrs]**

Alcohols: Definition and classification with example and IUPAC nomenclature. **Monohydric alcohols:** methods of preparation of alcohols from alkenes – a) Hydration of alkenes(mechanism) b) Hydroboration-oxidation method, and from Grignard reagent. Distinction tests between 1°, 2°and 3°alcohols by Victor Meyer and oxidation method. Conversion of 1° to 2°, 2° to 3° and 1° to 3° alcohols. Dehydration of 1°, 2°, 3° alcohols and comparison of their rates. **Dihydric alcohols:** Glycol – preparation from vicinal dihalides

and uses. Pinacols – synthesis, mechanism of pinacol-pinacolone

rearrangement. **Trihydric alcohols:** Glycerol, synthesis from propene, reactions with HNO_3, H_2SO_4, oxalic acid and HI. Uses of glycerol. [**05 Hrs**]

Phenols: Definition, IUPAC nomenclature, classification with examples, acidity of phenols, effect of substituents on acidity of phenols. Mechanism of Reimer-Tiemann reaction and Kolbe reaction. Fries and Claisen rearrangement with examples. Conversion of phenol to phenolphthalein. [**05 Hrs**]

Ethers: Nomenclature, Williamson ether synthesis, reactions – cleavage and auto-oxidation-Ziesel's method (estimation of $-OCH_3$). **Crown ethers:** Introduction with examples, application as phase transfer catalysts. [**02 Hrs**]

Carbonyl Compounds: Nomenclature, synthesis of aldehydes and ketones from alcohols. Distinction between aldehydes and ketones – oxidation and reduction method. Addition of alcohols- formation of hemiacetal and acetal. Condensation with NH_2OH and 2,4-DNP. Mechanism of aldol condensation, Perkins reaction, Cannizzaro reaction, Illustrations of Wolf-Kishner and Clemmensen reduction.

[**04Hrs**]

UNIT-III: Physical Chemistry **[16 Hrs]**

Thermodynamics

First law of thermodynamics: Statement and mathematical equation.

Second law of thermodynamics: Spontaneous and non-spontaneous processes– definition and examples. Definition and significances of entropy, variation of entropy with P, T and V (derivation). Criteria of spontaneity in terms of entropy change. Heat engine – Carnot cycle and efficiency of heat engine(derivation).Carnot's theorem and thermodynamic scale of temperature. Different statements of second law of thermodynamics (Numerical problems)

Free energy-Helmholtz and Gibb's free energy, Gibb's-Helmholtz equation at constant pressure and constant volume (derivation), thermodynamic criteria for spontaneity in terms of A and G. Variations of Helmholtz free energy with V and T, Variation of Gibb's free energy with P and T (derivation). Clausius-Clapeyron equation with differential form (derivation) and its applications in liquid-vapor equilibrium. Vant-Hoff's reaction isotherm-derivation and its applications. Nernst heat theorem and third law of thermodynamics. Calculation of absolute entropy of water (Problems).

Partial molar quantities: Introduction, partial molar volume and partial molar free energy (chemical potential)-definition and formulation of Gibb's-Duhem equation. [**10 Hrs**]

Phase equilibria: Definition of the terms- Phase, component and degree of freedom with examples. Statement of Gibb's phase rule and thermodynamic derivation.Applications-(a) one component system-water system (b) reduced phase rule and reduced system, two component system- Silver-lead system(eutectic type), desilverization of lead and $FeCl_3$-H_2O system (congruent melting point).

Freezing mixtures: Definition and examples, Explanation based on KI-water system.[**06 Hrs**]

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PRACTICALS

Paper:ChemistryPractical-III Hours: 64 Code: CHSDSCP-III

Contact Hours/Week	Credits	Scheme of Evaluation:Max.Marks:50		
		Continuous Internal Assessment (CIA)		Semester End Examination(SEE)
		C1	C2	C3
04	02	05 Marks	05 Marks	40 Marks

LIST OF EXPERIMENTS

PART-A: Semimicro Qualitative Analysis of Inorganic Salt Mixtures

Systematic semimicro qualitative analysis of two anions and two cations in a given salt mixture. The constituent ions in the mixture to be restricted to the following.

Anions: HCO_3^-,CO_3^{2-},S^{2-},SO_2^{2-},NO_2^-, Cl^-,Br^-,I^-,NO_3^-,BO_3^{3-}, $PO^{3-}$and SO_4^{2-}.

Cations:Pb^{2+},Bi^{3+},Cu^{2+},Cd^{2+},Al^{3+},Fe^{2+},Fe^{3+},Mn^{2+},Zn^{2+},Co^{2+},Ni^{2+},Ca^{2+},Sr^{2+},Ba^{2+},Mg^{2+},K^+, Na^+ And NH_4^+.

Spot tests should be carried out wherever feasible
The students are required to write any two ionic reactions for both anions and cations given.
Minimum of eight mixture to be analysed.

PART-B:**Preparation of CoordinationComplexes**

1. Preparation of hexamminenickel(III)chloride.
2. Preparation of potassiumtris(oxalato)ferrate(III)and estimate the iron
3. Preparation of ammoniumcopper(II)sulphate tetrahydrate.
4. Preparation of potassium trisoxalato aluminate(III) trihydrate.
5. Preparation of mercury tetrathiocyanato cobaltate(II).(Demonstration)
6. Preparation of Prussian blue.

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ELECTIVE PAPER

Paper: Chemistry Elective-I Hours : 64 **Code: CHSEC-I**

Contact Hours/Week	Credits	Scheme of Evaluation:Max.Marks: 100		
		Continuous Internal Assessment (CIA)		Semester End Examination(SEE)
		C1	C2	C3
03	03	10 Marks	10 Marks	80 Marks

PAPER: Chemistry Elective-I [48 Hours]

UNIT-I: Industrial chemistry [16Hrs]

Fuels: Definition, classification with examples, characteristics, calorific value, determination of calorific value of a solid or liquid fuel (bomb calorimetric method). Applications of gaseous fuels. Comparison between solid, liquid and gaseous fuels. Compressed natural gas, water gas, producer gas and LPG – their production, composition, and applications. **Explosives:** Definition, classification with examples, characteristics of explosives. Preparation and uses of dynamite, cordite and RDX.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination. **[08 Hrs]**

Fertilizers: Economic importance, synthesis of nitrogenous fertilizers- CAN, ammonium sulfate, ammonium nitrate and urea. Phosphate fertilizers-calcium dihydrogen phosphate, super phosphate. **Abrasives:** Definition, classification with examples – hardness, manufacture and applications of carborundum, alundum and tungsten carbide. **Refractories:** Definition, properties, classification with examples. Different steps involved in the manufacture of refractories. Applications of refractories. **Ceramics:** Introduction, types, manufacturing process, applications. **Glasses**: introduction, types, and compositions with examples and uses. **[08 Hrs]**

UNIT-II: Organic chemistry [16 Hrs]

Drugs: Definition, chemotherapy and chemotherapeutic agents, types of drugs, antipyretics, analgesics, anaesthetics, antiseptics, antibacterial, antibiotics, antimalarial and sulpha drugs with examples. Synthesis and uses of aspirin, paracetamol, and sulphaguanidine. **Antibiotics**: Structure and mode of action of penicillin-G, chloramphenicol. **Antimalarial**: Structure and mode of action of Chloroquine. **Anticancer/antiviral**: Structure and mode of action of 5-flurouracil. **[08 Hr]**

Pesticides-General introduction to pesticides(natural and synthetic),benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines(DDT,Gammaxene);Organophosphates(Malathion,Parathion);Carbamates(Carbofuran and carbaryl);Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Dyes: Introduction, colour and constitution, chromophore-auxochrome theory. chemical methods of classification of dyes with examples, synthesis and uses of malachite green, Indigo, alizarin and methyl orange. **[08 Hrs]**

UNIT-III:Physical Chemistry **[16 Hrs]**

Radiation Chemistry: Definition, primary and secondary stages in radiochemical process, G- value, LET of radiation, radiation chemistry comparison with photochemistry. Units of radiation - rad, gray, Roentgen. Chemical dosimeters- Frick-dosimeter, Cericsulphate dosimeter. Theories of radiolysis – Lind's and EHT theories. Radiolysis of water, cysteine and acetic acid. **[5 Hrs]**

Polymers: Introduction, monomer, repeating units, types(linear, branched and network)with examples, degree of polymerization,Classification: Addition polymerization(freeradical, ionicZiegler–Natta polymerization),Condensation polymerization(polyesters, polyamides and Urea-formaldehyde resins). Molar masses of polymers–number average and mass average, determination of molarmass by viscosity and osmotic pressure method. Applications of polymers as plastics in electronic, automobile components, medical fields, and aerospace materials. Problems of plastic waste management.

[06Hrs]

Elementary Quantum Chemistry: Blackbody radiation**,** plank'sradiation law, Rayleigh-Jeanslaw, photo electric effect, and Compton effect(Explanation with mathematical equations).Heisenberg uncertainty principles.Operators–Linear, non-linear, Laplacian, Hermitian and Hamiltonian operators. Postulates of quantum mechanics, Schrodinger wave equation (explanation with mathematical expression) and its importance, wave function, physical significance of wave function. SWE for particle in one-dimensional box (Numerical problems). **[05 Hrs]**

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FOURTH SEMESTER

Paper: Chemistry-IV Hours : 64 Code:CHSDSC-IV

Contact Hours/Week	Credits	Scheme of Evaluation:Max.Marks: 100		
		Continuous Internal Assessment (CIA)		Semester End Examination(SEE)
		C1	C2	C3
03	03	10 Marks	10 Marks	80 Marks

PAPER:Chemistry-IV [48 Hours]

UNIT-I: Inorganic Chemistry [16 Hrs]

Nuclear chemistry: Fundamental particles of nucleus, nucleons. Isotopes, isobars and isotones (definition with suitable examples), Nuclear forces (brief explanation), nuclear stability-n/p ratio, mass defect, packing fraction, binding energy, nuclear fission-(definition with suitable examples),calculation of energy release in nuclear fission, modes of release of fission energy (uncontrolled and controlled). Nuclear reactor–Principal components, types of reactors- working of Thermal reactors and fast breeder reactors. Nuclear fusion and its advantages over nuclear fission reactions, hydrogen bomb, Q values of nuclear reactions (Numerical problems). [**05Hrs**]

Indicators: Definition, types (acid-base, redox, adsorption indicators and universal indicators) with examples. Theory of indicator- Ostwald's theory and quinonoid theory, indicator constant. Action of phenolphthalein and methyl orange in acid-base solution, colour change and pH range. pH titration curves for strong acid versus strong base, weak acid versus strong base and strong acid versus weak base, choice of indicators in these types of titrations. [**04 Hrs**] **Organic reagents in inorganic analysis:** Advantages of organic precipitants over inorganic reagents, structures and uses of EDTA in the volumetric estimations of Mg, Ca and Zn. Oxine in the gravimetric estimation of Mg. DMG in the gravimetric estimation of Ni. 1,10-phenanthroline in the colorimetric estimation of Iron. [**03 Hrs**]

Gravimetry: Introduction to gravimetric analysis–precipitation methods(various steps involved to be

discussed), advantages of gravimetric analysis, purity of the precipitates, co-precipitation and post-precipitation, conditions of precipitation, Nucleation, crystal growth, digestion. Precipitation from homogeneous solution (hydroxides and sulphates), washing and ignition of precipitate (general discussion only). [**04Hrs**]

UNIT-II: Organic Chemistry **[16 Hrs]**

Carboxylic acids: Definition, IUPAC Nomenclature, classification with examples. Synthesis by Arndt-Eistert reaction, resonance structure of carboxylate ion and its stability. Effect of substituents on acidity of aliphatic and aromatic carboxylic acids. **Hydroxy acids**: Synthesis of lactic, citric, and tartaric acids. Effect of heat on α, β, γ-hydroxy acids. [**03 Hrs**]

Amines: Definition, IUPAC Nomenclature, classification with example. Separation of amine mixture by Hinsberg's method using toluene sulphonyl chloride. Distinction tests for 1°, 2°, 3° amines (acetylation and Hoffmann's exhaustive methylation. Action of nitric acid on different amines. Both aliphatic and aromatic1°,2°,3° amines, basicity of amines, effect of substituents on basicity of aliphatic and aromatic amines. Hoffmann-Martius rearrangement.

Diazonium Compounds: Preparation, mechanism of preparation and synthetic applications of benzene diazonium chloride. Conversion to phenol, halobenzene, phenyl hydrazine and coupling reaction.[**05 Hrs**]

Stereochemistry: Introduction, definition, elements of symmetry (plane, centre and alternative axes), asymmetry and dissymmetry, Chirality, designation of configuration (D-L and R-S). Optical activity – explanation–cause of optical activity(non-superimpossibility). Enantiomers and diastereomers optical isomerism in tartaric acid and biphenyl compounds, racemisation, resolution, methods of resolution (Chemical and biochemical methods) Walden inversion, asymmetric synthesis (partial and absolute). **Geometrical isomerism:** Definition with example, designation of cis-trans and E-Z notations with examples. Characteristics and identification of geometrical isomers. Geometrical isomerism in aldoximes and ketoximes, Beckmann rearrangement with mechanism. [**08 Hrs**]

UNIT-III: Physical Chemistry **[16 Hrs]**

Chemical Kinetics: Molecularity, order, rate and rate constant of reactions (definitions). Zero order reaction (statement and rate equation). Differential and integrated rate equations for second order kinetics, derivation of second order rate equation when a = b. and a ≠ b, unit of 2^{nd} order rate constant,

half-life period. Determination of the order of the reaction-differential and time for half change method. Effect of temperature on rate of reaction. Temperature coefficient, Arrhenius equation, concept of activation energy-determination using Arrhenius equation and graphical method. Theories of reaction rate: derivation of rate constants from-(i) simple collision theory, (ii) transition state theory (using classical thermodynamics).Problems on half-life period and energy of activation. Experimental methods for the study of chemical kinetics: Conductometric (saponification of esters)and spectrophotometric (kinetics of oxidation of Indigo carmine by chloramine-T). [**09 Hrs**] **Spectrophotometry and Photochemistry:** Lambert-Beer's law: Statement and mathematical equation to be derived(problems). Molar extinction coefficient-definition and its determination(graphical method),limitations of Beer'slaw. Spectrophotometer: Construction and working. Applications of spectrophotometry (mention only).

Photochemistry: Grothus-Draper's law, Stark-Einstein law of photochemical equivalence. Quantum efficiency: definition, reasons for low quantum yield and high quantum yield with examples (photochemical formation of HBr and HCl). Uranyl oxalate actinometer, Potassium ferrioxalate actinometer (Problems).

Photophysical processes: photosensitization (taking mercury as an example), photoinhibition, fluorescence and phosphorescence Chemiluminescence and bioluminescence (explanation with examples), mechanism (qualitative). [**07 Hrs**]

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