



**List of Courses Focus on Employability/ Entrepreneurship/
Skill Development**

Department : Chemistry

Programme Name : B. Sc.

Academic Year : 2019-20

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
01.	CBL-1	Inorganic Chemistry-1 Practical
02.	CBL-2	Physical Chemistry-I Practical
04.	CBT-3	Organic Chemistry-I
05.	CBL-3	Organic Chemistry-I Practical
06.	CBL-4	Physical Chemistry-II Practical
09.	CBL-5	Inorganic Chemistry II: Practical
10.	CBT-6	Organic Chemistry -II
11.	CBL-6	Organic Chemistry-II : Practical
12.	CBL-7	Physical Chemistry -III: Practical
13.	SEC-1	Select one from the Pool of 4 2 (4) SEC Courses offered By Different Departments
14.	CBL.8	Inorganic Chemistry- III: Practical
15.	CBT-9	Organic Chemistry- III
16.	CBL-9	Organic Chemistry- III Practical
17.	CBL-10	Physical Chemistry- IV Practical
19.	CBT-501	Analytical Chemistry
20.	CBT-502	Inorganic Chemistry - III
21.	CBT-503	Organic Chemistry - IV
22.	CBE	Biochemistry
23.	CBT-601	Physical Chemistry-IV
24.	CBT-603	Special Topics In Chemistry
25.	CBE	Polymer Chemistry
26.	CBL-103	Inorganic Chemistry & Physical Chemistry Practical
27.	CBL-203	Compound Identification and Physical Experiments
28.	CBL-303	Quantitative Analysis (Compound Identification and Volumetric Analysis)
29.	CBL-403	Organic Chemistry and Physical Chemistry Practical

गुरु घासीदास विश्वविद्यालय
(केन्द्रीय विश्वविद्यालय अधिनियम 2009 क्र. 25 के अंतर्गत स्थापित केन्द्रीय विश्वविद्यालय)
कोनी, बिलासपुर - 495009 (छ.ग.)



Guru Ghasidas Vishwavidyalaya
(A Central University Established by the Central Universities Act 2009 No. 25 of 2009)
Koni, Bilaspur - 495009 (C.G.)

30.	CBL-504	Laboratory I: Analytical Chemistry Practical
31.	CBL-505	Laboratory I: Inorganic Chemistry Practical
32.	CBL-506	Laboratory I: Organic Chemistry Practical
33.	CBL-604	Laboratory I: Inorganic Chemistry Practical
34.	CBL-605	Laboratory I: Organic Chemistry Practical
35.	CBL-606	Laboratory I: Physical Chemistry Practical

अध्यक्ष/Head
रसायन शास्त्र विभाग
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बिलासपुर 495009 (छ.ग.)
Bilaspur 495009 (C.G.)



Scheme and Syllabus

B.Sc. Hon's Programme: Department of Chemistry

Semester	Course Opted	Course Code	Name of the course	Credit	Hour / week
I	Core-1	CBT-1	Inorganic Chemistry I:	4	4
	Core -1 Practical	CBL-1	Inorganic Chemistry-I Practical	2	4
	Core -2	CBT-2	Physical Chemistry I:	4	4
	Core -2 Practical	CBL-2	Physical Chemistry-I Practical	2	4
	Generic Elective -1		1A Physics-I 1B Mathematics-I 1C Zoology-I 1D Botany-I	4	4
	Generic Elective - Practical		Generic Elective – Practical-I	2	4
	Ability Enhancement Compulsory Course (AECC)		English Communication / MIL	4	4
	ECA		ECA-Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	2	(2)
		TOTAL	24	28	
II	Core-3	CBT-3	Organic Chemistry-I	4	4
	Core -3 Practical	CBL-3	Organic Chemistry-I Practical	2	4
	Core -4	CBT-4	Physical Chemistry-II	4	4
	Core -4 Practical	CBL-4	Physical Chemistry-II Practical	2	4
	Generic Elective -2		2A Physics-II 2B Mathematics-II 2C Zoology-II 2D Botany-II	4	4
	Generic Elective - Practical		Generic Elective – Practical-II	2	4
	Ability Enhancement Compulsory Course (AECC)		Environmental Science	4	4
	ECA		ECA-Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	2	(2)
		Total	24	28	

Dr. B. K. Singh
22/06/18

Chauhan Akash
23.06.18
S. M. S.
21.06.18
Dr. M. S.
23.06.18
Dr. S. S.
23.06.18



SUMMER Internship: 15 days		Swayam Swachhta / NSS / Industrial/ others		2	100
III	Core-5	CBT-5	Inorganic Chemistry II	4	4
	Core -5 Practical	CBL-5	Inorganic Chemistry II: Practical	2	4
	Core -6	CBT-6	Organic Chemistry-II	4	4
	Core -6 Practical	CBL-6	Organic Chemistry-II : Practical	2	4
	Core - 7	CBT-7	Physical Chemistry-III	4	4
	Core - 7 Practical	CBL-7	Physical Chemistry-III: Practical	2	4
	Generic Elective -3		3A 3B 3C 3D	4	4
	Generic Elective - Practical			2	4
	Skill Enhancement Course (SEC - 1)		Select one from the Pool of SEC courses offered by different departments	4	2(4)
			Total	28	34
IV	Core-8	CBT-8	Inorganic Chemistry III:	4	4
	Core -8 Practical	CBL-8	Inorganic Chemistry III: Practical	2	4
	Core -9	CBT-9	Organic Chemistry III	4	4
	Core -9 Practical	CBL-9	Organic Chemistry III: Practical	2	4
	Core - 10	CBT-10	Physical Chemistry-IV	4	4
	Core -10 Practical	CBL-10	Physical Chemistry-IV: Practical	2	4
	Generic Elective - 4		4A 4B 4C 4D	4	4
	Generic Elective - Practical			4	4
	Skill Enhancement Course (SEC -2)		Select one from the Pool of SEC courses offered by different departments	4*	2(4)
			TOTAL	28	34
SUMMER Internship: 15 days		Swayam Swachhta / NSS / Industrial/ others		2	100
V	Core-11	CBT-11	Organic Chemistry IV	4	4
	Core-11 Practical	CBL-11	Organic Chemistry IV: Practical	2	4

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CHEMISTRY-DSE I-IV (ELECTIVES)

CHEMISTRY-DSE-I:	ANALYTICAL METHODS IN CHEMISTRY
CHEMISTRY-DSE-II:	BIOCHEMISTRY
CHEMISTRY-DSE-III:	NOVEL INORGANIC SOLIDS
CHEMISTRY-DSE-IV:	POLYMER CHEMISTRY
CHEMISTRY-DSE-V:	APPLICATIONS OF COMPUTERS IN CHEMISTRY
CHEMISTRY-DSE-VI:	RESEARCH METHODOLOGY FOR CHEMISTRY
CHEMISTRY-DSE-VII:	GREEN CHEMISTRY

SKILL ENHANCEMENT COURSE (ANY TWO) (CREDIT: 02 EACH)

SEC-1:	BASIC ANALYTICAL CHEMISTRY
SEC-2:	INTELLECTUAL PROPERTY RIGHTS (IPR)
SEC-3:	GREEN METHODS IN CHEMISTRY
SEC-4:	PHARMACEUTICAL CHEMISTRY
SEC-5:	CHEMISTRY OF COSMETICS & PERFUMES
SEC-6:	PESTICIDE CHEMISTRY

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Chauhan Akash



CHEMISTRY LAB-C1: INORGANIC CHEMISTRY-I PRACTICAL
(PSCHCR0101P)
60 LECTURES

(A) Titrimetric Analysis

- (i) Calibration and use of apparatus
- (ii) Preparation of solutions of different Molarity/Normality of titrants

(B) Acid-Base Titrations

- (i) Estimation of carbonate and hydroxide present together in mixture.
- (ii) Estimation of carbonate and bicarbonate present together in a mixture.
- (iii) Estimation of free alkali present in different soaps/detergents

(C) Oxidation-Reduction Titrimetry

- (i) Estimation of Fe(II) and oxalic acid using standardized KMnO_4 solution.
- (ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
- (iii) Estimation of Fe(II) with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Course Outcome:

After this course students will be able estimate amount of different type acids, bases, and metal ions in unknown sample.

Reference text:

- 1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.

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CHEMISTRY LAB-C II: PHYSICAL CHEMISTRY-I PRACTICAL
(PSCHCR0102P)
60 LECTURES

- 1. Surface tension measurements.**
 - Determine the surface tension by (i) drop number (ii) drop weight method.
 - Study the variation of surface tension of detergent solutions with concentration.
- 2. Viscosity measurement using Ostwald's viscometer.**
 - Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.
 - Study the variation of viscosity of sucrose solution with the concentration of solute.
- 3. Indexing of a given powder diffraction pattern of a cubic crystalline system.**
- 4. pH metry**
 - Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
 - Preparation of buffer solutions of different pH
 - Sodium acetate-acetic acid
 - Ammonium chloride-ammonium hydroxide
 - pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
 - Determination of dissociation constant of a weak acid.

Any other experiment carried out in the class.

Course Outcome:

After this course students will be able measure Surface tension, Viscosity & pH in unknown sample.

Reference Books

- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.*; W.H. Freeman & Co.: New York (2003).

Dr. H.H. S

BSS

Cham Akash

S. G. S.

Dr. S.



Semester II

CHEMISTRY-C III: ORGANIC CHEMISTRY I (PSCHCR0203L)
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Structure and Bonding: Classification, nomenclature and general structure of organic compounds. Hybridization, orbital representation of methane, ethane, ethylene, acetylene and benzene. Bond energy, bond length and bond angles. Polarity of covalent bonds—Inductive, resonance, hyper-conjugation and steric inhibition in resonance and its influence on acidity and basicity of organic compounds.

Mechanism of Organic reactions: Curved arrow notation, drawing electron movements with arrows, half-headed and double headed arrows. Homolysis and heterolysis of carbon-carbon bonds; Reactive species e.g. Carbocations, carbanions, free radicals and their stability. Nucleophiles and electrophiles.

Alkanes and cycloalkanes: Preparation and general reactions of alkanes and cycloalkanes, Bayer Strain theory of strainless ring; Conformation of ethane, *n*-butane and cyclohexane, chlorination of methane and side chain chlorination of toluene.

Alkenes: General methods for preparation of alkenes, Reactions of alkenes: Addition reactions (Electrophilic and free radical), Halogenation, Hydrohalogenation, Hydration, Hydroxylation, Hydroboration-oxidation, Mercuration-demercuration, Epoxidation and Ozonolysis.

Dienes: Conjugated and isolated Dienes; 1,2- versus 1,4-addition. Diels-Alder reaction of dienes: Mechanism

Alkynes: Preparation of alkynes, acidity and metal acetylides, Electrophilic addition reactions viz., Halogenation, Hydrohalogenation, Hydration, Hydroboration-oxidation, Mercuration-demercuration and Ozonolysis.

Course Outcome

On completion of this course, the students will be able to understand:

- Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms.
- Stereochemistry of organic molecules – conformation and configuration, asymmetric molecules and nomenclature.
- Aromatic compounds and aromaticity, mechanism of aromatic reactions.

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Cham Akash / S. P. S. S. / Dey



- Understanding hybridization and geometry of atoms, 3-D structure of organic molecules, identifying chiral centers.
- Electrophile, nucleophiles, free radicals, electronegativity, resonance, and intermediates along the reaction pathways.
- Mechanism of organic reactions (effect of nucleophile/leaving group, solvent), substitution vs. elimination.

Books Recommended:

1. "Organic Chemistry", R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P)Ltd., New Delhi.
2. "Organic Chemistry", S. M. Mukherjee, S. P. Singh, and R. P. Kapoor, 1st Edition (1985), New Age International (P) Ltd. Publishers, New Delhi.
3. "Organic Chemistry", I. L. Finar, [Vol. I, 6th Edition (1973), Reprinted in 1980 & Vol. II, 5th Edition (1975), Reprinted in 1996], ELBS and Longman Ltd., New Delhi.
4. "Organic Chemistry – Structure and Reactivity", Seyhan N. Ege, 3rd Edition (1998), AITBS Publishers and Distributors, Delhi.
5. "Organic Chemistry", Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998).
6. "Organic Chemistry", G. Solomon, Wiley India, Paper Back, 9th Edition.
7. "Modern Organic Chemistry", M. K. Jain and S. C. Sharma, Vishal Publishing CO. Jalandhar, India, 4th Edition (2012).

**PRACTICAL CORE COURSE – III ORGANIC CHEMISTRY –I LAB
(PSCHCR0203P)**

60 Lectures

1. Checking the calibration of the thermometer
2. Purification of organic compounds by crystallization using the following solvents:
a. Water b. Alcohol, c. Alcohol-Water
3. Determination of the melting points of unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.
5. Detection of special elements (N, S, Cl, Br, I).

Course Outcome:

After this course students will be able to purify organic compounds, basic characterizations & detection of special elements (N, S, Cl, Br, I).

Reference Books

- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)

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- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry*, 5th Ed., Pearson (2012)

CHEMISTRY LAB- C IV PHYSICAL CHEMISTRY-II LAB (PSCHCR0204P)

60 Lectures

Thermochemistry

- Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).
- Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
- Calculation of the enthalpy of ionization of ethanoic acid.
- Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
- Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
- Determination of enthalpy of hydration of copper sulphate.
- Study of the solubility of benzoic acid in water and determination of ΔH .

Any other experiment carried out in the class.

Course Outcome:

After this course students will be able to determine heat capacity, enthalpy & heat of solubility of different reactions.

Reference Books

- Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

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- Athawale, V. D. & Mathur, P. *Experimental Physical Chemistry* New Age International: New Delhi (2001).

CHEMISTRY LAB-C V INORGANIC CHEMISTRY LAB (PSCHCR0305P)

60 Lectures

(A) Iodo / Iodimetric Titrations

- Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically).
- Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically
- Estimation of available chlorine in bleaching powder iodometrically.

(B) Inorganic preparations

- Cuprous Chloride, Cu_2Cl_2
- Preparation of Manganese(III) phosphate, $MnPO_4 \cdot H_2O$
- Preparation of Aluminium potassium sulphate $KAl(SO_4)_2 \cdot 12H_2O$ (Potash alum) or Chrome alum.

Course Outcome:

After this course students will be able estimate amount of different type pollutants and metal ions in unknown sample. Also learn to synthesize inorganic compounds.

Reference Books:

- Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS. 1978

CHEMISTRY-C VI: ORGANIC CHEMISTRY-II (PSCHCR0306L)

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Alkyl halides: Preparation and general reactions of alkyl halides; Grignard reagents: preparation and synthetic applications; Reformatsky reaction; Wurtz reactions.

Substitution and Elimination Reactions: Nucleophilic substitution – SN1 and SN2 mechanisms; Elimination reaction: E1 and E2 mechanisms, Elimination Vs Substitution reactions; energy profile diagrams – transition states, intermediates (general considerations).

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Alcohols and ethers: General properties of alcohols. Synthesis of alcohols from alkenes *via* hydroboration-oxidation, oxymercuration-demercuration. Reactions of alcohols: Dehydration, oxidation and distinction of primary, secondary and tertiary alcohols. Acetal and ketal formation, Pinacole-pinacolone rearrangement. Preparation and general reactions of ethers; nucleophilic ring-opening of epoxides.

Aldehydes and Ketones: Preparation of carbonyl compounds. Oxidation and reduction reaction, Condensation reactions, Nucleophilic addition reactions: aldol condensation, Perkin reaction, Wittig Reaction, Cannizzaro reaction, benzoin condensation, Haloform reaction, Keto-enol tautomerism.

Carboxylic acids & its Derivatives: General method for the preparation of carboxylic acids, amides, esters, anhydrides, acid halides, and acid azides; Relative reactivity of carboxylic acids and their chemical reactions.

Stereochemistry: Optical activity and plane-polarized light. Plane and centre of Symmetry, Chirality, enantiomers, diastereoisomers, mesomers, atropisomers and racemic mixtures. Fischer, Newman and Sawhorse Projection Formula. E/Z, D/L and R/S nomenclature. Walden inversion.

Course Outcome:

After completion of the course, the learner shall be able to understand:

- Familiarization about classes of organic compounds and their methods of preparation.
- Basic uses of reaction mechanisms.
- Name reactions, uses of various reagents and the mechanism of their reaction.
- Preparation and uses of various classes of organic compounds.
- Organometallic compounds and their uses.
- Organic chemistry reactions and reaction mechanisms.
- Use of reagents in various organic transformation reactions.

Books Recommended

1. "Organic Chemistry", R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
2. "Organic Chemistry", S. M. Mukherjee, S. P. Singh, and R. P. Kapoor, 1st Edition (1985), New Age International (P) Ltd. Publishers, New Delhi.

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3. "Organic Chemistry – Structure and Reactivity", Seyhan N. Ege, 3rd Edition (1998), ITBS Publishers and Distributors, Delhi.
4. "Organic Chemistry", I. L. Finar, [Vol. I, 6th Edition (1973), Reprinted in 1980 & Vol. II, 5th Edition (1975), Reprinted in 1996], ELBS and Longman Ltd., New Delhi.
5. "A Guide Book to Mechanism in Organic Chemistry", P. Sykes, 6th Edition (1997), Orient Longman Ltd., New Delhi.
6. "Organic Chemistry", J. Clayden, N. Greeves, S. Warren, and E. Wothers, Oxford Univ. Press, Oxford (2001).
7. "Stereochemistry of Organic Compounds", D. Nasipuri, New Age International.
8. "Stereochemistry of Organic Compounds", P.S. Kalsi, New Age International.
9. "Organic Chemistry", G. Solomon, Wiley India, Paper Back, 9th Edition.
10. "Modern Organic Chemistry", M. K. Jain and S. C. Sharma, Vishal Publishing CO. Jalandhar, India, 4th Edition (2012).

CHEMISTRY LAB- C VI ORGANIC CHEMISTRY – II LAB (PSCHCR0306P)

60 Lectures

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2. Preparation of Derivatives of functional groups:

Course Outcome:

After this course students will be able to identify different functional groups of organic compounds & synthesize their derivatives.

Reference Books

- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry*, 5th Ed., Pearson (2012)

CHEMISTRY PRACTICAL-C VII PHYSICAL CHEMISTRY-III LAB (PSCHCR0307P)

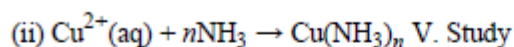
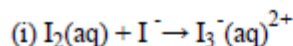
60 Lectures

- I. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.
- II. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method:
 - a. simple eutectic and
 - b. congruently melting systems.
- III. Distribution of acetic/ benzoic acid between water and cyclohexane.

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IV. Study the equilibrium of at least one of the following reactions by the distribution method:



the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
 - a. Acid hydrolysis of methyl acetate with hydrochloric acid.
 - b. Saponification of ethyl acetate.
3. Compare the strengths of HCl and H₂SO₄ by studying kinetics of hydrolysis of methyl acetate.

VI. Adsorption

- I. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

Course Outcome:

After this course students will be able to determine phase diagram, critical solution temperature & kinetics of reactions.

Reference Books:

- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.*; W.H. Freeman & Co.: New York (2003).

CHEMISTRY-C VIII: INORGANIC CHEMISTRY-III LAB (PSCHCR0408P)

60 Lectures

Gravimetric Analysis:

- i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
- ii. Estimation of copper as CuSCN
- iii. Estimation of iron as Fe₂O₃ by precipitating iron as Fe(OH)₃.
- iv. Estimation of Al (III) by precipitating with oxine and weighing as Al(oxine)₃ (aluminium oxinate).

Inorganic Preparations:

- i. Tetraamminecopper (II) sulphate, [Cu(NH₃)₄]SO₄.H₂O
- ii. *Cis* and *trans* K[Cr(C₂O₄)₂.(H₂O)₂] Potassium dioxalatochromate (III)

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- iii. Tetraamminecarbonatocobalt (III) ion
- iv. Potassium tris(oxalate)ferrate(III)

Chromatography of metal ions

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

- i. Ni (II) and Co (II)
- ii. Fe (III) and Al (III)

Course Outcome:

After this course students will be able to estimate different types of metal ions by gravimetric methods & synthesize inorganic complexes.

Reference Book:

- 1. Vogel, A.I. A text book of Quantitative Analysis, ELBS 1986.

CHEMISTRY-C IX: ORGANIC CHEMISTRY-III (PSCHCR0409L) (Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Aromatic Compounds: Introduction, nomenclature of benzene derivatives, the Kekule structure of benzene, Valance bond & molecular orbital theories of the structure of benzene, Huckel's rule: $(4n+2) \pi$ electron rule, Anti-aromatic compounds, non-aromatic, homoaromatic.

Electrophilic Substitution Reactions of Aromatic Compounds: Electrophilic substitution reactions (S_EAr), A general mechanism for electrophilic aromatic substitution – Arenium ions, Halogenation, Nitration and sulphonation of benzene, Friedel–Crafts alkylation and its limitations, Friedel–Crafts acylation; Effect of substituent's on reactivity and orientation.

Nucleophilic Substitution Reactions of Aromatic Compounds: Halobenzenes, and nucleophilic aromatic substitutions (S_NAr), bimolecular mechanism (A_ND_N), benzyne mechanism (D_NA_N). Preparation and uses of DDT and BHC.

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Phenols: General methods of preparation and reactions of phenol. Relative acidity of phenol, alcohol and carboxylic acid. Reimer-Tiemann and Kolbe reactions; Claisen and Fries rearrangements.

Nitrogen Containing Compounds: Nitrobenzene and reduction products. Amines and amides. Comparative basicity of aliphatic and aromatic amines, Diazonium salts: preparation (Diazo reaction) and synthetic applications (Sandmeyer reactions).

Polynuclear Aromatic Hydrocarbons: Synthesis and reactions of naphthalene, anthracene, phenanthrene.

Course Outcome:

After completion of the course, the learner shall be able to understand:

- Nitrogen containing functional groups and their reactions.
- Familiarization with polynuclear hydrocarbons and their reactions.
- Heterocyclic compounds and their reactions.
- Alkaloids and Terpenes
- Understanding reactions and reaction mechanism of nitrogen containing functional groups.
- Understanding the reactions and mechanisms of diazonium compounds.
- Understanding the structure and their mechanism of reactions of selected polynuclear hydrocarbons.
- Understanding the structure, mechanism of reactions of selected heterocyclic compounds.
- Classification, structure, mechanism of reactions of few selected alkaloids and terpenes.

Books Recommended:

1. "Organic Chemistry", R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
2. "Organic Chemistry", S. M. Mukherji, S. P. Singh, and R. P. Kapoor, 1st Edition (1985), 5th Reprint (1999), New Age International (P) Ltd. Publishers, New Delhi.
3. "Organic Chemistry – Structure and Reactivity", Seyhan N. Ege, AITBS publishers, Delhi (1998).
4. "Organic Chemistry", Paula Y. Bruice, 2nd Edition, Prentice-Hall International Inc, New Jersey, International Edition (1998).
5. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, and E. Wothers, Oxford Univ. Press, Oxford (2001).

Handwritten signatures and names:
A. K. Singh, A. S. S., Cham Akash, S. P. Singh, Singh



6. "Organic Chemistry", G. Solomon, Willey India, Paper Back, 9th Edition.

**CHEMISTRY PRACTICAL-C IX ORGANIC CHEMISTRY-III LAB
(PSCHCR0409P)**

60 Lectures

Organic preparations:

1. Acetylation of one of the following compounds: amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and phenols (β -naphthol, vanillin, salicylic acid) by any one method:
2. Benzoylation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and one of the following phenols (β -naphthol, resorcinol, p- cresol)
3. Hydrolysis of amides and esters.
4. Aldol condensation reactions.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization and melting point.

Course Outcome:

After this course students will be able to synthesize different types of organic compounds & their reactions.

Reference Books:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry 5th Ed., Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

**CHEMISTRY PRACTICAL-C X PHYSICAL CHEMISTRY-IV LAB
(PSCHCR0410P)**

60 Lectures

Conductometry

- I. Determination of cell constant
- II. Determination of equivalent conductance, degree of dissociation and dissociation

12

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A. K. Singh, A. S. S., Cham Arora, S. S. S., D. S. S.



Constant of a weak acid.

- III. Perform the following conductometric titrations:
- Strong acid vs. strong base
 - Weak acid vs. strong base
 - Mixture of strong acid and weak acid vs. strong base
 - Strong acid vs. weak base

Potentiometry

- I Perform the following potentiometric titrations:
- Strong acid vs. strong base
 - Weak acid vs. strong base
 - Dibasic acid vs. strong base
 - Potassium dichromate vs. Mohr's salt

Course Outcome:

After this course students will be able to estimate concentration of acids, bases & salts by conductometric and potentiometric titration methods.

Reference Books:

- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.*; W.H. Freeman & Co.: New York (2003).

**CHEMISTRY PRACTICAL-C XI ORGANIC CHEMISTRY IV LAB
(PSCHCR0511P)**

60 Lectures

- Functional group test for nitro, amine and amide groups.
- Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols, carbonyl compounds and esters)

Course Outcome:

After this course students will be able to identify functional groups such as nitro, amine and amide, alcohols, carboxylic acids, phenols, carbonyl compounds and esters etc.

Reference Books:

- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry 5th Ed.*, Pearson (2012)
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, University Press (2000).

Handwritten signatures and names:
A.K. Hill, D.S.S., Cham Arora, S. G. S., D. S. S.



After this course students will be able to learn safer starting materials, using renewable resources, use of enzymes & alternate sources of energy.

Reference Books:

1. Anastas, P.T and Warner, J.C. *Green Chemistry: Theory and Practice*, Oxford University Press, 1998
2. Kirchoff, M. and Ryan, M.A. *Greener approaches to undergraduate chemistry experiment*. American Chemical Society, Washington DC, 2002
3. Ryan, M.A. *Introduction to Green Chemistry*, Tinnesand; (Ed), American Chemical Society, Washington DC, 2002
4. Sharma, R.K.; Sidhwani, I.T. and Chaudhari, M.K. *Green Chemistry Experiments: A monograph*, I.K. International Publishing House Pvt Ltd. New Delhi, Bangalore ISBN 978-93-81141-55-7, 2013
5. Cann, M.C. and Connelly, M. E. *Real world cases in Green Chemistry*, American Chemical Society, 2008
6. Cann, M. C. and Thomas, P. *Real world cases in Green Chemistry*, American Chemical Society, 2008
7. Lancaster, Mike *Green Chemistry: An introductory text. 2nd Ed.* RSC publishing, ISBN 978-1-84755-873-2
8. Pavia, D.L., Kriz, G.S., Lampman, G.M. and Engels, R.G. *Introduction to Organic Laboratory Techniques – a Microscale Approach* 4th Ed., Brooks-Cole Laboratory Series for Organic Chemistry, 2006

SKILL ENHANCEMENT COURSE

SEC-1: BASIC ANALYTICAL CHEMISTRY

(Theory 02 Credits; Practicals 02 Credits)

Total 30 Lectures

25

Dr. H. H. S. *Dr. S. S.*
Cham Akash *S. S. S.* *Dr. S.*



- Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
- Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
- Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink.

Course Outcome:

After this course students will be able to understand analysis of soil, water, cosmetics & food products, chromatographic techniques.

Reference Books:

- Willard, H. H. *Instrumental Methods of Analysis*, CBS Publishers.
- Skoog & Lerry. *Instrumental Methods of Analysis*, Saunders College Publications, New York.
- Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry 6th Ed.*, Saunders College Publishing, Fort Worth (1992).
- Harris, D. C. *Quantitative Chemical Analysis*, W. H. Freeman.
- Dean, J. A. *Analytical Chemistry Notebook*, McGraw Hill.
- Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India.
- Freifelder, D. *Physical Biochemistry 2nd Ed.*, W.H. Freeman and Co., N.Y. USA (1982).
- Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA. 16 (1977).
- Vogel, A. I. *Vogel's Qualitative Inorganic Analysis 7th Ed.*, Prentice Hall.
- Vogel, A. I. *Vogel's Quantitative Chemical Analysis 6th Ed.*, Prentice Hall.
- Robinson, J.W. *Undergraduate Instrumental Analysis 5th Ed.*, Marcel Dekker, Inc., New York (1995).

SEC-3: GREEN METHODS IN CHEMISTRY

(Theory 02 Credits; Practicals 02 Credits)
Total 30 Lectures

Tools of Green chemistry, Twelve principles of Green Chemistry, with examples.

The following Real world Cases in Green Chemistry should be discussed:

- A green synthesis of ibuprofen which creates less waste and fewer byproducts (Atom economy).
- Surfactants for Carbon Dioxide – replacing smog producing and ozone depleting solvents with CO₂ for precision cleaning and dry cleaning of garments.

Dr. H. H. S. *BSS*
Cham Akash *S. S. S.* *Dr. S.*



UNIT - 3

Aryl Halogen Compounds: Chlorobenzene, electrophilic and nucleophilic aromatic substitutions (S_NAr) □ bimolecular mechanism (A_ND_N), benzyne mechanism (D_NA_N). Side chain chlorination of toluene. Structure and application of DDT and BHC.

UNIT - 4

Phenols: General methods of preparation and reactions of phenol. Relative acidity of phenol, alcohol and carboxylic acid. Reimer-Tiemann and Kolbe reactions.

UNIT - 5

Nitrogen Containing Compounds: Nitrobenzene and reduction products. Amines and amides. Comparative basicity of aliphatic and aromatic amines, Diazonium salts: preparation (Diazo reaction) and synthetic applications (Sandmeyer reactions)

Books Recommended:

1. "Organic Chemistry", R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
2. "Organic Chemistry", S. M. Mukherji, S. P. Singh, and R. P. Kapoor, 1st Edition (1985), 5th Reprint (1999), New Age International (P) Ltd. Publishers, New Delhi.
3. "Organic Chemistry – Structure and Reactivity", Seyhan N. Ege, AITBS publishers, Delhi (1998).
4. "Organic Chemistry", Paula Y. Bruice, 2nd Edition, Prentice-Hall International Inc, New Jersey, International Edition (1998).
5. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, and E. Wothers, Oxford Univ. Press, Oxford (2001).
6. "Organic Chemistry", G. Solomon, Wiley India, Paper Back, 9th Edition.
- 7.

Semester- V

CBT 501 ANALYTICAL CHEMISTRY

UNIT- 1

Statistical Evaluation: Determinate and Indeterminate errors. Accuracy and Precision, relative and standard deviation. Methods for minimizing errors. Significant figures.

UNIT-2

Instrumental Methods of Chemical Analysis: Principle, instrumentation and applications of nuclear magnetic resonance, infra-red spectroscopy and electron spin resonance.

UNIT-3

Solvent Extraction: Distribution law, Craig concept of counter-current distribution, important solvent extraction systems.



UNIT-4

Chromatography: Classification of chromatographic methods, general principle and application of adsorption, partition, ion-exchange, thin layer and paper chromatography.

UNIT-5

Spectrophotometry: Lambert-Beer's law and its limitations, nomenclature and units. spectrophotometric determination of one component (iron, chromium, manganese, nickel, titanium and phosphorus), spectrophotometric determinations of dissociation constants of an indicator, photometric errors.

Books Recommended

1. "Analytical Chemistry", G. D. Christian, 4th Edition (1986), John Wiley & Sons, New York.
2. "Modern Methods of Chemical Analysis", R. L. Pecsok, L. D. Shields, T. Cairns, and I. C. McWilliam, 2nd Edition (1976), John Wiley
3. "Principles of Instrumental Analysis", D.A. Skoog, 5th Edition (1998), Saunders College Publishing, Philadelphia, London, New York.
4. "Basic Concepts of Analytical Chemistry", S. M. Khopkar, 2nd Edition (1998), New Age International Publications, New Delhi.
5. "Environmental Chemistry", A. K. De, 3rd Edition (1994), Wiley Eastern, New Delhi.
6. "Instrumental Methods of Analysis", H. H. Willard, L. L. Merritt, and J. A. Dean, 6th Edition (1986), CBS Publishers & Distributors, Shahdara, Delhi.

CBT 502 INORGANIC CHEMISTRY-III

Unit-1

Magnetic Properties of Transition Metal Complexes: Types of magnetic behaviour, methods of determining magnetic susceptibility, L-S and J-J coupling, orbital contribution to magnetic moments. Correlation of magnetic moment data and stereochemistry of Co(II) and Ni(II) complexes; anomalous magnetic moments.

Unit-2

Theories of Metal- Ligand bonding: Limitations of valence bond theory; Crystal-field theory and crystal-field splitting in octahedral, tetrahedral and square planar complexes. Jahn-Teller Distortion. Factors affecting the crystal-field parameters.



Unit-3

Thermodynamic and Kinetic aspects of Metal Complexes: A brief outline of thermodynamic and kinetic stabilities of metal complexes and factors affecting the stability. Substitution reactions of square-planar complexes – Trans effect.

Unit-4

Electronic Spectra of Transition Metal Complexes: Types of electronic transitions, selection rule for d-d transitions, spectroscopic ground states. Explanation of electronic spectra on the basis of Orgel energy level diagrams for d^1 , d^4 , d^6 and d^9 states.

Unit-5

Chemistry of f-block Elements: Comparative study of actinide elements with respect to electronic configuration, atomic and ionic radii, oxidation states and complex formation; occurrence and principles of separation. General features and chemistry of actinides, principles of separation of Np, Pu and Am from U. Trans-Uranium elements.

Books References:

1. "Inorganic Chemistry", J.E. Huheey, E.A. Keiter and R.L. Keiter, O.K. Medhi, Fourth Edition, Pearson.
2. "Basic Inorganic Chemistry", F. A Cotton, G. Wilkinson, and Paul L. Gaus, 3rd Edition (1995), John Wiley & Sons, New York.
3. "Concise Inorganic Chemistry", J. D. Lee, 5th Edition (1996), Chapman & Hall, London.
4. "Inorganic Chemistry", A. G. Sharpe, 3rd International Student Edition (1999), ELBS / Longman, U.K.
5. "Inorganic Chemistry", D. F. Shriver and P. W. Atkins, 3rd Edition (1999), ELBS, London.
6. "Inorganic Chemistry" Keith F. Purcell and John C. Kotz W. B. Saunders Com. (1987), Hong Kong.
6. "Principles of Inorganic Chemistry" Puri Sharma and Kalia Vishal Publishing House.
7. "Electronic Spectra of Transition Metal Complexes", R K Ray, New Central Book Agency (P) Ltd.
8. "General and Inorganic Chemistry" (Part-I); R P Sarkar; New Central Book Agency (P) Ltd.
9. "General and Inorganic Chemistry" (Part-II); R P Sarkar; New Central Book Agency (P) Ltd.
10. "Selected Topic in Inorganic Chemistry" W. U. Malik, G. D. Tuli, R. D. Madan (1994) S. Chand and Company Ltd.
11. "Fundamental Principles of Inorganic Chemistry" D. Banerjee Sultan Chand & Sons 3rd Edition (1993).



SEMESTER V

CBT-503: ORGANIC CHEMISTRY-IV

UNIT - 1

Methods of Determining Reaction Mechanism: Mechanism of bonds breaking and formation. Inter and intra-molecular migration of groups, crossover experiments, exchange with solvents, importance reactive intermediates. Isotopic substitution in a molecule: primary and secondary kinetic isotope effects - their importance in mechanistic studies.

UNIT - 2

Molecular Rearrangements Involving Electron Deficient Atoms: Pinacol-pinacolone, Beckmann, Hofmann, Lossen, Curtius and Wolff rearrangements, Baeyer-Villiger oxidation.

UNIT - 3

Reagents and reactions in Organic Synthesis: Reducing agents: lithium aluminium hydride, sodium borohydride, Birch reduction. Oxidizing agents: Osmium tetroxide, Woodward & Prevost oxidation and m-Chloroperbenzoic acid. Hydroboration.

UNIT - 4

Photochemistry: Principles of photochemistry, photochemical reactions of carbonyl compounds and olefins.

UNIT - 5

Heterocyclic Compounds: Synthesis and chemistry of furan, pyrrole, indole and quinoline.

Books Recommended

1. "Organic Chemistry", I. L. Finar, [Vol. I, 6th Edition (1973), Reprinted in 1980 & Vol. II, 5th Edition (1975), Reprinted in 1996], ELBS and Longman Ltd., New Delhi.
2. "A Guide Book to Mechanism in Organic Chemistry", P. Sykes, 6th Edition (1997), Orient Longman Ltd., New Delhi.
3. "Organic Chemistry", R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
4. "Organic Chemistry", S. M. Mukherji, S. P. Singh, and R. P. Kapoor, 1st Edition (1985), 5th Reprint (1999), New Age International (P) Ltd. Publishers, New Delhi.
5. "Organic Chemistry", J. Clayden, N. Greeves, S. Warren, and E. Wothers, Oxford Univ. Press, Oxford (2001).
6. "Organic Chemistry", G. Solomon, Wiley India, Paper Back, 9th Edition.
7. "Modern Organic Chemistry", M. K. Jain and S. C. Sharma, Vishal Publishing CO. Jalandhar, India, 4th Edition (2012).



Semester – V

CBE- BIOCHEMISTRY

UNIT – 1

Amino acids: Amino acids – Preparative methods, physical properties, dipolar nature, chemical reactions and configuration. Concept of unnatural amino acids. Importance of amino acids.

UNIT – 2

Peptides and Proteins: Peptides: Peptide-linkage, peptide synthesis and structure of polypeptides. Proteins: General characteristics and primary, secondary and tertiary structure. Common deficiency diseases.

UNIT – 3

Metalloproteins: Enzymes: Classification, nomenclature, co-enzymes (representative examples from different classes). Enzyme kinetics and enzyme inhibition. Hemoglobin: Oxygen and carbon dioxide transport by hemoglobin.

UNIT – 4

Vitamins and Hormones: Chemical constitution and physiological functions of vitamins A, B2 (Riboflavin), C (Ascorbic acid); Thyroxin and estrone.

UNIT – 5

Drugs: Classification, preparation and Mechanism of action of the following:

- (i) Antipyretics and Analgesics : Aspirin, Paracetamol,
- (ii) Sulpha drugs: Sulphanilamide, Sulphaguanidine
- (iii) Antimalarials: Chloroquine
- (iv) Antibiotics: Chloramphenicol.

Books Recommended

1. "Organic Chemistry", R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
2. "Organic Chemistry", S. M. Mukherji, S. P. Singh, and R. P. Kapoor, 1st Edition (1985), 5th Reprint (1999), New Age International (P) Ltd. Publishers, New Delhi.
3. "Organic Chemistry", I. L. Finar, Vol. II, 5th Edition (1975), Reprinted in 1996, ELBS and Longman Ltd., New Delhi.
4. "Biochemistry" L. Stryer, 5th edition (2002) Freeman & Co New York.
5. "Principles of Biochemistry" D. L. Nelson M.M. Cox, Lehninger, 3rd edition (2002) McMillan North Publication.



Semester-VI

CBT-601: PHYSICAL CHEMISTRY-IV

Unit-1

Quantum Mechanics: A review of black body radiation, the wave nature of electron, uncertainty principle, Schrödinger's wave equation. Eigen functions and Eigen values and quantum mechanical operators. Expectation value of a physical quantity. Orthogonalization and normalization of wave functions. The particle in a one dimensional box problem and its solutions. Particle in a three dimensional box.

Unit-2

Molecular Spectroscopy: Pure rotational spectra, selection rules, Diatomic molecules-Rigid rotor model. Vibrational-rotational spectra of diatomic molecules. Harmonic oscillator-rigid rotor approximation. Anharmonicity effect. Normal modes of vibration. Infrared spectra of linear molecules. Electronic spectra of diatomic molecules. Vibrational structure. Franck-Condon principle. Nuclear Magnetic Resonance spectroscopy. Chemical shifts. Spin-spin splitting.

Unit-3

Thermodynamics of Solutions: Chemical potential of ideal gases. Chemical potential of real gases and fugacity, activity and activity coefficient (concept and physical significance), Variation of fugacity with temperature and pressure. Thermodynamics of Colligative properties: Freezing point depression, Elevation of boiling point, Osmotic pressure, van't Hoff equation, Measurement of osmotic pressure.

Unit-4

Surface chemistry: Adsorption, Gibbs adsorption equation, Adsorption Isotherms- Langmuir, Freundlich and BET. Heterogeneous catalysis: kinetics of unimolecular reactions-inhibition and activation energy. Bimolecular surface reactions: reactions between a gas molecule and an adsorbed molecule, the reaction between two adsorbed molecules. Nature of surface. Concept of active centers, Kinetics of enzymatic reactions: Michaelis-Menten equation, effect of temperature and pH.

Unit-5

Nuclear and Radiation Chemistry: Nuclear reactions-Bethe's notation, types of nuclear reactions (n , p , α , d and γ), compound nucleus theory and nuclear reactions.

Radiation chemistry: Elementary ideas of radiation chemistry, radiolysis of water and aqueous solutions, units of radiation chemical yield (G value), radiation dosimetry (Fricke's dosimeter).



Unit-4

Inorganic Polymers: Classification, Types of Inorganic Polymerization, Comparison with organic polymers, Boron-oxygen and boron-nitrogen polymers, silicones, coordination polymers, sulfur-nitrogen, sulfur-nitrogen-fluorine compounds.

Unit -5

Bioinorganic Chemistry: Essential and trace element in biological process, metalloporphyrins, Haemoglobin structure and biological functions, Myoglobin, synthetic models of O₂ carriers, Biological role of alkali metals ions. Electron transfer reaction in biological system.

Books Recommended:

1. "Inorganic Chemistry", J.E. Huheey, E.A. Keiter and R.L. Keiter, O.K. Medhi, Fourth Edition, Pearson.
2. "Basic Inorganic Chemistry", F. A Cotton, G. Wilkinson, and Paul L. Gaus, 3rd Edition (1995), John Wiley & Sons, New York.
3. "Concise Inorganic Chemistry", J. D. Lee, 5th Edition (1996), Chapman & Hall, London.
4. "Inorganic Chemistry", A. G. Sharpe, 3rd International Student Edition (1999), ELBS / Longman, U.K.
5. "Inorganic Chemistry", D. F. Shriver and P. W. Atkins, 3rd Edition (1999), ELBS, London.
6. "Inorganic Chemistry" Keith F. Purcell and John C. Kotz W. B. Saunders Com. (1987), Hong Kong.
6. "Principles of Inorganic Chemistry" Puri Sharma and Kalia Vishal Publishing House.
7. "Electronic Spectra of Transition Metal Complexes", R K Ray, New Central Book Agency (P) Ltd;
8. "General and Inorganic Chemistry" (Part-I); R P Sarkar; New Central Book Agency (P) Ltd.
9. "General and Inorganic Chemistry" (Part-II); R P Sarkar; New Central Book Agency (P) Ltd.
10. "Selected Topic in Inorganic Chemistry" W. U. Malik, G. D. Tuli, R. D. Madan (1994) S. Chand and Company Ltd.
11. "Fundamental Principles of Inorganic Chemistry" D. Banerjee Sultan Chand & Sons 3rd Edition (1993).

SEMESTER- VI CBT-603: SPECIAL TOPICS IN CHEMISTRY

Unit-1

Symmetry and Group Theory in Chemistry

Symmetry elements and symmetry operation, definition of a group, subgroup, relation between orders of a finite group and its subgroup. Point symmetry group. Character table and their use.

UNIT - 2

Green Chemistry: Introduction and importance of green chemistry? Principles of green chemistry. Green alternative solvents and reagents in organic synthesis. Recent advances in green synthetic methodologies.

UNIT - 3

Chemical Toxicology:

Toxic chemicals in the environment, biochemical effects of arsenic, cadmium, lead, mercury, carbon dioxide, chloro-fluorocarbons, pesticides. Chemical and bio-warfare agents. Environmental and public health.



UNIT - 4

Separation Techniques:

Liquid-liquid solvent extraction, super critical fluid extraction. Theory of chromatography, terminology used in chromatography, high performance liquid chromatography, gas chromatography and size exclusion chromatography.

UNIT - 5

Chemistry of some Typical Natural Products:

A study of the following compounds involving their isolation, structure elucidation and synthesis: Alkaloids- Hofmann exhaustive methylation, nicotine; Terpenes- Isoprene rule, citral, flavonoids- quercetin.

Books Recommended

1. "Chemical Applications of Group Theory" F. Albert Cotton, 3rd Edition 1993, Wiley-India .
2. "Environmental Chemistry", A. K. De, 3rd Edition (1994), Wiley Eastern, New Delhi.
3. "Analytical Chemistry", G. D. Christian, 4th Edition (1986), John Wiley & Sons, New York.
4. "Principles of Instrumental Analysis", D.A. Skoog, 5th Edition (1998), Saunders College Publishing, Philadelphia, London, New York.
5. "Basic Concepts of Analytical Chemistry", S. M. Khopkar, 2nd Edition (1998), New Age International Publications, New Delhi.
6. "Instrumental Methods of Analysis", H. H. Willard, L. L. Merritt, and J. A. Dean, 6th Edition (1986), CBS Publishers & Distributors, Shahdara, Delhi.
7. "Organic Chemistry", I. L. Finar, [Vol. 2, 6th Edition (1973), Reprinted in 1980 & Vol. II, 5th Edition (1975), Reprinted in 1996], ELBS and Longman Ltd., New Delhi.
8. "New Trends in Green Chemistry", V. K. Ahluwalia and M. Kidwai (2004) Kluwer Academic Publishers , Netherland.
9. "Green Chemical Syntheses and Processes" Paul T. Anastas, Lauren G. Heine and Tracy C. Williamson (2000) American Chemical Society- Science.

Semester-VI

CBE-POLYMER CHEMISTRY

Unit-1

Introduction: Classification of polymers, various structures of copolymers such as linear, branched and cross-linked copolymers and their types, Configuration and conformation of polymers, Types of inorganic polymers, Nature of molecular interaction in Polymers, Tacticity of polymers.

Unit-2

Polymerization reactions: Addition and condensation - Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes, basic methods of polymerization: mass (bulk), suspension & emulsion.

Unit-3

Molecular Weight of polymer: Degree of polymerization, Polydispersity Index. Polydispersity and molecular weight distribution, Number average molecular weight, weight average molecular weight,





and Z average molecular weight, determination of molecular weight by end group analysis, colligative property measurement, viscosity, osmotic pressure, light scattering.

Unit-4

Structure and Properties of polymers- Morphology of crystalline polymer, Crystallization and melting point, tensile strength, mechanical properties of crystalline polymers, Glass transition temperature (T_g) and measurement of T_g. importance of glass transition temperature.

Unit-5

Preparation and applications of commercial polymers

Fabrics – natural and synthetic (acrylic, polyamides, polyester)

Rubbers– natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization;

Polymer additives; Introduction to liquid crystal polymers, conducting polymers

Fire Resistance Polymers.

Books Recommended

1. “Textbook of Polymer Science”, Billmeyer, F. W. John Wiley & Sons, Inc.
2. Gowariker, V. R., Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.
3. *Molecular Weight Distribution in Polymer* by L.H. Peebles, Wiley Interscience N.Y. (1971).
4. *Polymer Chemistry*, by Seymour R.B. and Carraher, Marcel Dekker (2000).
5. *Introduction to Polymer Chemistry*, C.E Carraher Jr. ,Taylor and Francis 1st edition (2007), Boca Raton, FL.
6. *Principle of Polymerization* G. Odian, 3rd edition (1991) John Wiley, Singapore.





B. Sc. V SEM

CBL 504

Laboratory I: Analytical Chemistry Practical

Credits :

1. Estimation of total hardness of water sample.
2. Determination of available chlorine in bleaching powder
3. Determination of strength of H_2O_2 sample.
4. Estimation of formalin.
5. Estimation of dissolved oxygen in water samples.
6. Estimation of Ca in milk.

Note: Experiments may be added/deleted subject to availability of time and facilities.

B. Sc. V SEM

CBL 505

Credits : 2

Laboratory II: Inorganic Chemistry Practical

1. Redox titrimetric estimation using standard potassium dichromate solution
 - A) $Fe^{III} - Cr_2O_7^{2-}$ in mixture
 - B) Fe and Cu in mixture
2. Redox titrimetric estimation based on permanganometry.
 - A) Estimation of Fe^{II} and Fe^{III} in a mixture
 - B) Estimation of $CaCO_3$ dolomite in a mixture

Note: Experiments may be added/deleted subject to availability of time and facilities.



CBL 506

Credits : 2

Laboratory III: Organic Chemistry Practical

Organic preparation and characterization by UV-VIS spectroscopy and IR spectroscopy .

- Hydrolysis of ester: Preparation of benzoic acid from ethyl or methyl benzoate
- Hydrolysis of amide/imide : preparation of phthalic from phthalimide
- Preparation of the following compounds: nitrobenzene, p-nitroaniline from acetanilide, p-bromoaniline, o-chlorobenzoic acid, aspirin

Note: Experiments may be added/deleted subject to availability of time and facilities.

B. SC VI SEM

CBL 604

Laboratory I: Inorganic Chemistry Practical

Credits : 2

1. Complexometric titration

- Determination of Zinc against EDTA using Eriochrome Black T as indicator.
- Determination of Zinc against EDTA using Xylenol orange as indicator.
- Determination of Ca^{2+} & Mg^{2+} ions in a given solution using EDTA.
- Determination of Cu using pyrocatechol violet as indicator
- Determination of Ni using murexide as indicator.

Note: Experiments may be added/deleted subject to availability of time and facilities.



B. SC VI SEM

CBL 605

Laboratory II: Organic Chemistry Practical

Credits : 2

1. Quantification of Organic acids Acid/Base and Iodometric Titration
2. Quantification of protein from milk (casein) and egg (albumin)
3. Analysis of dye formation (methyl orange, methylene blue, fluorescein) by UV-Vis spectroscopy and colorimetric titration.
4. Synthesis of aspirin.
5. Distillation of common organic solvents (ether, methanol, ethanol) and measurement of boiling point using kjedals apparatus.
6. Study of metal binding capacity of organic acids and phenolic compounds by UV-Vis spectroscopy/ Colorimetrically.

Patra

B. Sc. VI SEM

CBL 606

Laboratory III: Physical Chemistry Practical

Credits :

1. Conductometric titration: acid-base.
2. Potentiometric titration: acid-base.
3. To determine the molecular weight of given substance by Rast's camphor method.
4. To determine the solubility of Benzoic acid at different temperatures and to determine Δ of the dissolution process.
5. Kinetics of acid-catalysed hydrolysis of sugar (chemical method/polarimeter).
6. To study the kinetics of Iodine Clock reaction.

Patra