B.Sc. CHEMISTRY – PROGRAMME SYLABUS
I YEAR - I SEMESTER

COURSE CODE: 7BCH1C1

CORE COURSE – I - FUNDAMENTALS OF CHEMISTRY

Unit I Atomic and molecular composition of matter:

1.1. Atom – constituents of an atom. Elementary particles and composite particles (hadrons). Atomic Structure: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Atomic spectrum of hydrogen. Zeemann effect. Molecules – molecular weight – mole – Avogadro number – calculating number of moles.

1.2. **Quantum mechanics:** Fundamental postulates of quantum mechanics. Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and $\psi 2$. Schrödinger equation for hydrogen atom. Radial and angular parts of the wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals.

1.3. Quantum numbers – principal – orbital – angular momentum quantum numbers (n,l and m). Significances of quantum numbers. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin – spin quantum number (s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Relative energies of atomic orbitals – anomalous electronic configurations.

Unit II Periodic table:

2.1. **Periodicity of Elements:** Modern periodic law. Structure of modern periodic table (long form of periodic table). Classification of elements as s, p, d, f block elements.

2.2. **Periodic variation of properties:** Detailed discussion on the variation various fundamental properties of the elements. Effective nuclear charge – shielding or screening effect and Slater rules. Atomic radii (van der Waals) and ionic radii. Ionization enthalpy, successive ionization enthalpies and factors affecting ionization energy and applications of ionization enthalpy. Electron gain enthalpy, trends of electron gain enthalpy. Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of metallic character in periodic table.

2.3.**Comparison of different groups and periods:** anomalies between first and second rows. Diagonal relationships. Participation of d – orbital in compound formation. Periodic anomalies of the non-metals and posttransition metals.

Unit III

3.1.Sources of organic compounds.

3.2.Naming of organic compounds with single or more number of functional groups in trivial and IUPAC systems.

3.3.Molecular weight determination of organic acids and bases by silver salt and platinicchloride methods. Problems arriving empirical and molecular formula using percentage composition of elements and molecular weight.

3.4.Structural formula – Shapes of organic molecules. sp3, sp2 and sp hybridization in organic compounds with suitable examples.

3.5.Classification of organic compounds as aliphatic, aromatic, alicyclic and hetero cyclic compounds.

3.6.Steric and electromeric effects. Inductive effect, +I and –I effects, resonance effects (delocalized chemical bonding), rules for resonance, resonance stabilization energy, hyperconjugation. Explanation with suitable examples for each.

Unit IV Physical properties and chemical constitution:

4.1 Classification of physical properties of materials as additive properties, constitutive properties, additive constitutive properties and colligative properties with suitable examples. Vector and scalar properties with suitable examples. Extensive and intensive properties.

4.2 Dipole moment, calculation of dipole moment and bond length. Bond moment and dipole moment. Calculating percentage of ionic character from dipole moment and electronegativity differences.

4.3 Magnetic properties, para, dia, ferro antiferro and ferri magnetism. Curie temperature (TC). Magnetic susceptibility, Determination of magnetic susceptibility, spin only magnetic moment and its relationship to number of unpaired electrons.

4.4 Molar volume, surface tension and parachor. Atomic and structural parachors and their uses to fix the exact structure.

Unit V Introduction to computers:

5.1. **Basics:**Types of computer – different components o a computer – constants – variables – bits and bytes. Binary number system – representation of integers – conversion of a decimal to binary and vice- versa. Other number systems and their mutual conversion.

5.2. Programming – algorithm – flow charts . operating systems. Expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Compiled versus interpreted languages. Debugging. Simple programs using these concepts for calculating the rate constants, velocity of gaseous molecules and molar concentration, normality of a solution, matrix addition, matrix Multiplication and statistical analysis.

5.3. List of computer software and their uses in chemistry.

Text Books:

1. Inorganic chemistry – R.D. Madhan
2. Advanced inorganic chemistry – Sathyapraash
3. Inorganic Chemistry – J.D. Lee
4. Organic chemistry – PL. Soni
5. Organic Chemistry – Sharma
6. Organic Chemistry – Morrison & Boyd
7. Organic Chemistry – I.L. Finar (Vol. I & II)
8. Advanced Physical Chemistry –Puri,Sharma & Pathania.
9. Physical Chemistry – G. W. Castellan 7th edition
10. Physical Chemistry – S. Glasstone

Books for Reference:

1. Inorganic Chemistry – Shriver and Atkins 7th edition
2. Inorganic Chemistry – Catherine 2nd edition.
3. Organic Chemistry – Mc Muray 7th edition
4. Organic Chemistry – L. G. Wade 6th edition
5. Organic Chemistry – J. Clayden 7th edition
6. Organic Chemistry – Y. Paula 4th edition
7. Physical Chemistry – Iran N Levin 6th edition
8. Physical Chemistry – Peter Atkins 7th edition
9. Physical Chemistry – Paul Monk 4th edition

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I YEAR – I SEMESTER
COURSE CODE: 7BCH1P1

CORE COURSE II - INORGANIC AND ORGANIC VOLUMETRIC ANALYSIS PRACTICAL - I

Inorganic Volumetric Estimation:

S. No	Standard	Link	Estimation
	Acid – Base neutralization		
1	Sodium carbonate	Hydrochloric acid	Sodium hydroxide
2	Oxalic acid	Sodium hydroxide	Oxalic acid
3	Sodium carbonate	Hydrochloric acid	Sodium Carbonate
	Redox – Permanganometry		
4	Oxalic acid	permanganate	Ferrous sulphate
5	Ferrous ammonium sulphate	permanganate	Ferrous sulphate
6	Oxalic acid	permanganate	Oxalic acid
7	Ferrous ammonium sulphate	permanganate	Oxalic acid
	Dichrometry		
8	Ferrous ammonium sulphate	Potassium dichromate	Ferrous sulphate
	Iodimetry		
9	Potassium dichromate	Sodium thiosulphate	Potassium dichromate
10	Potassium dichromate	Sodium thiosulphate	Copper sulphate
11	Potassium dichromate	Sodium thiosulphate	Permanganate

II. Organic Volumetric Estimation:

1. Estimation of phenol
2. Estimation of aniline
3. Estimation of glucose

Distribution of marks in the external practical examinations.

Total marks – 60

Record Note – 10 marks
Viva – voce – 10 marks
Inorganic procedure – 5 marks
Organic procedure – 5 marks
Correct report with less than 1% error – each 15 – marks
Report with more than 1% error less 1 mark for every 0.3%
Report with more than 3% error - only 3 marks

II YEAR - III SEMESTER
COURSE CODE: 7BCH3C1

CORE COURSE - V - ORGANIC CHEMISTRY – I

Unit I Isomerism:

1.1. Constitutional Isomerism (Structural isomerism) such as chain isomerism, functional isomerism, positional isomerism, tautomerism.

1.2. **Conformational Analysis:** two dimensional representations of three dimensional molecular structures such as Fischer projection, Newman projection and sawhorse formula. Conformations and their relative stabilities of ethane, propane and butane. Stability of cyclic hydrocarbons, Bayer strain theory and its modification. Conformations of cyclohexane.

1.3. Configurational Isomerism (Stereo isomerism): Geometrical isomerism and E – Z notation. Cis – trans isomerism in maleic and fumaric acid, 2- buteen and di-substituted cyclohexane derivatives.

1.4. **Optical Isomerism:** Conditions for a compound to be optically active with suitable examples. Optical activity, specific rotation and its experimental method of determination. . Absolute configuration. R and S notation of configurational isomers. Enantiomers and diastereomers. Optical isomerism in lactic acid and tartaric acid. Optical activity in substituted biphenyles, allenes, spiranes and organic nitrogen derivatives. Racemic mixture and resolution of racemic mixtures by chemical and chromatographic methods. Calculating enantiomeric excess and optical purity. Biological importance of configurational isomerism.

Unit II

2.1. **Reaction intermediates:** Homolytic fission and Heterolytic fission of bonds. Sources and stability of carbocations and carbanions. Role of Steric and electromeric effects on the stability of reaction intermediates. Relative stabilities of primary, secondary, tertiary and allyl carbocations, carbanions and free radicals. Nucleophilic and electrophilic reagents.

2.2. **Types of reactions:** Substitution, addition, elimination, rearrangement, insertion and polymerization reaction with suitable examples. SN1, SN2, SNI, SE1, SE2 E1 and E2reaction mechanisms. Competition between SN1 and E1. Structural and medium preference between competing reactions.

2.3. **Free radicals:** sources of free radicals, stability of free radicals. Role of steric and electromeric effects on the stability of free radicals. Long living and short living free radicals. Mechanism of reactions involving free radicals. Radical inhibitors and their role in food preservation. BHA and vitamin E. Carbenes, formation structure and electrophilic and nucleophilic nature of carbenes.

Unit III

3.1. **Aliphatic hydrocarbons:** classification of hydrocarbons – alkanes, alkenes alkynes and cycloalkanes. Sources of alkanes, petroleum refining, catalytic cracking. Structure and properties of alkanes. Uses of alkanes, LNG, LPG and gasoline. Octane number and its variation with structure.

3.2. **Alkenes:** preparation of alkenes by catalytic cracking, dehydration, dehydrohalogenation. Bredt's rule, Zaitsav's rule and Hoffman products. Cis – trans isomerism

in alkenes and their relative stabilities.Properties of alkenes. Electrophilic addition to double bonds - hydrohalogenation and markovnikov's rule. Halogenation – halonium ion formation. Free radical addition and peroxide effect. Hydration – oxymercuration and demercuration, hydroboration. Hydrogenation of alkenes addition of carbenes to alkenes. Epoxidation and hydroxylation – osmium tetrxoide hydroxylation. Osonolysis, polymerization and hydrogenation of alkenes. Commercial importance of alkenes.

3.3. **Alkynes:** Synthesis of alkynes from acetylide ion, by elimination reaction, manufacture of acetylene. Acidity of alkynes and the synthesis of other alkynes from acetylide ion. Reduction of alkynes by using lithium in ammonia and hydrogenation over the Lindlar catalyst. Addition of hydrogen halides, halogens to alkynes. Mercury (II) catalyzed hydration of alkynes. Oxidation of alkynes by hydroboration reaction. Commercial importance of acetylene and methyl acetylene and MAPP gas.

Unit IV Aromatic hydrocarbons:

4.1. **Sources of aromatic compounds:** Naming of aromatic compounds (aryl derivatives and aryl substituted alkyl derivatives). Structure and stability of benzene, molecular orbital theory. Aromaticity and the 4n + 2 (Huckel rule). Aromaticity of ions. Polycyclic aromatic compounds, annulenes.

4.2. **Reactions of benzene:** electrophilic aromatic substitutions. Halogenation, alkylation, acylation, nitration, sulphonation and hydroxylation and their mechanisms. Nucleophilic substitution reactions. Wurtz – Fittig reaction, comparison with Friedel – Crafts reaction.

4.3. Substituent effect on further substitution. Activating and deactivating groups. Directing effects, ortho, para directing groups and meta directing groups. Explanation for activating and directing effects of substituents in the conversion of mono substituents into disubstituents. Additive effects in the conversion of di- substituted into tri- substituted aromatic compounds.

Unit V Alcohols, Phenols and Ethers:

5.1. Alcohols: classification of alcohols, preparation properties and uses of alcohols. Rectified spirit, absolute alcohol, methylated spirit and power alcohol. Preparation, properties and uses of allyl alcohol. Polyhydric alcohol: Estimation of number of hydroxyl groups in a polyhydric alcohol.

5.2. **Phenols:** Preparation and properties phenols. Comparison of phenols with alcohols. Libermann, Lederer – Manasse, Reimer – Tiemann reactions. Elbs persulphate reaction. Conversion of phenol in to phenolic acids. Preparation properties and uses of substituted phenols such as anisole and quinols. Preparation and properties of catechol, resorcinol, pyrogallol, hydroxylquinol and phloroglucinol. Conversion of catechol into safrole. Protection of hydroxyl groups and their regeneration.

5.3. **Ethers:** Preparation of diethyl ether, chlorex and vinyl ether.Estimation of alkoxy group– Zeisel's method. Thioalcohols and thioethers: Preparation and uses of ethyl mercaptan, sulphonal, epoxides and mustard gas. Peroxides – preparation, properties and uses. Aromatic ethers, preparation properties and uses of guaicol, veratrole, eugenol, anethole phenacetin and dulcin. Conversion of ethers into alcohols. Crown ethers. Organic sulphides.

Text Books:

1. Organic chemistry – PL. Soni
2. Organic Chemistry – Sharma
3. Organic Chemistry – Morrison & Boyd
4. Organic Chemistry – I.L. Finar (Vol. I & II)

Books for Reference:

1. Organic Chemistry – Mc Muray 7th edition
2. Organic Chemistry – L. G. Wade 6th edition
3. Organic Chemistry – J. Clayden 7th edition
4. Organic Chemistry – Y. Paula 4th edition
5. Organic chemistry – Jerry March

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II YEAR - III SEMESTER
COURSE CODE: 7BCH3P1

CORE COURSE - VI -INORGANIC & ORGANIC QUALITATIVE ANALYSIS
PRACTICAL - II

Hrs. Per week: 6

I.Inorganic Qualitative Analysis:

To analyse a mixture of inorganic salt contains two anions and two cations. One of the anion should be interfering anionic radicals.

II.Organic Qualitative Analysis:

To analyse an organic compound to identify the special elements present, Aromaticity, saturation and functional groups.

External mark distribution:

Record note book – 10 marks
Viva – voce – 10 marks
Inorganic qualitative analysis – 20 marks
Organic qualitative analysis – 20 marks

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III YEAR -V SEMESTER
COURSE CODE: 7BCH5C1

CORE COURSE - IX - ORGANIC CHEMISTRY – II

Unit I Organic halogen compounds:

1.1. **Alkyhalides:** classification and preparation. Reactions of alkyl halides: Substitution and elimination reactions of alkyl halides. Uses of alkyl halides as a starting material in organic synthesizes, insecticides, pesticides and refrigerants.Poly halogen derivatives: Preparation and applications of chloroform, carbon tetrachloride, westron and Freon. Halogen derivatives of unsaturated hydrocarbons: Preparation and uses of vinyl chloride, allyl chloride and allyl iodide.

1.2**. Aryl halides:** aryl halides and aryl alkyl halides. Preparation, properties and uses of aryl halides. Nucleophilic substitution reactions of chlorobenzen. Bimolecular and elimination - addition (benzyne) mechanisms of nucleophilic substitution reactions. Von Richter reaction of halogenonitrobenzene. Benzyl chloride and benzylidene chloride. Distinguishing aryl and aryl alkyl halogen derivatives. BHC and DDT preparation and properties.

1.3. **Organo metallic compounds:** Grignard reagent preparation properties and uses of Grignard reagent as a synthetic agent. Organo copper and organo lithium compounds and their uses as synthetic agents and catalysts. Limitations, in the usage of organo metallic compounds as synthetic agents. Preparation and synthetic uses of Gilman reagent.

Unit II Carbonyl Compounds:

2.1. **Carbonyl Compounds (Aldehydes and Ketones):** general methods of preparation of aliphatic and aromatic aldehydes and ketones. Conversion of an alcohol in to carbonyl compound by using N-bromosuccinimide and Oppenauer oxidation. Rosenmund's reduction, Stephen's method and Sommelet reactions. General properties of aldehydes and ketones. MPV reduction, Clemmenson reduction, Wolff – Kishner reduction. Oxidation of aldehydes and ketones. Baeyer – Villiger oxidation.

2.2. Nucleophilic addition reactions and Condensation reactions. Comparison of reactivity of aliphatic and aromatic aldehydes and ketones. Addition of hydrogen cyanide, and alcohols and protection of carbonyl groups and regeneration. Addition of amines to produce imines and enamines. Schmidt reaction, aldol condensation, Claisen codensation, Claisen – Schmidt condensation, Knovenagel, benzoin and Darzen - Glycdic condensation – Stork condensation reactions. Perkin reaction. Differences between aldehydes and ketones. Wittig reaction of carbonyl compounds and its synthetic applications. Preparation and properties of formaldehyde and acetaldehyde, polymerization, Cannizzaro reaction. Tischenko reactions. Chloral preparation and its properties.

2.3. α, β – unsaturated carbonyl compounds. Preparation and properties α, β unsaturated carbonyl compounds. Conjugated nucleophilic additions. Reactions of α, β unsaturated compounds with Grignard reagent and with Gilman reagent. Preparation and properties of acetyl acetone and acetonyl acetone. Active methylene group and generation of carbanion.

Unit III Aliphatic and aromatic carboxylic acids and their derivatives:

3.1. C**arboxylic acids:** preparation and properties of aliphatic and aromatic mono – carboxylic acids. Systematic conversion of a hydrocarbon into a carboxylic acid with same and more number of carbon atoms. Comparison of acidity of aliphatic and aromatic carboxylic acids.

Effects of substituents and their position on the acidity of carboxylic acids. Ortho effects. Reactions of carboxylic acids and formation acyl halides, amides, esters, etc. Preparation, properties and estimation of urea.

3.2. **Dicarboxylic acids and substituted carboxylic acids:** preparation, properties and uses of oxalic acid, malonic acid, succinic acid and phthalic, maleic and fumaric acids. Preparation and properties of hydroxy acids, amino acids and halogen substituted acids. Action of heat on various hydroxyl acids and amino acids.

3.3. **Carboxylic acid derivatives:** carboxylic esters, carboxyl chlorides and amides preparation and their properties. Active methylene group. Preparation of malonic ester and its synthetic uses. Acetoacetic ester and its synthetic uses.

Unit IV Organic Nitrogen derivatives.

4.1. **Organic nitro compounds:** preparation and properties of nitro methane, nitroso methane, nitrobenzene, dinitrobenzene, trinitrobenzene, trinitrotoluene, trinitrophenol and trinitroglycerine.

4.2. **Amines:** classification of amines, preparation aliphatic and aryl amines. Systematic conversion of a hydrocarbon into an amine through different intermediates. Properties of aliphatic amines and aryl amines. Comparison of basicity of aliphatic amines with aromatic amines. Effect of substituents on the basicity of amines and anilines. Alkylation and acylation of amines. Substitution reactions of amines with alkyl halides. Hoffmann elimination. Electrophilic substitutions of aryl amines. Diazotization of amines – Sandmeyer reaction. Synthetic applications of diazonium chloride.

4.3. **Heterocyclic compounds:** definition and classification heterocyclic compounds. Preparation and properties of furan, pyrole, pyridine and thiophene. Comparison of the basicity of pyrole and pyridine. Preparation, properties and biological importance of imidazole, pyrimidine and purine. Fischer indole synthesis and properties of indole.

Unit V Colourants

5.1. **Dyes and pigments:** Definition of dyes, pigments, chromophores and auxo – chromes with suitable examples. Differences between dyes and pigments. Classification of dyes based on chromophores, method of application and uses with suitable examples. Chromophores – auxochrome theory and modern theory of colour and constitution. Definitions and examples of mordents and leuco bases. Colour index of dyes and its significances. Phototropism and its importance in applications of dyes with suitable examples. Toxicity of dyes and pigments.

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III YEAR - V SEMESTER
COURSE CODE: 7BCH5C2

CORE COURSE - X - PHYSICAL CHEMISTRY – III

Unit I Spectroscopy

1.1. **Fundamentals of spectroscopy:** Definition, fundamentals of light such as wavelength, velocity, frequency, photons and definite energy of a photon. Electromagnetic spectrum. Fundamentals of materials such as equipartion principle and different types of movements of particles in a material and quantization of electronic, rotational, vibrational and spin energies. Selection rule. Beer – Lambertz law. Different types of spectroscopy and their applications.

1.2.**Rotational or microwave spectroscopy:** rigid rotator, derivation of equation for rotational constant for a diatomic molecule. Calculation of bond length and hence dipole moment and percentage of ionic character of a bond.

1.3. **Vibrational spectroscopy:** harmonic oscillator, zero – point energy, force constant, Hook's law. Anharmonicity, overtones, combination bands and Fermi resonance. Different types of vibrations. Factors determining the absorption frequency of a functional group. Effect of hydrogen bonding. Vibrational frequencies of different functional groups.

1.4. **Magnetic Resonance Spectroscopy:** Introduction to Nuclear magnetic resonance (nmr) and electron spin resonance spectroscopy (esr). NMR active elements and esr active species. Larmor precession and larmor frequency. Shielding and deshielding of protons, shielding constant , chemical shift and factors determine chemical shift. Spin – spin coupling and spin coupling constants. Chemically and magnetically equivalent nuclei. Introduction to esr and hyperfine structure.

Unit II Phase rule:

2.1. **Fundamentals:** Definition of phase, component and degrees of freedom. Derivation of phase rule. Phase diagram of one component systems such as water, sulphur and carbon dioxide.

2.2. **Two component systems:** Reduced phase rule. Classification of two component systems. Phase diagram of simple eutectic systems such as lead – silver, potassium iodide – water system. Phase diagram of two component systems that forms compounds with congruent melting point and incongruent melting points like ferric chloride – water and copper sulphate – water systems respectively.

2.3. **Solutions of non – electrolytes:** Solution of liquids in liquids. Ideal and non-ideal solutions, Raoult's law. Azeotropic mixtures. Steam distillation. Solubility of different types of partially miscible liquids, critical solution temperature (CST).

2.4. **Distribution law:** Distribution law and its validity. Derivation of distribution law. Deviation from distribution law. Applications of distribution law. Solvent extraction.

Unit III Chemical Kinetics

3.1. **Rate of a reaction:** Law of mass action. Rate and rate constant of a chemical reaction. Definitions and comparison of order and molecularity of a reaction. Rate equation for a zero – order reaction with examples.

3.2. **Rate of a first order reaction:** derivation of rate equation for a first order reaction. Examples for first order reactions. Pseudo first order reaction. Application of first order rate equation to acid catalysed ester hydrolysis and inversion of sucrose.

3.3. **Second order reactions:** derivation of rate equation or a second order reaction involving a single reactant and reactions involving two reactants. Examples for second order reactions. Applications of second order rate equation to saponification of esters.

3.4. Half – life of a reaction, relationship between initial concentration and half – life of reactions of different orders.

3.5. Methods for determining the order of a reaction: by using differential and integral rate equations. Half – life method. Isolation method.

3.6. **Theories of reaction rate:** collision theory. Effect of temperature on the rate of a reaction – Arrhenius equation. Activated complex formation theory (absolute reaction rate theory (ARRT). Lindemann theory of unimolecular reactions.

Unit IV Photochemistry

4.1. **Fundamentals:** photochemical reactions. Comparison of photochemical and thermal reactions. Consequences of light absorption - Jablonsky diagram. Fluorescence and phosphorescence. Chemiluminescence.

4.2. **Laws of photochemistry:** Beer – Lambert law and its limitations. Grotthus – Draper law of photochemical activation. Stark – Einstein law of photochemical equivalence. Quantum efficiency and reasons for variation of quantum yield. Experimental dtermination of quantum yield.

4.3. **Kinetics of photochemical reactions:** derivation of kinetic equation or a photochemical reaction. Rate equations for photochemical reactions between hydrogen and chlorine and hydrogen and bromine.

4.4. Lasers – population inversion, optical pumping, Q – switching

Unit V Group theory

5.1. **Fundamentals:** definition of a group. Various symmetry elements and corresponding symmetry operations. Identification of possible symmetry elements in a molecule. Deduction of point group. Order of a group, sub – groups and classes.

5.2. Group multiplication table. Construction group multiplication tables for C2V, C3V C2h and D2h with suitable examples.

5.3. Matrix representation of symmetry operations.

5.4. Applications of symmetry operations and group theory in chemistry.

Text Books:

1. Advanced Physical Chemistry –Puri,Sharma & Pathania.
2. Physical Chemistry – G. W. Castellan 7th edition
3. Physical Chemistry – S. Glasstone
4. application of group theory in chemistry - F.A. Cotton

Books for Reference:

1. Physical Chemistry – Iran N Levin 6th edition
2. Physical Chemistry – Peter Atkins 7th edition
3. Physical Chemistry - Paul Monk 4th edition

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III YEAR – V SEMESTER
COURSE CODE: 7BCH5P1

CORE COURSE - XI - GRAVIMETRIC ESTIMATION AND ORGANIC PREPARATION PRACTICAL – III

Max. Marks: 60 **Duration: 6 Hrs.**

I. Gravimetric Estimation

1. Estimation of barium as barium chromate / sulphate
2. Estimation of lead as lead chromate / sulphate
3. Estimation of calcium as calcium oxalate
4. Estimation of nickel as nickel dimethyl glyoxime complex

II. Preparation of organic compounds

Preparations involving the following methods

a). Oxidation, b). Reduction, c). Hydrolysis, d). Nitration
e). Ozasone formation, f). Bromination, g). Diazotisation
h). Benzoylation.

III. Determination of melting and boiling points of simple organic compounds: (not for examination purpose)

IV. Separation of organic mixture: (not for examination purpose)

Distribution of External marks:

1. Record	10 marks	
2. Viva – voce	10 marks	
3. Gravimetric estimation	20 marks	
a. Procedure	5 marks	
b. Experiment	15 marks	
4. Organic preparation		20 marks
a. Procedure	5 marks	
b. Crude sample	10 marks	
c. Recrystallized sample	5 marks	
		60 marks

Gravimetric Experiments:

Less than 1% error.....15 marks
1 – 2 % error…...12 marks
2 – 3 % error…...9 marks
3 – 4 % error…... 6 marks
>4% error.....3 marks

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III YEAR - V & VI SEMESTER
COURSE CODE: BCH6P1

CORE COURSE – XII - PHYSICAL CHEMISTRY PRACTICAL – IV
(University Examination will be held in the sixth semester only)

Max. Marks: 60 **Duration: 6 Hrs.**

1. Phase diagram:
a. Simple eutectic
b. Compound formation
2. Determination of molecular weight:
a. Rast-macro method (using naphthalene as solvent)
b. Transition temperature (using sodium thio sulphate penta hydrate as salt hydrate)
3. Critical solution temperature
a. CST of phenol – water system
b. Estimation of sodium chloride by studying the CST of phenol-water system
4. Kinetics
Determination of relative strength of acids by acid catalysed hydrolysis of ester
5. Partition co-efficient
a. Study of equilibrium $KI + I_2 \leftrightarrow KI_3$ by studying the partition co-efficient of iodine between water and carbon tetra chloride.
b.Determination of association factor of benzoic acid in benzene
6. Electrochemistry
a. Conductometric titration between an acid and a base (HCl Vs NaOH)
b. Potentiometric method – Potentiometric titration between 1. an acid and a base (HCl Vs NaOH) and 2. $KMnO_4$ Vs FAS
7. Thermochemistry
a. Determination of heat of solution – ammonium oxalate

Distribution of External marks:

Record	10 marks
Viva – voce	10 marks
Procedure	10 marks
Experiment	30 marks
	60 marks

III YEAR - V SEMESTER
COURSE CODE: 7BCHE1A

ELECTIVE COURSE - I (A) – ANALYTICAL CHEMISTRY

Unit I Analytical data analysis and Laboratory hygiene:

1.1.**Need of statistical analysis:** definition for accuracy precision and error. Sources of errors and classification of errors – systematic (determinate) errors and random (indeterminate) errors. Distribution of errors. Methods of minimisation of errors.

1.2.**Data analysis:** Mean standard deviation and coefficient of variance. Significant figure.

1.3.**Reliability of results:** Q – test. Student – t – test and F-test – confidence limit and rejection of experimental data. curve fitting – methods of least squares – problems involving straight line graphs.

1.4. **Laboratory Hygiene and Safety:** Storage and handling of chemicals – carcinogenic, corrosive, explosive, toxic and poisonous chemicals – general precautions for avoiding accidents – first aid techniques for acid in eye, alkali in eye, acid burns, alkali burns, bromine burns, poisoning, inhalation of gases, cut by glasses and heat burns – methods to avoid poisoning – treatment for specific poisons.

Unit II Separation purification and Chromatographic and Electrophoretic methods:

2.1. **Separation and Purification Techniques:**Solvent extraction – Soxhelt extraction – Principles and applications of distillation, fractional distillation, steam distillation – crystallization and sublimation.

2.2. Basic principle of chromatography. Various types of chromatographic technique. Column chromatography, thinlayer chromatography, Paper chromatography, Gas chromatography, ion exchange chromatography and HPLC.

2.3. Basic principles of electrophoresis. Isoelectric point. Electrophoretic mobility. Electrophoretic separation of proteins.

Unit III Colorimetry and spectrophotometry:

1.1.**Theory of colorimetry and spectrophotometry**: Beer – Lambert's law and its limitations. Standard series method and balancing methods.

1.2.Reagents, solutions and experimental procedure for the estimation of iron, lead nickel and tin.

1.3Basic principles of spectrofluorimetry. Reagents, solutions and experimental procedure for the estimation of aluminium, cadmium, calcium and zinc.

Unit IV Gravimetry:

4.1. Basic principle, advantages of gravimetric analysis. Solubility product. Super saturation. Co-precipitation and post precipitation. Digestion. Precipitation from homogeneous solutions. Precipitants . specific and selective precipitant. sequestering agents.

4.2.Thermogravimetric analysis – Principle – instrumentation – characteristics of thermogravimetric curve – Applications of TGA for calcium oxalate monohydrate. Differential Thermal Analysis – Principle – instrumentation – characteristics of differential thermal curve – Applications of DTA for calcium oxalate monohydrate.

Unit V Electro-analytical techniques:

5.1. Electro- gravimetry: theory of electro-gravimetry. Faraday's laws. Ohm's law. Electrical units – ampere, volt, ohm and coulomb. Polarised and depolarised electrodes. Current density, current efficiency, decomposition potential and overpotential. Electrolytic separation of copper from nickel and copper from lead. Estimation of antimony, copper, lead and tin in alloys.

5.2. **voltammetry:** principles of voltammetry. Experimental setup for polorographic analysis. Types of polorographic methods. Determination of lead in tap water.

5.3. **Electrochemical analytical techniques:** Basic principles of voltametric analytical techniques. Potentiometric titrations and conductometric titrations. Irreversible electrode processes and overvoltage. Applications of overvoltage. Polorography and its applications.

Books for Reference:

1. R.Gopalan, P.S.Subramanian and K.Rengarajan, Elements of Analytical Chemistry, Sultan Chand & Sons, New Delhi, 1995.
2. Douglas A.Skoog and D.M.West, Principles of Instrumental Analysis, W.B.Saunders, New York, 1982.
3. Gurdeep Chatwal, Sham Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House, Mumbai, 1998.
4. Vogel's quantitative chemical analysis – 5th edition.

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III YEAR – V SEMESTER
COURSE CODE: 7BCHE2A

ELECTIVE COURSE II (A) – INDUSTRIAL CHEMISTRY

Unit I

1.1.**Paints:** Paint – definition – classification of paints based on their applications – constituents – Requisites of a good paint

1.2.**Pigments:** Definition – composition, characteristics and uses of white lead, Zinc oxide Lithopone and TiO2 – Blue pigments – Ultra marine blue – characteristics – uses. Red pigments – red lead –characteristics and uses. Green pigments – chrome green, Guigwet's green and chromium oxide – characteristics and their uses.

1.3.**Varnishes:** Definition – constituents of varnish – characteristics of a good varnish – uses – Japans varnish. Enamel – definition – Types – Ingredients and uses.

Unit II

2.1.**Ceramics:** Definition, classification of ceramics, general properties of ceramics – permeable (porous) and impermeable (non porous wares) – Basic raw material – Manufacture – applications of colour to pottery.

2.2.**Glass:**Definition – physical and chemical properties of glass – raw materials – Manufacture – types of glasses.

2.3.**Cement:** Raw materials – Portland cement – composition – types of Portland cement – Manufacture – Uses of Cement – Cement Raw Materials in India – Growth of Cement Industry in India. Chemistry of setting of cements.

Unit III

3.1.**Soap:** Definition – General consideration in soap making – manufacture of soap – toilet and transparent soaps.

3.2.**Detergents:** Definition – classification of face active agents – anionic detergents – cationic detergents – shampoo – raw materials

3.3.**Refractories:-** Introduction, Classification – Properties – Manufacture – Fire clay bricks – manufacture – Uses

Unit IV

4.1.**Fertilizers:** Definition – manufacture of Ammonium sulphate, CAN. Manufacture of urea and estimation of urea. Manufacture of phosphoric acid. Manufacture of superphosphates and uses of phosphate as fertilizer. Mixed fertilizers (NPK) – Fertilizer industries in India.

4.2.**Sugar Industry:** Manufacture of sugar from molasses and beetroot – sugar industries in India. Fermentation: Manufacture of spirits and wines. Distillation: Manufacture of vinegar and ethyl alcohol.

4.3.**Match industries:** Manufacture – chemistry of lighting and pyrotechny

Unit V

5.1.**Adhesives:** definition – classification of adhesives – animal glue – preparation – uses– protein adhesives – starch adhesives – preparation – uses.

5.2.**Enamels:** Introduction – Raw Materials – Manufacture and Applications

5.3.**Explosives:** Definition – Classification – Characteristics of explosives – Nitro cellulose, T.N.T. Picric acid, Gun Powder, Cordite and Dynamite.

Books for Reference:

1. B.K. Sharma – "Industrial Chemistry", 1st Ed., (1983), Goel Publication, Meerut.
2. B.N. Charabarthy – "Industrial Chemistry", 1st Ed., Oxford and IBh Publishing. New Delhi.
3. P.L. Soni – "Text Book of Organic Chemistry", 26th Ed., (1994), S. Chand & Co, New Delhi.
4. Arun Bahl and B.S. Bahl – "Text Book of Organic Chemistry", 11th and 18th Ed., (2006), S.Chand, New Delhi.
5. Krishnamoorthy, P. Vallinayagan & K. Jaya Subramanian – "Applied Chemistry", 2nd Ed., (1999, 2001), Tata MaGraw-Hill Publishing Co. Ltd., New Delhi

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