Curriculum of
B.Sc. in Chemistry (2026-27)

Hassan University
Hemagangothri
Hassan

B. Sc. Program

Subject: CHEMISTRY

Semester	Theory/Practical Courses	Contact Hours/ Week	Credits	Max. Marks	Continuous Internal Assessment		Semester End Examination (SEE) C3	
					C1	C2	Duration (Hours)	Marks
I	Chemistry-I	3	3	100	10	10	3	80
	Chemistry Practical-I	4	2	50	05	05	3	40
II	Chemistry-II	3	3	100	10	10	3	80
	Chemistry Practical-II	4	2	50	05	05	3	40
III	Chemistry-III	3	3	100	10	10	3	80
	Chemistry Practical-III	4	2	50	05	05	3	40
	Chemistry Elective Paper[a]	2	2	50	05	05	2	40
IV	Chemistry-IV	3	3	100	10	10	3	80
	Chemistry Practical-IV	4	2	50	05	05	3	40
	Chemistry Elective Paper[a]	2	2	50	05	05	2	40
	Chemistry Skill Practical[b]	4	2	50	05	05	3	40
V	Chemistry-V	3	3	100	10	10	3	80
	Chemistry-VI	3	3	100	10	10	3	80
	Chemistry Practical-V	4	2	50	05	05	3	40
	Chemistry Skill Practical[b]	4	2	50	05	05	3	40
VI	Chemistry-VII	3	3	100	10	10	3	80
	Chemistry-VIII	2	2	50	05	05	2	40
	Chemistry Practical-VI	4	2	50	05	05	3	40
	Chemistry Skill Practical[b]	4	2	50	05	05	3	40

Note: a-Courses are common for III and IV Semesters

b- Courses are compulsory and common for IV/V/VI Semesters

B.Sc. CHEMISTRY SYLLABUS

FIRST SEMESTER

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

Contact Hours/ Week	Credits	Scheme of Evaluation: Max. Marks: 100		
		Continuous Internal Assessment		Semester End Examination (SEE)
		Assignment C-1	Test C-2	C-3
03	03	10 Marks	10 Marks	80 Marks

Paper: Chemistry-I **Code: CHSDSC-I**

PAPER: Chemistry-I [48 Hours]

Unit-I Inorganic Chemistry: **16 Hours**

Atomic Structure: de-Broglie matter waves -dual nature of electron. Heisenberg's uncertainty principle and its significance. Schrodinger wave equation:-Explanation of the terms involved (no derivation). Significance of ψ and ψ^2. Atomic orbitals, 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 to Z = 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 into s, p, d, and f blocks. Atomic radii covalent, ionic and van der Waal's radii (explanation with examples). Additive nature of covalent radii. Variation of covalent radii down a group and across a period-explanation for the observed trends, isoelectronic ions, variation of ionic radii in isoelectronic ions. Determination of ionic radii by Pauling's method. Comparison of the size of atoms with corresponding anions and cations.

[04 Hours]

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 electronegativity (charge on the atom and hybridization). Pauling, Mulliken and Allred-Rochow scale of electronegativity (problems to be solved). Applications of electronegativity. **[05 Hours]**

Unit-II Organic Chemistry **16 Hours**

Basic Concepts: Arrow notations and their significance, bond cleavage, types of reagents: -electrophiles and nucleophiles. Reaction intermediates: -generation, stabilities and reactions involving carbocations, carbanions, carbon free radicals, nitrenes and carbenes.

Electronic displacement effects: Inductive effect, electromeric effect, resonance effect, hyperconjugation effect and their significance. Strengths of organic acids and bases: Comparative study with emphasis on factors effecting pK_a values. Relative strength of carboxylic acids (formic acid, acetic acid, chloroacetic acid, trichloroacetic acid, propionic acid, benzoic 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.

[06 Hours]

Alkanes: Definition general formula & IUPAC nomenclature, Preparation (Corey-House, Wurtz method), Mechanism of free radical substitution of methane.

Alkenes: Definition general formula & IUPAC nomenclature, 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 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: Definition general formula & IUPAC nomenclature, Methods of preparation (Dehydrohalogenation), reactions (with HCN, H_2, HX, and H_2O). Acidic character of terminal alkynes.

[06 Hours]

Alkyl halides: Definition general formula & IUPAC nomenclature, Elimination reactions (Mechanism of E_1 and E_2 reactions). Saytzeff and Hoffmann's elimination. Substitution reactions (S_N^1 and S_N^2 reactions with energy profile diagram). Effect of nature of alkyl groups, leaving groups, nucleophiles, and solvents on substitution reactions.

[04 hours]

Unit-III Physical Chemistry **16 Hours**

Gaseous State: Elementary aspects of kinetic theory of gases, ideal and real gases (No derivation).

Molecular Velocities: 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. Types of Molecular Velocities-Most probable, average, and root mean square velocities definition and equation (no derivation) and their relationship. Numerical problems

Behavior of real gases: Deviation from ideal gas behaviour, compressibility factor (Z) and its variation with pressure. Causes of deviation from ideal behaviour.

[04 Hours]

Critical Phenomenon: 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 (V_C) by Cailletet and Mathias method. Relationship of vander- Waals constant (a and b) with critical constants T_C, P_C and V_C (derived using isotherm of CO_2), Law of corresponding state and reduced equation state. Numerical problems on T_C, P_C and V_C vander Waals constant (a and b).

[04 Hours]

Liquification of gases: Inter molecular forces, Vander-waal's forces of attraction, brief account of dipole-dipole, dipole-induced dipole, induced dipole-induced dipole interactions (London forces). Principle underlying liquification of gases - Joule Thomson effect, Joule Thomson experiments. Joule Thomson effect is an iso-enthalpic process ($\Delta H=0$), Joule-Thomson coefficient and its significant, inversion temperature definition and its relation between Vander Waal's constants a and b. Numerical problems. **[04 Hours]**

Adsorption: Introduction, principle, 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 Fricundlich and Langmuir adsorption isotherms (to be derived), List of applications of adsorption. **[04 Hours]**

FIRST SEMESTER PRACTICALS

Paper: Chemistry Practical-I **Code: CHDSCP-I**

Contact Hours/ Week	Credits	Scheme of Evaluation: Max. Marks: 50		
		Continuous Internal Assessment		Semester End Examination (SEE)
		C-1	C-2	C-3
04	02	05 Marks	05 Marks	40 Marks

LIST OF EXPERIMENTS

Part - A: Volumetric Analysis

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. Preparation of standard sodium carbonate solution, standardization of hydrochloric acid solution, and estimation of sodium hydroxide present in the given solution.
4. Preparation of standard oxalic acid solution, standardization of sodium hydroxide solution and estimation of sulphuric acid present in the given solution.
5. Preparation of standard potassium biphthalate solution, standardization of sodium hydroxide solution, and estimation of oxalic acid present in the given solution.
6. Preparation of standard oxalic acid solution, standardization of potassium permanganate solution, and estimation of ferrous ammonium sulphate present in the given solution.
7. Preparation of standard ferrous ammonium sulphate solution, standardization of potassium permanganate solution, and estimation of hydrogen peroxide present in the solution.
8. Preparation of standard potassium dichromate solution, and estimation of ferrous and ferric ion in the given solution mixture.
9. Preparation of standard potassium dichromate solution, and estimation of ferrous ammonium sulphate present in the given solution (potassium ferrocyanide as an external indicator).
10. 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.

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Part - B

1. Separation of pigments in leaves/flowers by thin layer chromatography (Demonstration).
2. Separation of *o*- and *p*-nitroanilines in a mixture by column chromatography (Demonstration).
3. Estimation of calcium content in chalk as calcium oxalate using decinormal potassium permanganate solution.
4. Estimation of ammonium chloride using 0.05N sodium hydroxide and 0.1N hydrochloric acid solutions (back titration).
5. Estimation of sulphuric acid and oxalic acid in the given mixture using standard sodium hydroxide and standard potassium permanganate solutions.
6. Estimation of carbonate and bicarbonate in the given mixture by double indicator method.

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B.Sc. CHEMISTRY SYLLABUS

SECOND SEMESTER

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

Contact Hours/ Week	Credits	Scheme of Evaluation: Max. Marks: 100		
		Continuous Internal Assessment		Semester End Examination (SEE)
		Assignment C-1	Test C-2	C-3
03	03	10 Marks	10 Marks	80 Marks

PAPER: Chemistry-II [48 Hours]

Unit-I Inorganic Chemistry **16 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-Haber cycle, numerical calculations of lattice energy and electron gain enthalpy 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 favouring 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 bond approach. Sigma and Pi bonds– explanation by taking H_2, O_2 and N_2 as 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_6 as examples. VSEPR theory-postulates with, NH_3, H_2O, SO_2, 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 energy level diagrams and bond orders of species like H_2, He_2, He_2^+, N_2, O_2, F_2, HF, NO and CO. Prediction of magnetic properties of these species. **[07 Hours]**

Unit-II Organic Chemistry **16 Hours**

Cycloalkanes: Nomenclature of cycloalkanes, Synthesis of cycloalkanes (From calcium salts of dicarboxylic acids). Reactions of cycloalkanes (with Cl_2, H_2 and HBr). Sachse-Mohr theory of strainless rings. Conformation of cyclohexanes and their stabilities (mono and disubstituted). Conformational analysis of ethane and n-butane and their energy profile diagrams.

[04 Hours]

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

[04 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 and 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 **16 Hours**

Liquid State - *Surface tension* - definition and its explanation, determination of surface tension using stalagmometer, effect of temperature and solute on surface tension. ***Viscosity***- definition, coefficient of viscosity, determination of viscosity using Ostwald viscometer, effect of temperature, size, weight, shape of molecules and inter molecular forces. Numerical problems.

[03 Hours]

Solid state: Introduction- amorphous and crystalline 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.

Symmetry elements–plane, axis and centre of symmetry, element of symmetry in cubic crystal. Crystal system, Bravias Lattices – types of 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.

[07 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 undergo association and dissociation. Applications of distribution law in solvent extraction process. Numerical problems.

[03 Hours]

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. Michaelis-Menten equation (mention), Michaelis-Menten constant and its significance.

[03 Hours]

SECOND SEMESTER PRACTICALS

Paper: Chemistry Practical-II Code: CHDSCP-II

Contact Hours/ Week	Credits	Scheme of Evaluation: Max. Marks: 50		
		Continuous Internal Assessment		Semester End Examination (SEE)
		C-1	C-2	C-3
04	02	05 Marks	05 Marks	40 Marks

LIST OF EXPERIMENTS

Part A: Qualitative analysis of organic compounds

The following classes of organic compounds (at least 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

Carboxylic acids: Benzoic acid, Cinnamic acid

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.

Part B: Organic preparations:

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*-cresyl benzoate from *p*-cresol (Esterification).
5. Preparation of *p*-bromo acetanilide from acetanilide (Bromination).
6. Preparation of benzoic acid from ethyl benzoate (Hydrolysis).
7. Preparation 2,4-dinitrophenylhydrazone of benzaldehyde (Condensation).

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QUESTION PAPER: THEORY EXAMINATION

(Applicable to **DSC-1** and **DSC-2**)

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

Instructions: Draw a neat labelled diagrams wherever necessary.

PART-A

Answer all of the following 8 X 1 = 08

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

PART-B: Inorganic Chemistry

Answer any three of the following 3 X 8 = 24

2
3
4
5

PART-C: Organic Chemistry

Answer any three of the following 3 X 8 = 24

6
7
8
9

PART-D: Physical Chemistry

Answer any three of the following 3 X 8 = 24

10
11
12
13

The sub-questions in Q2-Q13 shall be of (3+3+2) or (5+3) or (4+4) Marks

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SCHEME OF VALUATION
DSCP-1: CHEMISTRY-1 (PRACTICALS):

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

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

Distribution of Marks

Record	5 Marks
Part A	25 Marks
Part B	10 Marks

Part A

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

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

Experiment **(8)**	Preparation of standard solution and calculation of its normality			03 Marks
	Titration values			
	Discrepancy	Standardization	First titration	Second titration
	± 0.2 cm^3	03 Marks	07 Marks	07 Marks
	± 0.3 cm^3	02 Marks	05 Marks	05 Marks
	Any other value	01 Mark	02 Marks	02 Marks
	Calculation	Normality of link solution = 01 Mark Normality of given solution = 01+ 01 Mark Weight/dm^3 or 250cm^3 = 01+ 01 Mark		

Part B

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

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

Distribution of Marks

Record	5 Marks
Part A	25 Marks
Part B	10 Marks

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

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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.

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: 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). **[06 Hrs]**

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- Causes and 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. **[05 Hrs]**

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

Alcohols: Definition and classification. **Monohydric alcohols:** Preparation of alcohols by Hydroboration-oxidation method. Hydration of alkenes. 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, 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, Applications 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, Wolf-kishner and Clemmensen reduction. **[04 Hrs]**

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: Chemistry Practical-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_4^{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.

PART-B: Preparation of Coordination Complexes

1. Preparation of hexamminenickel(III)chloride.
2. Preparation of potassiumtris(oxalato)ferrate(III) and estimate the iron
3. Preparation of ammonium copper(II) sulphate tetra hydrate.
4. Preparation of potassium trisoxalatoaluminate(III) trihydrate.
5. Preparation of mercury tetra thiocyanatocobaltate(II). (Demonstration)

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ELECTIVE PAPER

Paper: Chemistry Elective-I **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 **[16 Hrs]**

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 their 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 Hrs]**

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**, classification of dyes based on applications 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, Ceric sulphate 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 (free radical, ionic Ziegler–Natta polymerization), Condensation polymerization (polyesters, polyamides, and Urea-formaldehyde resins). Molar masses of polymers –number average and mass average, determination of molar mass 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. **[06 Hrs]**

Elementary Quantum Chemistry: Black body radiation, plank's radiation law, Rayleigh-Jeans law, photo electric effect, and Compton effect (Explanation with mathematical equations). Heisenberg uncertainty principles. Operators – Linear, non-linear, Laplacian , Hermition 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 partical in one- dimensional box (Numerical problems). **[05 Hrs]**

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FOURTH SEMESTER

Paper: Chemistry-IV **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. Nuclear fusionand its advantages over nuclear fission reactions, hydrogen bomb, Q values of nuclear reactions (Numerical problems).

[05 Hrs]

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). **[04 Hrs]**

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

Carboxylic acids: Definition, 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, 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 aromatic 1°, 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-super impossibility). 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 2nd 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's law. 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 (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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PRACTICALS

Paper: Chemistry Practical-I **Hours:64** **Code: CHSDSCP-IV**

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: Physical Chemistry (Non-Instrumental) Experiments

1. Determination of the density of liquid using specific gravity bottle and its viscosity using Ostwald's Viscometer [Carbon tetrachloride, ethyl acetate, water, 1% NaCl solution].
2. Determination of the density of liquid using specific gravity bottle and its surface tension using Stalagmometer [Carbon tetrachloride, ethyl acetate, water, 1% NaCl solution].
3. Determination of molecular mass of a non-volatile solute by Walker-Lumsden method [Urea, NaCl, KCl].
4. Determination of rate constant of the decomposition of hydrogen peroxide catalysed by $FeCl_3$.
5. Determination of transition temperature of the salt hydrates [sodium thiosulphate, strontium chloride].
6. Determination of rate constant of saponification of ethyl acetate by titrimetry.
7. Determination of percentage composition of sodium chloride by miscibility temperature method [phenol-water system].
8. Determination of first order rate constant of acid hydrolysis of ethyl acetate.
9. Thermometric titration of a strong acid against strong base.
10. Determination of heat of neutralization of strong acid and strong base.

PART-B: Ore/synthetic mixture analysis

1. Determination of iron in the given sample of hematite using potassium dichromate.
2. Estimation of manganese in the given sample of pyrolusite.
3. Estimation of calcium and magnesium in the given sample of dolomite by EDTA method.

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SKILL BASED COURSE (ELECTIVE - COMPULSORY)

Paper: Chemistry Skill Practical Hours:64 Code: CHSSEC-I

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:

1. Determination of total acidity of vinegar/waste water by acid-base titration.
2. Spectrophotometric determination of creatinine in urine.
3. Determination of aspirin in their tablet preparations by acid-base titrimetry.
4. Determination of purity of a commercial sample of boric acid.
5. Determination of calcium in pharmaceuticals by EDTA titration.
6. Determination of iron in pharmaceuticals by visual and potentiometric titrations.
7. Food adulteration: Determination of adulteration in food stuffs (Demonstration).
8. Analysis of cement (Demonstration).

9. Determination of nitrite-Nitrogen in fertilizers by spectrophotometry.

PART-B
ORGANIC ESTIMATIONS

1. Estimation of aspirin by colorimetric method.
2. Estimation of vitamin-C by iodometric method.
3. Estimation of paracetamol by titrimetric method
4. Estimation of acetone by haloform method
5. Estimation of glucose (sugar) by colorimetric method

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ELECTIVE PAPERS

Paper: Chemistry Elective-II **Hours: 48** **Code: CHSEC-II**

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

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

Inorganic polymers: Definition – examples, general properties, comparison with organic polymers, glass transition temperature. **Silicones:** Definition, nomenclature, preparation (linear, cross-linked and cyclic). Factors affecting the nature of silicon polymers, properties (chemical and thermal stabilities, chemical properties) uses of silicon polymers, silicon fluids/oils–uses, silicon elastomers – rubbers, silicon resins (preparation and uses). **Phosphazenes:** Definition, types, preparation, structures, properties, nature of bonding and uses. Crystalline polymetaphosphates – Maddrell's and Kuroll's salts, properties and uses and sulfur-nitrogen compounds.

[08 Hrs]

Silicates: Structure, classification - silicates with discrete anions, silicates containing chain anion, silicates with layer structure, silicones with three dimensional net-work and applications.

Inorganic fibers: Introduction, properties, classification, asbestos fibers, optical fibers, carbon fibers and applications.

Zeolites: Introduction, types of zeolites, manufacture of synthetic zeolites and applications.

Inorganic pigments: General information and economic importance

White pigments: Titanium dioxide and zinc oxide pigments

Color pigments: Iron oxide, chromium oxide, mixed metal oxide pigments and ceramic colorants, corrosion protection pigments, luster pigments, luminescent pigments and magnetic pigments

[08 Hrs]

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

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. **Petrochemicals**: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives -Xylene. **[08 Hrs]**

Concept of Energy in Biosystems: Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism). **Nucleic Acids:** Components of nucleic acids: Adenine, guanine, thymine and cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation. **[08 Hrs]**

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

Batteries: Classification, characteristics, primary, secondary batteries. Working of the following batteries- Lead acid and Lithium batteries, Fuel cells. Energetics of cell reactions: Effect of temperature, pressure, and concentration on energetics of cell reactions (calculation of ΔG, ΔH and ΔS).

Corrosion: Introduction, definition, types of corrosion, electrochemical theory of corrosion. Thermodynamic aspects of corrosion. Corrosion rate, factors affecting corrosion rate- metal and environmental factors-temperature, pH of the medium, humidity, presence of impurities electrical conductivity of the medium, concentration of the medium. Evan diagrams in corrosion cells. **[08 Hrs]**

Prevention of corrosion- designing aspects, effect of allying and surface coating, painting, phospating, and anodic protection (passivation) cathodic protection. Corrosion inhibitors. Introduction, classification, characteristics and requirements of efficient corrosion inhibitors and their significance, corrosion inhibition mechanism.

Electroplating: Introduction, electroplating of chromium (hard and decorative).

Electro less plating: Introduction, distinction between electroplating and electro-less plating process, Electro-less plating of copper. **[08 Hrs]**

SCHEME OF EXAMINATION

QUESTION PAPER: THEORY EXAMINATION

(Applicable to **DSC-3, DSC-4, Elective-I and II**)

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

Instructions: Draw a neat labelled diagrams wherever necessary.

PART-A

Answer all of the following 8 X 1 = 08

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

PART-B: Inorganic Chemistry

Answer any three of the following 3 X 8 = 24

2
3
4
5

PART-C: Organic Chemistry

Answer any three of the following 3 X 8 = 24

6
7
8
9

PART-D: Physical Chemistry

Answer any three of the following 3 X 8 = 24

10
11
12
13

The sub-questions in Q2-Q13 shall be of (3+3+2) or (5+3) or (4+4) Marks

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DSCP-III: CHEMISTRY-III (PRACTICALS)

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

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

Distribution of Marks

Record	5 Marks
Part A	25 Marks
Part B	10 Marks

PART A

Q.No.1: Systematic semimicro qualitative analysis of inorganic salt mixtures (two anions and two cations). **25 Marks**

Two anions and two cations should be given from the following constituent ions.

Anions: HCO_3^-, CO_3^{2-}, Cl^-, Br^-, NO_3^-, BO_3^{3-} and SO_4^{2-}.

Cations: Pb^{2+}, Bi^{3+}, Al^{3+}, Mn^{2+}, Zn^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, K^+ Na^+ and NH_4^+.

Note: 1. Mixtures requiring elimination of phosphate and borate anions should not be given (avoid cations like Mn^{2+}, Ca^{2+}, Sr^{2+} and Ba^{2+} when borate is given).

2. Two anions from the same group should not be given.
3. Salts that yield $SrSO_4$ $BaSO_4$, $CaSO_4$ and $PbSO_4$ on double decomposition shall be avoided.
4. Two cations from the same group should not be given. However, combinations like Mg^{2+}/NH_4^+, K^+/NH_4^+ and Na^+/ NH_4^+ shall be given.
5. NH_4^+ radical may be analyzed and reported in the beginning of detection of cations (ammonium radical shall be considered in the zero group).

DISTRIBUTION OF MARKS

Preliminary Test	Physical state, colour, litmus paper test and solubility test	03 Marks
Detection of anions	Confirmation of two anions with all test	08 Marks
	Confirmation of one anion with all tests	04 Marks
	Identification of group only	01 Mark
Detection of cations	Group separation table for cations (w.r.t presence of given cations)	02 Marks
	Confirmation of two cations with all tests	08 Marks
	Confirmation of one cation with all tests	04 Marks
Balanced chemical/ ionic equation for confirmatory tests	Confirmatory test of any ONE anion given	02 Marks
	Confirmatory test of any ONE cation given	02 Marks

Q.No.2: Procedure writing for any one of the following. **10 Marks**

1. Preparation of mercury tetrathiocyanatocobaltate(II).
2. Preparation of tetraammonium copper(II) sulphate.
3. Preparation of potassium trisoxalatoaluminate(III).
4. Preparation of tristhioureacopper(I) chloride.

DISTRIBUTION OF MARKS

Reaction equation	03 Marks
Calculation of theoretical Yield	02 Marks
Procedure writing	05 Marks

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DSCP-IV: CHEMISTRY-IV (PRACTICALS)

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

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

Distribution of Marks

Record	5 Marks
Part A	25 Marks
Part B	10 Marks

PART A

Q.No.1: Physical Chemistry (Non-Instrumental) Experiments **25 Marks**

Any one of the following experiments shall be given to the candidate.

1. Determination of the density of liquid using specific gravity bottle and its surface tension using Stalagmometer [Carbon tetrachloride, ethyl acetate, water and 1% NaCl].
2. Determination of the density of liquid using specific gravity bottle and its viscosity using Ostwald's viscometer [Carbon tetrachloride, ethyl acetate, water and 1% NaCl].
3. Determination of rate constant of the decomposition of hydrogen peroxide catalyzed by $FeCl_3$ solution.
4. Determination of rate constant of saponification of ethyl acetate.
5. Determination of amount of HCl in the given solution using 1N NaOH solution by thermometric titration method.
6. Determination of percentage composition of the given NaCl solution by miscibility. Temperature method (water phenol system)
7. Determination of first order rate constant of acid hydrolysis of ethyl acetate.

DISTRIBUTION OF MARKS

Experiment	Density of the liquid		Surface tension of the liquid		Viscosity of the liquid	
Determination of density and surface tension of the liquid. **OR** Determination of density and viscosity of the given liquid	**Error**	**Marks**	**Error**	**Marks**	**Error**	**Marks**
	±2%	08	±4%	12	±4%	12
	±3%	06	±6%	10	±6%	10
	±4%	04	±8%	08	±8%	08
	Any other value	02	Any other value	04	Any other value	04

	Calculation and unit	01+ 01	Calculation and unit	02 + 01	Calculation and unit	02 + 01

Experiment			Marks	
Determination of percentage composition of the given NaCl solution by miscibility Temperature method (water phenol system)	Experiment Skill		04	
	Unknown 1		Unknown 2	
	Error	Marks	Error	Marks
	8 %	08	8 %	08
	10 %	06	10 %	06
	12 %	04	12 %	04
	Any other value	02	Any other value	02
	Graph	05		

Experiment	Constant values of K	Marks
Determination of first order rate constant of decomposition of hydrogen peroxide using ferric chloride catalyst	05 Values	16
	04 Values	14
	03 Values	12
OR	02 Values	10
Determination of second order rate constant of saponification of ester.	Any other value	06
	Calculation	03
OR	Unit	01
Determination of first order rate constant of acid hydrolysis of ester.	Graph	04
	K from the Graph	01
Experiment	**Error**	**Marks**
Determination of amount of HCl in the given solution using 1N NaOH solution by thermometric titration method	± 0.2 cm^3	18
	± 0.3 cm^3	16
	± 0.4 cm^3	14
	± 0.5 cm^3	12
	Any other value	08
	Graph	04
	Calculation of Normality and Weight/liter	02
	Unit	01

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PART B

Q.No.2: Procedure writing for any one of the following. **10 Marks**

Any one of the following experiments shall be given to the candidate.

PART-B: Ore/synthetic mixture analysis

1. Determination of iron in the given sample of hematite using potassium dichromate.
2. Estimation of manganese in the given sample of pyrolusite.
3. Estimation of calcium and magnesium in the given sample of dolomite by EDTA method.

B.Sc. CHEMISTRY SYLLABUS
FIFTH SEMESTER

Paper: Chemistry-V **Code: CHSDSC-V**

Contact Hours/Week	Credits	Scheme of Evaluation: Max. Marks: 100		
		Continuous Internal Assessment (CIA)		Semester End Examination (SEE)
		Assignment C-1	Test C-2	C-3
03	03	10 Marks	10 Marks	80 Marks

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

Unit-I: Inorganic Chemistry **16 Hours**

Coordination Chemistry:- Introduction-(central metal ion, coordination number, coordination sphere and complex ion) Ligands, classification of ligands with suitable examples. Bridging and inner metallic complexes, chelation. Rules for IUPAC naming of co-ordination compounds with examples, Physical methods to study the formation of complexes– change in conductance, change in color, change in P^H and solubility. **[05 Hours]**

Metal-Ligand equilibria in solution:

Stability of complexes - kinetic andthermodynamic stability of metal complexes, Stability of complex ion, stability constant,Step-wise and overall formation constant and their relationship, trends in step-wise constant, factors affecting the stability of metal complexes with reference to the nature of the metal ion and ligand, chelate effect, and their thermodynamic origin. Determination of formation constant by spectrophotometric method. Geometries of coordination complexes for coordination numbers 3 to 8 with examples. **[06Hours]**

Metal-ligand bonding in transition metal complexes:-

Valence bond theory:- Salient features, outer and inner orbital octahedral complexes, formation, geometry and magnetic properties of octahedral complexes on the basis of VBT, - $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$, $[Co(CN)_6]^{3-}$, $[CoF_6]^{3-}$ $[Cr(H_2O)_6]^{3+}$ and $[Fe(H_2O)_6]^{2+}$. Formation, geometry and magnetic properties of tetrahedral and square planner complexes on the basis of VBT- $[Ni(CO)_4]$,$[Ni(CN)_4]^{2-}$, $[Cu(NH_3)_4]^{2+}$, $[Zn(NH_3)_4]^{2+}$and$[PtCl_4]^{2-}$, limitations of VBT. **[05 Hours]**

Unit-II: Organic Chemistry **16 Hours**

Carbohydrates: Definition, classification with examples. Monosaccharides: Structural elucidation (Ring and open chain structure) of fructose. Haworth projection formula of glucose and fructose. Determination of ring size by the methylation method (glucose). Definition and mechanism of mutarotation and epimerization. Interconversion reactions: aldose to ketose (glucose to fructose), ketose to aldose (fructose to glucose), chain elongation (arabinose to glucose) and chain degradation (glucose to arabinose). Disaccharides: Structural elucidation of sucrose, Haworth projection formula of sucrose. Polysaccharides: Partial structures of starch (amylase and amylopectin) and cellulose.

[07 Hours]

Heterocyclic compounds: Classification, nomenclature of 5 and 6-membered and fused heterocycles with examples. Preparation of furan, pyrrole and thiophene (from Paul-Knorr synthesis). Pyridine from acetylene, Indole (Fischer method), Quinoline (Skraup's method). Aromaticity, resonance structure and reactions of pyrrole and pyridine.

Alkaloids: Introduction, general properties. Synthesis and structural elucidation of nicotine. Structural formulae and the physiological importance of quinine, atropine and cocaine. **Terpenes:** Introduction, definition, classification, and isoprene rule. Synthesis and structural elucidation of citral. Structural formulae and biological importance of α-terpeneol and menthol.

Vitamins: Introduction, classification, occurrence, structure and function of vitamin-A, vitamin-B_1, B_2, B_6, vitamin-C, vitamin-D_2, vitamin-E (alpha, beta and gamma) and vitamin-H. **[09 Hours]**

Unit-III: Physical Chemistry **[16 Hours]**

Physical properties and chemical constitution: Parachor - Definition, Sugden equation and parachor applications with respect to structural elucidation of benzene and quinone. Numerical problems based on parachor values. **Rehochor-** Definition, equation.

Dipole moment: Definition, measurement of dipole moment (temperature method). Dipole moment and structure of molecules (triatomic, tetraatomic and pentaatomic, cis and trans, planar and non-planar, ortho, para and meta isomers).(Numerical problems)

Polarisation - Induced polarisation, orientation polarisation, and molar polarisation, Clausius-Mossotti equation (no derivation). **[05 Hours]**

Molecular Spectroscopy: Electromagnetic radiation – regions of spectra, molecular energy levels, absorption and emission spectra. Gross and specific selection rules for IR and Microwave spectra.

Microwave Spectroscopy: Introduction, Expression for rotational spectrum of a diatomic molecule considering it as a rigid rotator- expression for moment of inertia (to be derived), expression for rotational energy (to be derived), expression for rotational spectral lines (to be derived), Applications of microwave spectra - calculation of bond length. (Numerical problems)

Vibration Spectroscopy: Introduction, expression for vibrational energy levels and potential energy of a simple harmonic oscillator. Zero-point energy, determination of force constant and bond energies. Applications of vibration spectra (Mention only). Vibrational modes of H_2O and CO_2 molecules (Numerical problems).

Raman Spectroscopy: Selection rules, origin of Raman spectrum, quantum mechanical theory-Stokes and Anti-Stokes lines. Pure rotational Raman spectra for a diatomic molecule (to be derived), vibrational Raman spectra for diatomic molecules (explanation with equation).

Electronic spectra: Concepts of potential energy curves for bonding and anti-bonding molecular orbitals, statement of the Born-Oppenheimer approximation, Franck-Condon principle. **[11 Hours]**

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Paper: Chemistry-VI **Code: CHSDSC-VI**

Contact Hours/Week	Credits	Scheme of Evaluation: Max. Marks: 100		
		Continuous Internal Assessment (CIA)		Semester End Examination (SEE)
		Assignment C-1	Test C-2	C-3
03	03	10 Marks	10 Marks	80 Marks

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

Unit-I: Inorganic Chemistry **16 Hours**

Non-aqueous solvents: Types of solvents and their general characteristics. Reactions in non aqueous solvents with respect to Liquid ammonia- ionization, Precipitation, Ammonolysis, complex formation and Redox reactions Ionization of weak acids, Advantages and disadvantages. Role of alkali metals in Liquid Ammonia. Liquid SO_2-reasons for the solvent properties, typical reactions-acid-base, solvolysis, precipitation, amphoteric and redox.

HSAB: Classification of acids and bases as Hard and Soft. Pearson's HSAB concept, acid-base strength, hardness and softness **[07 Hours]**

Metallurgy: Types of metallurgy: Pyrometallurgy: Extraction of Nickel from sulphide ore–general metallurgy followed by Mond's process (purification), manganese from oxide ores–reduction by the Aluminothermite process–refining by electrolytic process.

Hydrometallurgy: Extraction of gold from native ore by cyanide process and refining by quartation process.

Electrometallurgy: Extraction of lithium by fusion method followed by electrolysis of lithium chloride.

Powder metallurgy: Importance, metal powder production and applications, production of tungsten powder. Extraction of (1) Thorium from monazite sand–purification by iodine method,

(2) uranium from pitch blende– production of U_3O_8 by carbonate method, U_3O_8 to UO_2 by reduction, UO_2 to U by fluoride method. **[09 Hours]**

Unit-II: Organic Chemistry **16 Hours**

Active methylene compounds:- Definition and preparation of acetoacetic ester and malonic ester. Synthetic applications of acetoacetic ester- mono and dicarboxylic acid (butanoic acid, and succinic acid), antipyrin. Synthetic applications of malonic ester- α, β-unsaturated acid and barbutaric acid. keto-enol tautomerism in acetoacetic ester. **[03 Hours]**

Polymers:-Introduction, classification. Polymerization:- types (addition and step growth). Synthetic rubbers:– Synthesis and application of butyl rubber, neoprene, buna-S. Synthetic fibers:- Synthesis and application of Nylon-6, nylon-6,6.

Thermoplastic and thermosetting resins:– Definition with examples. **[03 Hours]**

Amino acids and nucleic acids: Amino acids: Introduction, Gabriel Pthalimide synthesis, Zwitter ion, isoelectric point. Peptides: Synthesis of peptides by the carbobenzoxy method. Proteins: Definition and classification of proteins based on molecular shape (fibrous and globular), and denaturation. Enzymes: Definition and classification with an example each. Nucleic acids: Introduction, types, nucleosides, nucleotides. Structure and functions of DNA. **[04 Hours]**

Oils and Fats: Definition, chemical nature of oils and fats, simple and mixed glycerides taking palmitic, stearic and olelic acid as examples. Rancidity, Analysis of oils and fats (Definition and calculation of Iodine and saponification values).

Soaps and Detergents:-Definition and types. Manufacture of soaps (hot process), Mechanism of cleansing action of soaps. Detergents:- Definition, preparation of detergents, Merits and demerits of syndets in relation to soaps. **Waxes:-** Definition and types with examples. **[06 Hours]**

Unit-III: Physical Chemistry **16 Hours**

Colligative properties: Definition and examples.

Lowering of vapour pressure: Raoult's law (to be derived), relationship between relative lowering of vapour pressure and molar mass (to be derived). Experimental determination of molar mass of the solute by Dynamic method (problems).

Elevation in boiling point: Definition, its relation to lowering of vapour pressure and molar mass (to be derived). Ebullioscopic constant of the solvent and its relation to the boiling point (only equation). Experimental determination of molar mass of the solute by Walker–Lumsden method (problems).

Depression in freezing point: Definition, its relation to lowering of vapour pressure and molar mass (to be derived). Cryoscopic constant and its relation to melting point (only equation), Determination of molar mass of non-volatile solute by Rast method (problems).

Semipermeable membrane: Definition, types with examples. Preparation of artificial semipermeable membrane (copper ferrocyanide) by Morse-Frazer method.

Osmotic pressure: Definition of osmosis, reverse osmosis and osmotic pressure. Determination of osmotic pressure by Berkely-Hartley's method (problems). Applications of osmotic pressure (mention only). Osmotic laws and analogy with gas laws: Relationship between molar mass and osmotic pressure (to be derived). Isotonic solutions, plasmolysis and haemolysis. Abnormal molecular mass, causes, vant Hoff's factor (problems). **[10Hours]**

Ionic equilibria: Ionic equilibria in aqueous solutions, strong and weak electrolytes- definition and examples. Activity and activity coefficient–definition and their relation. ionic strength and its calculation. Hydrolysis of salts-Derivation of hydrolysis constant, degree of hydrolysis and expression for pH of the solution of salt of weak acid and weak base (ammonium acetate as an example), effect of temperature on degree of hydrolysis. **[06 Hours]**

FIFTH SEMESTER PRACTICALS

Paper: Chemistry Practical-V **Code: CHSDSCP-V**

Contact Hours/Week	Credits	Scheme of Evaluation: Max. Marks: 50		
		Continuous Internal Assessment (CIA)		Semester End Examination (SEE)
		C-1	C-2	C-3
04	02	05 Marks	05 Marks	40 Marks

Part - A

GRAVIMETRIC ESTIMATIONS

1. Gravimetric estimation of barium as barium sulphate.
2. Gravimetric estimation of iron as iron(III) oxide.
3. Gravimetric estimation of copper as copper(I) thiocyanate.
4. Gravimetric estimation of nickel as nickel dimethylglyoximate.
5. Gravimetric estimation of magnesium as magnesium-8-hydroxy oxinate.
6. Gravimetric estimation of sulphate as barium sulphate.
7. Gravimetric estimation of aluminum as aluminum oxide.
8. Gravimetric estimation of zinc as zinc oxide.
9. Gravimetric estimation of calcium as calcium oxide.
10. Gravimetric estimation of lead as lead chromate.

Part - B.

1. Isolation of Casein from milk
2. Isolation of caffeine from Tea powder.
3. Separation and identification of amino acids by circular paper chromatography.
4. Qualitative analysis of amino-acids (Glycine, Lysine and Glutamic acid) and proteins (Albumine, Gelatine and casein).
5. Qualitative analysis of Carbohydrates (Glucose, Fructose, Sucrose and Starch).

B.Sc. CHEMISTRY SYLLABUS

SIXTH SEMESTER

Paper: Chemistry-VII **Code: CHSDSC-VII**

Contact Hours/Week	Credits	Scheme of Evaluation: Max. Marks: 100		
		Continuous Internal Assessment (CIA)		Semester End Examination (SEE)
		Assignment C-1	Test C-2	C-3
03	03	10 Marks	10 Marks	80 Marks

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

Unit-I: Inorganic Chemistry **16 Hours**

Isomerism in co-ordination complexes:-Structural isomerism- Ionization, Hydrate, linkage, Ligand isomerism. Stereo-isomerism – Geometrical and optical isomerism exhibited by co-ordination compounds of co-ordination number 4 and 6 with suitable examples. **[04 Hours]**

Metal- ligand bonding

Crystal field theory:- Salient features, crystal field splitting of d-orbitals in octahedral, tetrahedral, and square planar complexes with suitable examples, crystal field stabilization energies and its calculations for various d^n configurations in octahedral complexes, factors affecting the magnitude of CFSE in octahedral complexes(Δ_o), (oxidation state of the metal ion, nature of ligand, size of the orbitals, geometry of the complex), high spin (HS) and low spin (LS) complexes, magnetic properties of metal complexes based on crystal field theory-$[Co(NH_3)_6]^{3+}$, $[CoF_6]^{3-}$, $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$ and $[Ni(CN)_4]^{2-}$. Limitations of CFT **Molecular orbital theory:** Octahedral and tetrahedral complexes with examples (sigma bonding only) **[08 Hours]**

Magnetic properties of coordination compounds: Introduction, magnetic susceptibility and its determination- Gouy and Faraday method, the effects of temperature on magnetic moment (μ_{eff}), brief account on ferromagnetism, anti-ferromagnetism and ferrimagnetism. **[04 hours]**

Unit-II: Organic Chemistry **16 Hours**

Photochemistry: Introduction, principles of photochemistry, Jablonski diagram, sensitisers, quenchers, photochemical reaction of 1,3-butadiene (Sensitised and non-sensitised). Photochemical reaction and mechanism of carbonyl compounds: Norrish type-I (one example), Norrish type-II (one example). Reactions and mechanism of the Barton reaction. Photo-oxidation of benzaldehyde, photo-reduction of benzophenone. **Pericyclic reactions:** Electrocyclic reaction, cycloaddition reaction (2+2, 3+2 and 2+4), sigmatropic reactions (3,3 and 5,5). **[08 Hours]**

Spectroscopy: UV spectroscopy: Introduction, chromophores and auxochrome, blue shift and red shift. Woodward-Hoffman's rule and its applications (acyclic dienes, heteroannular dienes,

homoannular dienes, and alpha-beta unsaturated carbonyl compounds). **IR spectroscopy**: Introduction, modes of vibration, stretching frequency of –OH (free and H-bonded -alcohols, acids, phenols), alkyl – C-H, C-C (single, double and triple bonds), C=O and C-O groups (aldehydes, ketones, esters), fingerprint region, and identification of functional groups in simple organic molecules. **NMR spectroscopy**: Basic principles of proton magnetic resonance, nuclear magnetic spin quantum number I, nuclear magnetic resonance-chemical shift (δ value), uses of TMS reference, nuclear shielding effects, equivalent and non-equivalent protons, spin-spin splitting and coupling. Applications of NMR spectroscopy to simple organic molecules (ethyl alcohol, propane, methylamine, toluene, acetone, acetophenone). **[08 Hours]**

Unit-III: Physical Chemistry **16 Hours**

Electrochemistry-I: Introduction, electronic and electrolytic conduction and differences between them, specific conductance and molar conductance. Variation of specific and molar conduction with dilution, ionic conductance, Degree of dissociation, Ostwald's dilution law **(to be derived)** and its limitations. Debye- Huckel onsager theory of strong electrolyte (qualitative treatment with relaxation effect, electrophoretic effect and viscous effect) ionic mobility. Kohlrausch law and its applications, Transport numbers and its determination by moving boundary method, Anomalous transport number, relationship between ionic mobility and transport number **(to be derived)**, problems.

Applications of conductance measurements:(a) Solubility and solubility product of sparingly soluble salts, (b) Ionic product of water (c) Degree of ionization (α) and ionization constant (K_a) of weak electrolyte.

Conductometric titrations: (i) Strong acid versus strong base, (ii) Mixture of weak acid and strong acid versus strong base and iii) precipitation titrations. **[07 Hours]**.

Electrochemistry-II: Electrolytic and Electro chemical cells **(galvanic cells)**-Daniel cell **(construction, working and cell reaction)**. Reversible and irreversible cells, rules for representation of a cell, Types of reversible electrodes- metal-metal ion, metal –metal insoluble salt, redox and amalgam electrodes. Electrode potential, Standard electrode potential, sign convention for electrode potential, Nernst equation for single electrode potential **(to be derived)**.

Reference electrodes –construction and working of metal-metal insoluble salt electrode (calomel electrode), Silver- silver chloride electrode. Weston standard cell (Construction, working, reaction and standard emf). Equilibrium constant and free energy of a cell reaction, Concentration cell with transport, concentration cell without transport, EMF of concentration cell **(to be derived)**. Liquid junction potential, Salt bridge. Application of concentration cell- i) valency of ions and ii) solubility product of sparingly soluble salt. Problems.

Applications of EMF measurements - (a) Determination of pH of a solution using - (i) quinhydrone electrode, (ii) glass electrode. (b) Potentiometric titration- principle and location of end point in acid-base, Oxidation - reduction and Precipitation reactions. **[08 Hours]**

SIXTH SEMESTER

Paper: Chemistry-VIII **Code: CHSDSC-VIII**

Contact Hours/Week	Credits	Scheme of Evaluation: Max. Marks: 50		
		Continuous Internal Assessment (CIA)		Semester End Examination (SEE)
		Assignment C-1	Test C-2	C-3
02	02	05 Marks	05 Marks	40 Marks

PAPER: Chemistry-VIII **[32 Hours]**

Unit-I: **16 Hours**

Silicates: Structure, classification - silicates with discrete anions, silicates containing chain anion, silicates with layer structure, silicones with three dimensional net-work and applications.

Glass: Raw materials, glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass. **[07 Hours]**

Surface Coatings: Objectives, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, constituents and their functions, manufacture of lithopone and titanium dioxide. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), **[04Hours]**

Nanotechnology: Definition, uses and nature of nanotechnology. Nanomaterials: Definition, properties and applications. Carbon nanotubes: Definition, types, methods of preparation (mention), properties and industrial applications of carbon nanotubes, Nanowires: Definition, types, production of crystalline nanowires by vapour-liquid-solid synthesis method, application of nanowires. **[05 Hours]**

Unit-II **16 Hours**

Semiconductors: Metals, insulators and semiconductors. Band theory, energy bands, intrinsic and extrinsic semiconductors. Conductivity: electrons and holes, temperature dependence on conductivity, Optical properties: absorption spectrum, photoconductivity, photovoltaic effect and luminescence.

Junction properties: metal-metal junctions, metal-semiconductor junctions, p-n junctions, transistors, industrial applications of semiconductors: Mixed oxides, spinels and other magnetic materials.

[07 Hours]

Colloids:-origin of charge on colloidal particles, theories of electrical double layer:- Helmholtz-Perrin, Gouy-Chapman and Stern electrical double layer (qualitative), electrical properties:- Zeta potential, electrophoresis and electro osmosis.

Stability of colloids, coagulation of colloids, Hardy-Schulze rule and coagulation value, mutual coagulation, definition of lyophilic and lyophobic sols with examples, protective action of lyophilic sols, gold number.

Emulsions:- Types with examples, emulsifying agents- Definition, examples and importance

Gels: Preparation of gels (double decomposition method), types of gels:- elastic and non elastic gels-explanation with examples. Properties of gels. Application of colloids (mention only).

[06Hours]

Buffer Solutions: Introduction, definition, types with examples, Hendersons and Bach equations(both to be derived), role of Buffers in pH maintenance in industry (Sugar,Paper, and beverages) **[03 Hours]**

SIXTH SEMESTER PRACTICALS

Paper: Chemistry Practical-VI **Code: CHSDSCP-VI**

Contact Hours/Week	Credits	Scheme of Evaluation: Max. Marks: 50		
		Continuous Internal Assessment (CIA)		Semester End Examination (SEE)
		C-1	C-2	C-3
04	02	05 Marks	05 Marks	40 Marks

PHYSICAL CHEMISTRY EXPERIMENTS (INSTRUMENTAL)

Part - A

1. Determination of equivalent conductance at infinite dilution ($\lambda\infty$) of strong electrolytes [NaCl or KCl or HCl].
2. Conductometric titration of (i) Strong acid v/s strong base (ii) Mixture of strong and weak acids v/s strong base.
3. Determination of second order rate constant for saponification of ethyl acetate by conductivity measurements
4. Potentiometric titration of ferrous ammonium sulphate against potassium dichromate.
5. Determination of pKa of weak acid by potentiometric method.
6. Colorimetric estimation of Fe^{3+} ion using ammonium thiocyanate as complexing agent.
7. Colorimetric estimation of Cu^{2+} ion using NH_4OH as complexing agent.
8. Determination of first order rate constant for colorimetric study of oxidation of indigo caramine by chloramine-T.
9. Determination of partial molar volume of NaCl –H_2O system from density measurements

PART - B

1. Determination dissociation constant (Ka) of weak acid by conductometric method.
2. pH titration of strong acid against strong base.
3. Colorimetric titration of iron(II) solution against potassium permanganate.
4. Determination of percentage composition of a given mixture containing two miscible liquids by Abbe's refractometer.
5. Determination of solubility of sparingly soluble salt by conductivity method ($BaSO_4$).

SCHEME OF VALUATION FOR V SEM PRACTICAL EXAMINATION
DSCP-V: CHEMISTRY-V (PRACTICALS)

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

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

Distribution of Marks

Record	5 Marks	**Part - A**	30 Marks	**Part - B**	05 Marks

Q.No.1: Record **05 Marks**

Q.No.2: In the first fifteen minutes the candidates are required to write detail Procedure for any one of the experiments given from PART-B in the syllabus **05 Marks**

PART A
GRAVIMETRIC ESTIMATION

Q.No.3: Any one of the following experiments may be given **30 Marks**

1. Gravimetric estimation of barium as barium sulphate.
2. Gravimetric estimation of iron as iron (III) oxide.
3. Gravimetric estimation of copper as copper (I) thiocyanate.
4. Gravimetric estimation of nickel as nickel dimethyl glyoximate.

DISTRIBUTION OF MARKS

Experiment	Marks
Experimental skill	05
Discrepancy between the theoretical and reported value (in Percentage)	
± 3%	22
± 4%	19
± 5%	16
± 6%	13
Any other value	10
Calculation	03

PART-B

Any one of the following experiments given for procedure writing (1,2, and 3) OR qualitative tests (4 and 5)

1. Isolation of Casein from milk
2. Isolation of caffeine from Tea powder.
3. Separation and identification of amino acids by circular paper chromatography.
4. Qualitative analysis of amino acids (Glycine, Lysine and Glutamic acid) and proteins (Albumin, Gelatine and casein).
5. Qualitative analysis of carbohydrates (Glucose, Fructose, Sucrose and Starch).

SCHEME OF VALUATION FOR VI SEM PRACTICALS EXAMINATION
DSCP-VI: CHEMISTRY-VI (PRACTICALS)

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

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

Distribution of Marks

Record	5 Marks	**Part - A**	30 Marks	**Part - B**	05 Marks

Q.No.1: Record **05 Marks**

Q.No.2: In the first fifteen minutes the candidates are required to write brief procedure for the given experiment from **PART-B.** **05 Marks**

PART A

Q.No.3: Any one of the following experiments shall be given to the candidate. **30 Marks**

DISTRIBUTION OF MARKS

Experiment-1	**Discrepancy**	**Marks**
Determination of equivalent conductance at infinite dilution ($\lambda\infty$) of strong electrolytes (KCl, NaCl or HCl)	Cell constant with SI Unit	4 + 1
	$\pm$4%	16
	$\pm$6%	14
	$\pm$8%	12
	$\pm$10%	10
	Any other value	08
	Graph	05
	Calculations with SI Units	04
Experiment-2	**Discrepancy**	**Marks**
Conductometric titration of mixture of strong acid and weak acid versus strong base.	Strong acid + weak acid	
	$\pm$ 0.2 cm^3	10 + 10
	$\pm$ 0.3 cm^3	09 + 09
	$\pm$ 0.4 cm^3	08 + 08
	$\pm$ 0.5 cm^3	07 + 07
	Any other value	06 + 06
	Graph	05
	Calculation of both strong acid and weak acid concentration and Wt/L	05
Experiment-3	**Discrepancy**	**Marks**
Determination of rate constant of saponification of ethyl acetate by conductivity measurements .	K-Constant values	
	06 values	20
	05 values	18
	04 values	16
	03 values	14
	Any other value	12
	Calculation	03
	K from graph with units	02
	Graph	05

Experiment-4	Discrepancy	Marks
Potentiometric titration of FAS v/s $K_2Cr_2O_7$ Solution	$\pm$ 0.2 cm^3	20
	$\pm$ 0.3 cm^3	18
	$\pm$ 0.4 cm^3	16
	$\pm$ 0.5 cm^3	14
	Any other value	12
	Graph	05
	Calculation of Normality and weight/L with SI Unit	03 + 02
Experiment-5	**Discrepancy**	**Marks**
Determination of pK_a value of weak acid potentiometrically	$\pm$ 0.2	20
	$\pm$ 0.5	18
	$\pm$ 0.7	16
	$\pm$ 0.8	14
	Any other value	12
	Graph	05
	Calculation	05

Experiment-6	Discrepancy	Marks
Colorimetric estimation of Cu^{2+} and verification of Beers law	Preparation of standard solutions	05
	Determination of λmax	02
	$\pm$ 0.2 cm^3 (0.2 mg)	18
	$\pm$ 0.3 cm^3 (0.3 mg)	16
	$\pm$ 0.4 cm^3 (0.4 mg)	14
	$\pm$ 0.5 cm^3 (0.5 mg)	12
	Any other value	10
	Graph (St. line passing thru the origin)	05 Marks
Experiment-7	**Discrepancy**	**Marks**
Colorimetric estimation of Fe^{3+} and verification of Beers law	Preparation of standard solutions	05
	Determination of λmax	02
	$\pm$ 0.2 cm^3 (0.01 mg)	18
	$\pm$ 0.3 cm^3 (0.015 mg)	16
	$\pm$ 0.4 cm^3 (0.02 mg)	14
	$\pm$ 0.5 cm^3 (0.025 mg)	12
	Any other value	10
	Graph (st. line passing thro the origin)	05 Marks
Experiment-8	**Discrepancy**	**Marks**
Determination of first order rate constant for colorimetric study of oxidation of indigo-carmine by chloramine-T.	**K-Constant values**	
	06 values	20
	05 values	18
	04 values	16
	03 values	14
	Any other value	12
	Calculation	03
	K from graph with units	02
	Graph	05

Determination of first order rate constant for colorimetric study of oxidation of indigo-carmine by chloramine-T.	**K-Constant values**	
	06 values	**20**
	05 values	**18**
	04 values	**16**
	03 values	**14**
	Any other value	**12**
	Calculation	**03**
	K from graph with units	**02**
	Graph	**05**

Experiment-9	Discrepancy	Marks
Determination of partial molar volume of NaCl –H_2O system from density measurements	Preparation of solutions	**05**
	Calculations with SI Units	**04**
	4%	**16**
	6%	**14**
	8%	**12**
	10%	**10**
	Any other value	**06**
	Graph	**05 Marks**

Any one of the following PART-B Experiments given for procedure writing

1. Determination of the dissociation constant (Ka) of a weak acid by the conductometric method.
2. pH titration of strong acid against strong base.
3. Colorimetric titration of FAS against potassium permanganate.
4. Determination of the percentage composition of a given mixture containing two miscible liquids by Abbe's refractometer.
5. Determination of solubility of a sparingly soluble salt by the conductivity method ($BaSO_4$).

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SKILL ENHANCEMENT COURSE (COMPULSORY)
ELECTIVE COMPULSORY PRACTICAL PAPER
FOR IV / V / VI -SEMESTER

Paper: Chemistry Skill Practical **Code: CHSSEC-I**

Contact Hours/Week	Credits	Scheme of Evaluation: Max. Marks: 50		
		Continuous Internal Assessment		Semester End Examination (SEE)
		C-1	C-2	C-3
04	02	05 Marks	05 Marks	40 Marks

LIST OF EXPERIMENTS

PART-A:

1. Determination of total acidity of vinegar and wine by acid-base titration.
2. Determination of aspirin in their tablet preparations by residual acid-base titrimetry.
3. Determination of purity of a commercial boric acid sample and Na_2CO_3 content of washing soda.
4. Determination of iron in pharmaceuticals by titrimetric method using potassium permanganate solution.
5. Estimation of vitamin-C by iodometric using Chloramine-T method.
6. Estimation of aspirin by colorimetric method.
7. Estimation of glucose (sugar) by colorimetric method.

PART-B
ORGANIC ESTIMATIONS

1. Determination of calcium in milk powder by EDTA titration.
2. Estimation of paracetamol by titrimetric method
3. Estimation of formaldehyde in commercial formalin
4. Estimation of aniline by bromide and bromate method
5. Food adulteration: Determination of adulteration in food stuffs.
6. Spectrophotometric determination of creatinine in urine.

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SCHEME OF VALUATION

CHSSECP-1: ELECTIVE COMPULSORY PRACTICAL PAPER

SEMESTER – IV / V/ VI

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

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

Distribution of Marks

Record	5 Marks	**Part - A**	30 Marks	**Part - B**	05 Marks

PART-A

1. Determination of total acidity of vinegar and wine by acid-base titration.
2. Determination of aspirin in their tablet preparations by residual acid-base titrimetry.
3. Determination of the purity of a commercial boric acid sample and Na_2CO_3 content of washing soda.
4. Determination of iron in pharmaceuticals by visual and potentiometric titration using cerium (IV) sulphate.
5. Estimation of vitamin-C (Ascorbic acid) / Vitamin-C tablets by iodometric using Chloramine-T method.
6. Estimation of aspirin by colorimetric method.
7. Estimation of glucose (sugar) by colorimetric method.

PART-A Experiments- 1, 2 and 3	Preparation of a standard solution and calculation of its normality		05 Marks
	Titration values		
	Discrepancy	**Standardization**	**Estimation**
	$\pm$ 0.2 cm^3	10 Marks	12 Marks
	$\pm$ 0.3 cm^3	08 Marks	10 Marks
	$\pm$ 0.4 cm^3	06 Marks	08 Marks
	Any other value	04 Mark	06 Marks
	Calculation	Normality of link solution = 01 Mark Normality of given solution = 01 Mark Weight/dm^3 or 250cm^3 = 01 Mark	

PART-A: Experiment-4	Discrepancy	Marks
Determination of iron in pharmaceuticals by visual and potentiometric titration using cerium (IV) sulphate.	$\pm$ 0.2 cm^3	24
	$\pm$ 0.3 cm^3	21
	$\pm$ 0.4 cm^3	18
	$\pm$ 0.5 cm^3	15
	Any other value	12

	Graph	06

PART-A: Experiments 5 Estimation of Vitamin-C (ascorbic acid) / Vitamin-C tablets by iodometric using Chloramine-T method		
Standardization of given $Na_2S_2O_3$ solution andcalculation of its normality		05 Marks
Estimation of ascorbic acid (Vitamin-C) by iodometric using Chloramine-T method		
Discrepancy	10 mg	18 Marks
	15 mg	15 Marks
	20 mg	12 Marks
	25mg	09 Marks
	Any other value	06Marks
Calculation		03Marks
Blank titration without ascorbic acid (Vitamin-C) solution		04Marks

PART-A: Experiments 6 and 7 Colorimetric estimation of aspirin and glucose (Sugar)		
Preparation of standard solution		06 Marks
Discrepancy	10-100 µg	18 Marks
	100-200 µg	15 Marks
	200-300 µg	12 Marks
	Any other value	08 Marks
Graph and Unit		05 + 01 = 06 Marks

PART-B (Procedure Writing) **05 Marks**

Outline Procedure writing from any one of the following experiments listed Below

1. Determination of calcium in milk powder by EDTA titration.
2. Estimation of paracetamol by the titrimetric method
3. Estimation of formaldehyde in commercial formalin
4. Estimation of aniline by the bromide and bromate method
5. Food adulteration: Determination of adulteration in food stuffs.
6. Spectrophotometric determination of creatine in urine.

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