UNIVERSITY  **OF MYSORE**

SYLLABUS (CBCS Scheme)

CHEMISTRY

FOR B.Sc. DEGREE PROGRAMME

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: 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 in to s, p, d, and f blocks. Atomic radii**,** covalent, ionic and van der Waal'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, 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.

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]**

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, hyperconjugation and their significance. Strengths of organic acids and bases: Comparative study with emphasis on factors effecting pK values. Relative strength of carboxylic acids (formic acid,

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]**

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. Energy distribution as a function of temperature. Types of Molecular Velocities- Most probable, average, and root mean square velocities definition and equation (no derivation) and their relationship. Law of equiportion of energy.

Behavior of real gases: Deviation from ideal gas behavior, compressibility factor (Z) and its variation with pressure. Causes of deviation from ideal behavior. [**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 (Vc) by Cailletet and Mathias method. Relationship of vander- Waals constant (a and b) with critical constants Tc, Pc and Vc (derived using isotherm of CO_2), Law of corresponding state and reduced equation state. Numerical problems on Tc, Pc and Vc 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 liquefaction of gases - Joule Thomson 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 Vander 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: Chemistry Practicals-I **Code: CHDSCP-1**

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. 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.

Part B

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. Separation of pigments in leaves/flowers by thin layer chromatography (Demonstration).

4. Separation of *o*- and *p*-nitroanilines in a mixture by column chromatography (Demonstration).
5. Estimation of calcium content in chalk as calcium oxalate using decinormal potassium permanganate solution.
6. Estimation of ammonium chloride using 0.05N sodium hydroxide and 0.1N hydrochloric acid solutions (back titration).
7. Estimation of sulphuric acid and oxalic acid in the given mixture using standard sodium 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-Haber cycle, 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 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 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 (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 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 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. [**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. Crystal system, Bravias Lattices – 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 undergo association 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: Chemistry Practicals-II **Code: CHDSCP-2**

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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RECOMMENDED BOOKS/REFERENCES:

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd Ed.,Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J. J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
4. Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O. K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.

5. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
6. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
7. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, P. L. Gaus; John Wiley, 6th Ed. (1999).
8. Advanced Inorganic Chemistry, F. A. Cotton, G. Wilkinson, 6th Ed.
9. Inorganic Chemistry, J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley, 4th Ed. (1993).
10. Vogel's Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
11. Advanced Organic Chemistry, Jerry March, John Wiley (2008).
12. Advanced Organic Chemistry, F A Carey and R J Sundberg, Plenum, (1990).
13. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall, (1998).
14. Stereochemistry of Organic Compounds, D Nasipuri, New-Age International, (1999).
15. Stereochemistry of Carbon Compounds, E L Eliel, S H Wilen and L N Mander, John Wiley, (1994).
16. Stereochemistry, Potapov, MIR, Moscow, 1984.
17. Organic Chemistry, Vol. I and II, I L Finar, Longman, (1999).
18. Laboratory Manual of Organic Chemistry, B.B. Dey, M V Sitaraman, T R Govindachari, Allied Publishers, New Delhi, (1996).
19. Practical Organic Chemistry - Mann and Saunders, (1980).
20. Textbook of Practical Organic Chemistry- A. I. Vogel, (1996).
21. Textbook of Quantitative Organic Analysis- A. I. Vogel, (1996).
22. Comprehensive Practical Organic Chemistry, V. K. Ahluwalia, R. Aggarwal, Uni. Press, (2000).
23. Practical Organic Chemistry (Quantitative analysis), B. B. Dey, M. V. Sitaraman, T. R. Govindachari, Allied Publishers, New Delhi, (1992).
24. Physical Chemistry, P. W. Atkins, Julio de Paula, ELBS, 7th Ed., (2002).
25. Physical Chemistry: A Molecular Approach, McQuarie and Simon, Viva, New Delhi, (2001).
26. Physical Chemistry, P. Atkins and J. D. Paula, 9th Ed., Oxford University Press (2010).
27. Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publications Meerut (1988)
28. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987)
29. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
30. Experimental Physical Chemistry by Wilson, Newcombe & others, Pergamon Press, (1962)
31. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983)
32. Surface Chemistry: Theory and Applications, J. J. Bikerman, Academic Press. New York (1972).
33. Physical Chemistry, Laideler K. J. and Meiser J. M. 3rd Ed. McGraw-Hill, (1999).
34. Physical Chemistry, Levine I. N., Physical Chemistry, 4th Ed. McGraw-Hill, (1995).
35. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson and P. L. Gaus; John Wiley, 6th Ed. (1999).
36. Chemistry of elements, N. N. Greenwood & A. E. Earnshaw, Butterworth Heinemann (1997).
37. Inorganic Chemistry, J. E. Huheey, E. A. Keiter & R. L. Keiter, Addison; 4th Ed. Wesley (1993).
38. Textbook of Inorganic Chemistry, G. S. Sodhi, Viva books Pvt. Ltd (2011).
39. Advanced Organic Chemistry, Jerry March, John Wiley (2008).
40. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum (1990).
41. A Guide Book to Mechanism of Organic Chemistry, Peter Sykes, Longman (2000).
42. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall (1998).
43. Modern Organic Reactions, H. O. House, Benjamin (1972).
44. Stereochemistry of Organic Compounds, D. Nasipuri, New-Age International (1999).
45. Stereochemistry of Carbon Compounds, E. L. Eliel, S. H. Wilen & L. N. Mander, John Wiley (1994).

46. Organic Chemistry, Volumes I and II, I L Finar, Longman. (1999).
47. Practical Organic Chemistry, Mann and Saunders, (1980).
48. Text Book of Practical Organic Chemistry, A. I. Vogel, (1996).
49. Test Book of Quantitative Organic Analysis, A. I. Vogel, (1996).
50. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, Universities Press (India), (2000).
51. Advanced Practical Organic Chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, (1992).
52. Experiments in Physical Chemistry, Shoemaker & Garland, McGraw Hill Int. Edn. (1966).
53. Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publications Meerut (1988).
54. Experimental Physical Chemistry, R. C. Behra and B Behra, Tata McGraw, New Delhi (1983).
55. Experimental Physical Chemistry, V.D. Atavale & Parul Mathur, New Age Int. NY. (2001).
56. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013).
57. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
58. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
59. Stereochemistry-Conformation and Mechanism-P. S. Kalsi, Wiley-Eastern Ltd, New Delhi.
60. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
61. Barrow, G.M. Physical Chemistry, Tata McGraw-Hill, 2007.
62. Castellan, G.W. Physical Chemistry, 4th Ed. Narosa, 2004.
63. P.W. Atkins: Physical Chemistry, 2002.
64. W.J. Moore: Physical Chemistry, 1972.
65. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
66. Jeffery, G.H., Bassett, J., Mendham, J.& Denney, R.C.
67. Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.
68. Rodgers, G. E. Inorganic & Solid-State Chemistry, Cengage Learning India Ltd., 2008.
69. Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry.John Wiley & Sons, 1974.
70. G.L. Miessler & Donald A. Tarr: Inorganic Chemistry, Pearson Publication.
71. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
72. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co., New York (1985).
73. Organic Chemistry-F. A. Carey, 4th Edition, McGraw Hill (2000).
74. Modern Organic Chemistry - R.O.C. Norman and D.J. Waddington, ELBS, 1983.
75. Organic Chemistry - L. Ferguson, Von Nostrand, 1985.
76. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.
77. Organic Chemistry- Mehta and Mehta, PHI Learning Pvt. Ltd, New Delhi,2005.
78. Text Book of Physical Chemistry - S. Glasstone, Mackmillan India Ltd., 1982.
79. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma, M. S. Patania, S. Chand & Co. 1987.
80. Physical Chemistry - Alberty R. A. and Silbey, R. J. John Wiley and sons, 1992.
81. Physical Chemistry - G. M. Barrow, McGraw Hill, 1986.
82. Physical Chemistry (3rd Edition) - Gilbert W. Castilian, Narosa Publishing House, 1985.

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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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ANNEXURE-II

UNIVERSITY OF MYSORE

SYLLABUS (CBCS Scheme)

CHEMISTRY

(III and IV SEMESTERS)

FOR B.Sc. DEGREE PROGRAMME

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 **[45 Hours]**

UNIT-I: Inorganic Chemistry **[15 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. [**04 Hrs**]

UNIT-II: Organic Chemistry **[15 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. [**04 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, Wolf-Kishner and Clemmensen reduction. [**04 Hrs**]

UNIT-III: Physical Chemistry **[15 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. [**05 Hrs**]

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PRACTICALS

Paper: Chemistry Practical-III **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 **[45 Hours]**

UNIT-I: Industrial chemistry **[15 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 uses. **[07 Hrs]**

UNIT-II: Organic chemistry **[15 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. **[07 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 **[15 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, 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). **[04 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 **[45 Hours]**

UNIT-I: Inorganic Chemistry **[15 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). [**03 Hrs**]

UNIT-II: Organic Chemistry [15 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. [**07 Hrs**]

UNIT-III: Physical Chemistry [15 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 $a \neq b$, 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'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). [**06 Hrs**]

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PRACTICALS

Paper: Chemistry Practical-IV **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 **Code: CHSSBC-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 PAPER

Paper: Chemistry Elective-II **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 **[15 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 **[07 Hrs]**

UNIT-II: Organic Chemistry **[15 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. **[07 Hrs]**

Concept of Energy in Biosystems: Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation offoodstuff (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 **[15 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 electroless plating process, Electroless plating of copper. **[07 Hrs]**

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REFERENCE BOOKS

1. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998).
2. Ashtoush Kar: Medicinal Chemistry.
3. H.E. Cox: Analysis of Foods.
4. H.E. Cox and Pearson: Chemical Analysis of Foods.
5. N. Shakuntala Manay and M. S. Swamy: Foods: Facts and Principles. 4th Ed. New Age International (1998).
6. P.l. Atkins and J. de Paula: Physical Chemistry, 7th Ed. 2002, Oxford University Press.
7. Swaminathan and Goswamy: Handbook on Fertilizer Technology 6th Ed. 2001, FAI.
8. J. R. Fired: Polymer Science and Technology, PrenticeHall.
9. Morrison, RT. & Boyd, RN. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.(Pearson).
10. Finar, I.L. Organic Chemistry (Volume 1 and 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson).
11. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed.
12. W. H. Freeman. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, 2002.
13. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
14. Cotton, F.A., Wilkinson, G. &Gaus, P.L. Basic Inorganic Chemistry, 3rd Ed.,Wiley. 3. Douglas, B.E., McDaniel, D.H. & Alexander, J. J. Concepts and Models in InorganicChemistry, John Wiley & Sons.

15. Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O. K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
16. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
17. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
18. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, P. L. Gaus; John Wiley, 6th Ed. (1999).
19. Advanced Inorganic Chemistry, F. A. Cotton, G. Wilkinson, 6th Ed.
20. Inorganic Chemistry, J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley, 4th Ed. (1993).
21. Vogel's Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
22. Advanced Organic Chemistry, Jerry March, John Wiley (2008).
23. Advanced Organic Chemistry, F A Carey and R J Sundberg, Plenum, (1990). 13. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall, (1998).
24. Stereochemistry of Organic Compounds, D Nasipuri, New-Age International, (1999).
25. Stereochemistry of Carbon Compounds, E L Eliel, S H Wilen and L N Mander, John Wiley, (1994).
26. Laboratory Manual of Organic Chemistry, B.B. Dey, M V Sitaraman, T R Govindachari, Allied Publishers, New Delhi, (1996).
27. Practical Organic Chemistry - Mann and Saunders, (1980).
28. Textbook of Practical Organic Chemistry- A. I. Vogel, (1996).
29. Textbook of Quantitative Organic Analysis- A. I. Vogel, (1996).
30. Comprehensive Practical Organic Chemistry, V. K. Ahluwalia, R. Aggarwal, Uni. Press, (2000).
31. Practical Organic Chemistry (Quantitative analysis), B. B. Dey, M. V. Sitaraman, T. R. Govindachari, Allied Publishers, New Delhi, (1992).
32. Physical Chemistry, P. W. Atkins, Julio de Paula, ELBS, 7th Ed., (2002).
33. Physical Chemistry: A Molecular Approach, McQuarie and Simon, Viva, New Delhi, (2001).
34. Physical Chemistry, P. Atkins and J. D. Paula, 9th Ed., Oxford University Press (2010).
35. Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publications Meerut (1988)
36. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987)
37. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
38. Experimental Physical Chemistry by Wilson, Newcombe & others, Pergamon Press, (1962)
39. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983)
40. Surface Chemistry: Theory and Applications, J.J. Bikerman, Academic Press. New York (1972).
41. Physical Chemistry, Laideler K. J. and Meiser J. M. 3rd Ed. McGraw-Hill, (1999).
42. Physical Chemistry, Levine I. N., Physical Chemistry, 4th Ed. McGraw-Hill, (1995).
43. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus; John Wiley, 6th Ed. (1999).
44. Chemistry of elements, N. N. Greenwood & A. E. Earnshaw, Butterworth Heinemann (1997).
45. Inorganic Chemistry, J. E. Huheey, E. A. Keiter & R. L. Keiter, Addison; 4th Ed. Wesley (1993).
46. Textbook of Inorganic Chemistry, G. S. Sodhi, Viva books Pvt. Ltd (2011).
47. Advanced Organic Chemistry, Jerry March, John Wiley (2008).
48. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum (1990).
49. A Guide Book to Mechanism of Organic Chemistry, Peter Sykes, Longman (2000).
50. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall (1998).
51. Modern Organic Reactions, H. O. House, Benjamin (1972).
52. Stereochemistry of Organic Compounds, D. Nasipuri, New-Age International (1999).
53. Stereochemistry of Carbon Compounds, E.L. Eliel, S.H. Wilen & LN. Mander, John Wiley (1994).
54. Practical Organic Chemistry, Mann and Saunders, (1980).
55. Text Book of Practical Organic Chemistry, A. I. Vogel, (1996).

56. Test Book of Quantitative Organic Analysis, A. I. Vogel, (1996).
57. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, Universities Press (India), (2000).
58. Advanced Practical Organic Chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, (1992).
59. Experiments in Physical Chemistry, Shoemaker & Garland, McGraw Hill Int. Edn. (1966).
60. Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publications Meerut (1988).
61. Experimental Physical Chemistry, R. C. Behra and B Behra, Tata McGraw, New Delhi (1983).
62. Experimental Physical Chemistry, V.D. Atavale&ParulMathur, New Age Int. NY. (2001).
63. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013). McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
64. Sykes, P.A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
65. Stereochemistry-Conformation and Mechanism-P. S. Kalsi, Wiley-Eastern Ltd, New Delhi.
66. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
67. Barrow, G.M. Physical Chemistry, Tata McGraw-Hill, 2007.
68. Castellan, G.W. Physical Chemistry, 4th Ed. Narosa, 2004.
69. P.W. Atkins: Physical Chemistry, 2002.
70. W.J. Moore: Physical Chemistry, 1972.
71. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
72. Jeffery, G.H., Bassett, J., Mendham, J.& Denney, R.C.
73. Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.
74. Rodgers, G. E. Inorganic & Solid-State Chemistry, Cengage Learning India Ltd., 2008.
75. Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry.John Wiley& Sons, 1974.
76. G.L. Miessler & Donald A. Tarr: Inorganic Chemistry, Pearson Publication.
77. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
78. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co., New York (1985).
79. Organic Chemistry-F. A. Carey, 4th Edition, McGraw Hill (2000).
80. Modern Organic Chemistry - R.O.C. Norman and D.J. Waddington, ELBS, 1983.
81. Organic Chemistry - L. Ferguson, Von Nostrand, 1985.
82. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.
83. Organic Chemistry- Mehta and Mehta, PHI Learning Pvt. Ltd, New Delhi,2005.
84. Text Book of Physical Chemistry - S. Glasstone, Mackmillan India Ltd., 1982.
85. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma, M. S. Patania, S. Chand &Co. 1987.
86. Physical Chemistry - Alberty R. A. and Silbey, R. J. John Wiley and sons, 1992.
87. Physical Chemistry - G. M. Barrow, McGraw Hill, 1986.
88. Physical Chemistry (3rd Edition) - Gilbert W. Castilian, Narosa Publishing House, 1985.

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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 tes	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

PART B

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 **OR** Determination of second order rate constant of saponification of ester. **OR** Determination of first order rate constant of acid hydrolysis of ester.	05 Values	16
	04 Values	14
	03 Values	12
	02 Values	10
	Any other value	06
	Calculation	03
	Unit	01
	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 experiments including reactions, structure wherever necessary. 10 Marks

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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