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List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

Colour Codes		
Name of the Subjects	Yellow	
Employability Contents	Green	
Entrepreneurship Contents	Light Blue	
Skill Development Contents	Pink	



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

Department : Chemistry

Programme Name : B. Sc.

Academic Year : 2018-19

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.	CBT-301	Organic Chemistry - II
10.	CBT-401	Physical Chemistry-III
11.	CBT-402	Organic Chemistry - III
12.	CBT-501	Analytical Chemistry
13.	CBT-502	Inorganic Chemistry - III
14.	CBT-503	Organic Chemistry - IV
15.	CBE	Biochemistry
16.	CBT-601	Physical Chemistry-IV
17.	CBT-603	Special Topics In Chemistry
18.	CBE	Polymer Chemistry
19.	CBL-103	Inorganic Chemistry & Physical Chemistry Practical
20.	CBL-203	Compound Identification and Physical Experiments
21.	CBL-303	Quantitative Analysis (Compound Identification and Volumetric Analysis)
22.	CBL-403	Organic Chemistry and Physical Chemistry Practical
23.	CBL-504	Laboratory I: Analytical Chemistry Practical
24.	CBL-505	Laboratory I: Inorganic Chemistry Practical
25.	CBL-506	Laboratory I: Organic Chemistry Practical
26.	CBL-604	Laboratory I: Inorganic Chemistry Practical
27.	CBL-605	Laboratory I: Organic Chemistry Practical
28.	CBL-606	Laboratory I: Physical Chemistry Practical

Datta

**अध्यक्ष/Head
रसायन शास्त्र विभाग
Deptt. of Chemistry**



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-1 Practical	2	4
	Core -2	CBT-2	Physical Chemistry I:	4	4
	Core -2 Practical	CBL-2	Physical Chemistry-1 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
Core -3 Practical		CBL-3	Organic Chemistry-1 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

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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

- 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.
- 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.
- Indexing of a given powder diffraction pattern of a cubic crystalline system.**
- 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).

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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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- 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, Willey 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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5. *Physical Chemistry*, W. J Moore, 5th Edition, Orient Blackswan publisher, 1999.
6. *Physical Chemistry*, P. Atkins and J. De Paul, 8th Edition (2006), International Student Edition, Oxford University Press.

SEMESTER - III

CBT 301: ORGANIC CHEMISTRY - II

UNIT - 1

Alcohols and ethers: General properties of alcohols and ethers. Synthesis of alcohols from alkenes, via hydroboration-oxidation, oxymercuration-demercuration, Reactions of alcohols: Comparative study of dehydration and oxidation of primary, secondary and tertiary alcohols. Synthesis and reactions of ethers.

UNIT - 2

Aldehydes and Ketones: Preparation of carbonyl compounds. Nucleophilic addition reactions, Condensation reactions: aldol condensation, Cannizzaro reaction, benzoin oxidation and reduction and Haloform reaction.

UNIT - 3

Carboxylic acids & its Derivatives: General method for the preparation of carboxylic acids, Relative reactivity of carboxylic acids and their chemical reactions.
Chemistry of acid halides, amides and esters. Concept of active methylene compounds (EAA and DEM).

UNIT - 4

Stereochemistry: Plane-polarized light and optical activity. Elements of Symmetry, Chirality and Enantiomers. Fischer, Newman and Sawhorse Projection Formula, Absolute configuration: The R, S and D, L configuration descriptions, Compounds containing more than one Chiral centres, Diastereoisomers and meso compounds, resolution of a racemic mixture.

UNIT - 5

Carbohydrates:

Introduction, monosaccharides, glycoside bond formation, mutarotation. Reactions of aldoses and ketoses (oxidation and reductions). Killiani synthesis, Osazone formation. Glucose-structure (including cyclic structure), Fructose (reactions only). Degradation of monosaccharides: Ruff degradation. Importance of polysaccharides in daily life.

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.



momenta, p^2 or d^2 case, spin-orbit coupling p^2 case, determining ground state terms-Hund's rule, Hole formulation. Derivation of term symbol for a d^2 configuration.

Books References:

1. "Basic Inorganic Chemistry", F. A Cotton, G. Wilkinson, and Paul L. Gaus, 3rd Edition (1995), John Wiley & Sons, New York.
2. "Concise Inorganic Chemistry", J. D. Lee, 5th Edition (1996), Chapman & Hall, London.
3. "Inorganic Chemistry", A. G. Sharpe, 3rd International Student Edition (1999), ELBS / Longman, U.K.
4. "Inorganic Chemistry", D. F. Shriver and P. W. Atkins, 3rd Edition (1999), ELBS, London.
5. "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. "General and Inorganic Chemistry" (Part-I); R P Sarkar; New Central Book Agency (P) Ltd.
8. "General and Inorganic Chemistry" (Part-II); R P Sarkar; New Central Book Agency (P) Ltd.
9. "Selected Topic in Inorganic Chemistry" W. U. Malik, G. D. Tuli, R. D. Madan (1994) S. Chand and Company Ltd.

Semester-I V

CBT-401: Physical Chemistry III

Unit-1

Thermodynamics: Second Law of Thermodynamics, statement of second law of thermodynamics, Carnot cycle, entropy, entropy changes in reversible and irreversible processes and of universe, physical concept of entropy, entropy changes of an ideal gas in different processes, entropy of an ideal gas, entropy changes in mixture of gases

Unit-2

Free energy and Chemical equilibrium: Free energy and its concept, Gibbs and Helmholtz free energies and their relationship, Free energy and equilibrium constant. Gibbs-Helmholtz equation, Criteria for reversible and irreversible processes based on entropy and free energy, Maxwell's relations, Partial molar quantities, chemical potential, Gibbs-Duhem equation.

Unit-3

Phase Equilibria: Thermodynamics of phase transition-Clapeyron-Clausius equation and its applications. Phase rule, phase, component, degree of freedom, thermodynamic derivation of phase rule, phase diagrams of one-component system: water, two component systems: lead-silver, The distribution law, applications to cases of dissociation and association of solutes in one of the phases.

Unit-4

Electrochemical Cells: Reactions in reversible cells, free energy and EMF of reversible cell. Single electrode potential (Nernst equation), its measurement and sign convention. Standard electrode



potential. EMF of reversible cell from electrode potentials. Types of reversible electrode, reference electrodes. Applications of EMF measurements: determination of ionic activities, pH, and equilibrium constant. Concentration cells with and without transference. Liquid junction potential and its elimination.

Unit-5

Photochemistry: Basic principles, Lambert-Beer's law, molar extinction coefficient, Laws of photochemistry, Photo chemical rate law, Kinetics of photochemical reactions like HCl Energy transfer in photochemical reactions, quenching of Fluorescence, Chemiluminescence.

Books Recommended

1. *Physical Chemistry*, P. Atkins and J. De Paul, 8th Edition (2006), International Student Edition, Oxford University Press.
2. *Physical Chemistry*, P. C. Rakshit, 5th Edition (1985), 4th Reprint (1997), Sarat Book House, Calcutta.
3. *Principles of Physical Chemistry*, B. R. Puri, L. R. Sharma, and M. S. Pathania, 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
4. *Physical Chemistry*, K. J. Laidler and J. M. Meiser, 3rd Edition, Houghton Mifflin Comp., New York, International Edition (1999).
5. *A text book on Physical Chemistry*, K. L. Kapoor, 3rd Edition, Vol. I-VI, Macmillan India Ltd, New Delhi (2005).
6. *An Introduction to Chemical Thermodynamics*, R P Rastogi & R. R. Mishra, 5th revised edition, Vikas publishing house, New Delhi (1978).
7. *Physical Chemistry*, W. J Moore, 5th Edition,, Orient Blackswan publisher (1999).

SEMESTER - IV

CBT 402: ORGANIC CHEMISTRY - III

UNIT - 1

Aromatic Compounds: Introduction, nomenclature of benzene derivatives, the Kekule structure of benzene, Valence bond & molecular orbital theories of the structure of benzene, Huckel's rule: $(4n+2)$ π electron rule, Anti-aromatic compounds, Aromatic compounds in biochemistry, spectroscopy of Aromatic compounds.

UNIT - 2

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, synthetic applications of Friedel-Crafts acylation; Clemmenson's reduction, effect of substituent's on reactivity and orientation.



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.
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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.



UNI T-4

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

UNI T-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. Mc William, 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. III SEM

Credits : 2

CBL 303

Quantitative analysis (Compound identification and Volumetric analysis)

1. Systematic identification of organic compounds with respect to following points
 - Functional group test
 - Specific test
 - M.P. determination
2. Volumetric inorganic analysis
 - Preparation of Standard solutions
 - Redox titrations

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

Satya



B. Sc. IV SEM

Credits : 2

CBL 403

1. Derivative preparation of carboxylic acid, alcohol, phenolic-OH, carbonyl compounds, hydrocarbons, carbohydrates and identification of the derivative by melting point determination.
2. Determination of indicator constant - colorimetry.
3. Determination of pH of a given solution using glass electrode.
4. Beer's Law - Determination of concentration of solution by colorimetry
5. Order of reaction of I_2 / Acetone / H^+ .
6. Equilibrium constant of methyl acetate hydrolysis reaction

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

Signature

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.

Signature



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} - $\text{Cr}_2\text{O}_7^{2-}$ 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.



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.