CHRIST UNIVERSITY

CHEMISTRY SYLLABUS FOR B.Sc.

(TRIPLE MAIN; SEMESTER SCHEME)

COURSE OBJECTIVE

Students opting for chemistry will acquire academic excellence in chemistry. This brings about a transformation in their basic thinking and instills confidence in facing the challenges of the modern times, scientifically.

Modular objective

CHE 131: In this introductory paper the students acquire knowledge of the basic concepts of inorganic chemistry, organic chemistry and physical chemistry.

CHE 231: In this paper they acquire a deeper knowledge about inorganic chemistry and learn environmental chemistry as this is required for a better perspective of the subject.

CHE 331: Here the students are expected to acquire a deeper knowledge about industrial chemistry and analytical chemistry.

CHE 431: In this paper they acquire a deeper knowledge about organic chemistry and physical chemistry as this is required for a better perspective of the subject.

CHE 531: The student learns to appreciate the role of organic chemistry in the present day world. He/she achieves academic excellence in organic chemistry and develops an interest in this branch to take up higher studies.

CHE 532: The student learns the importance of physical chemistry in the present world and gets encouraged to take up higher studies and a career in the subject.

CHE 631: To impart a sound knowledge in the inorganic aspects of chemistry with a special emphasis on coordination chemistry.

CHE 632: An awareness is created about the various topics in biochemistry and made to realize the role of chemistry in life processes.

Course structure for BSc Chemistry						
	Paper Semester Code	**Paper Title**	**Hours per week**	**Total theory hours**	**Maximum marks**	**Credits**
I	CHE 131	Chemistry-I Basic chemistry	4	60	100	3
	CHE 151	Titrimetric Analysis	2		50	1
II	CHE 231	Chemistry-II Inorganic and Environmental Chemistry	4	60	100	3
	CHE 251	Physical Chemistry practical	2		50	1
III	CHE 331	Chemistry-III Analytical and Industrial Chemistry	4	60	100	3
	CHE 351	Inorganic Qualitative Analysis	2		50	1
IV	CHE 431	Chemistry-IV Organic and Physical Chemistry	4	60	100	3
	CHE 451	Inorganic Quantitative Analysis	2		50	1
V	CHE 531	Chemistry-V Organic Chemistry	3	45	100	2
	CHE 551	Organic Chemistry practical	2		50	1
	CHE 532	Chemistry-VI Physical Chemistry	3	45	100	2
	CHE 552	Physical Chemistry practical	2		50	1
VI	CHE 631	Chemistry-VII Inorganic chemistry	3	45	100	2
	CHE 651	Project	2		50	1
	CHE 632	Chemistry-VIII Biochemistry	3	45	100	2
	CHE 652	Biochemistry practical	2		50	1

Assessment of theory papers

A. Continuous Internal assessment(CIA)for theory papers: 50 %(50 marks out of 100 marks)
B. End semester Examination(ESE): 50 %(50 marks out of 100 marks)

Components of the CIA

CIA I: Mid Semester Examination (MSE) (Theory) :25 marks

CIA II : Assignments : 10 marks

CIA III: Seminars/ presentations : 10 marks

Attendence

95-100% :05 marks

90-94% :04 marks

85-89% :03 marks

80-84% :02 marks

75-84% :01 marks

Question Paper Pattern for Semesters I to VI

Section A – 2 Mark Questions (12 to be answered out of 15) - 24

Section B – 4 Mark Questions (10 to be answered out of 14) - 40

Section C – 6 Mark Questions (6 to be answered out of 9) - 36

Total: **100 marks**

Semester I

CHE 131 Chemistry-I Basic Chemistry- 60Hrs

1. Periodicity of properties in elements – 4Hrs

Definition and periodicity of the following properties - atomic radii, ionic radii, ionisation potential, electron affinity and electronegativity (determination not needed), lanthanide contraction, inert - pair effect with examples.

2. S Block Elements- 4 Hrs

Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems.

3. P Block elements-5 Hrs

Comparative study (group-wise) of group 13 & 14 elements with respect to periodic properties. Allotropes of carbon-Graphite and diamond. Borazines, classification and structural principles of silicates. Structure and uses of hydrazine, hydroxylamine, Allotropes of phosphorous.

4.Types of Solvents- 4Hrs

Protic and aprotic solvents, aqueous and non aqueous solvents, liquid ammonia as an example of non-aqueous solvent.

5. Classification and nomenclature of organic compounds-3Hrs

Introduction, classification, IUPAC nomenclature of mono and bifunctional organic compounds.

6. Structural theory in Organic Chemistry-7 Hrs

Hybridizations, bond lengths and bond angles, bond energy; Localized and delocalized chemical bond, polarity of bonds, resonance, hyperconjugation, inductive and induced field effects, hydrogen bonding. Heterolytic and homolytic cleavage, nucleophiles, electrophiles and types of organic reactions -substitution, addition and elimination reactions; Reactive intermediates- carbocations, carbanions, free radicals and carbenes. energy profile diagrams-transition states.

7. Acyclic Hydrocarbons-10 Hrs

Alkanes

Methods of preparation with special reference to Wurtz, Kolbe and Corey House reactions. Mechanism of free radical halogenations of alkanes. Reactivity and selectivity of chlorination and bromination. Newman projection and Saw horse formulae, Fischer and Flying wedge formulae. Conformations, conformational analysis of ethane and n-butane.

Alkenes

Methods of preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regio-selectivity in alcohol dehydration; the Saytzeff rule, Hoffmann elimination, Markownikoff's rule, peroxide effect, hydroboration-oxidation oxymercuration reduction, epoxidation, ozonolysis, hydration, Birch reduction. hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes, substitution at the allylic and vinylic positions of alkenes; industrial applications of ethylene and propene.

Dienes*:* Conjugated and isolated dienes, resonance stabilization, 1,2-versus 1,4-addition, Diels-Alder reaction.

Alkynes*:* Preparation**,** Reduction, electrophilic addition, oxidation with $KMnO_4$, hydroboration- oxidation and hydrogenation reactions -acidity and metal acetylides.

8. Alicyclic hydrocarbons (Cycloalkanes)-3 Hrs

Nomenclature, methods of preparation and chemical reactions. Bayer's strain theory and its limitations. Ring strain in cyclopropane and cyclobutanes. Theory of stainless rings systems- Sachse-Mohr theory. Conformations of cyclohexanes, axial and equatorial bonds.

9. Phase rule- 5 Hrs

Statement and explanation of the terms with examples, one component systems – water and sulphur systems. Two component systems – KI-water and Pb-Ag systems. Eutectic and freezing mixtures and their applications. Efflorescence and deliquescence. Phase diagram of Fe-C system.

10. Elementary Thermodynamics – First law- 5 Hrs

Thermodynamic equilibrium, reversible and irreversible processes. State and path dependent functions; exact and inexact differentials. Concept of internal energy, heat and work. First law of thermodynamics, significance of internal energy and enthalpy. Work done in an isothermal and adiabatic expansion and compression of an ideal gas.

Heat capacity of a gas at constant pressure and at constant volume. relation between the two. Kirchoff's equation.

11. Colligative properties-6 Hrs

Raoult's law, lowering of vapour pressure. Determination of the molecular weight of a non volatile solute using (1) Relative lowering of vapour pressure (2) Elevation in boiling point, (3) Depression in freezing point (4) Osmotic pressure ; Osmotic pressure of dilute solution and its measurement by Berkeley – Hartley's method. Osmotic laws and analogy with gas laws. Relationship between ΔT_b, ΔT_f and relative lowering of vapour pressure, Abnormal molecular weight, vant Hoff factor, evaluation of degree of dissociation and association, Rast method. Activity and activity coefficient. Reverse osmosis and its applications.

12. Gases-4 Hrs

Maxwell Boltzmann distribution of molecular velocities, mean free paths, collision frequency, derivation of expression for most probable velocity, definitions and expressions for rms velocity and average velocity (no derivations), relationship between the three types of velocities.

Andrew's experiment on CO_2, critical constants and their determination, and relationship with van der Waals constant. Joule-Thomson effect, inversion temperature and their applications to the liquefaction of air and hydrogen. Law of corresponding states.

References/Text books

1. Advanced Inorganic Chemistry, **B.R.Puri and L.R.Sharma,** Shoban Lal Nagin Chand and Sons, 2004.

2."A New Concise Inorganic Chemistry*",* **J. D. Lee**, 5th Edition, Chapman & Hall, London, 1996.

3. A Text Book of Organic Chemistry Vol I&II , **I.L.Finar** VIth Edn. LBS & Longman group Ltd.

4.Advanced Organic Chemistry, **B. S. Bahl and A. Bahl,** S. Chand &co. VIth Edn,2006

5. Physical chemistry, **Daniels,F.,and Alberty, F.A**., 4th edition,Wiley,1992.

6. Textbook of Physical Chemistry , **Samuel Glasstone** ,2nd edition, Mcmillan,1998.

7. Chemistry, **Raymond Chang**, 6th edition, 1998.

Semester II

CHE 231-Chemistry II

Inorganic and Environmental Chemistry- (60 Hrs)

Inorganic Chemistry (40 Hrs)

1. Atomic Structure and Elementary Quantum Mechanics -7 Hrs

Blackbody radiation, Planck's radiation law, photoelectric effect, Compton effect, de Broglie's hypothesis, Heisenberg's uncertainty principle. Postulates of quantum mechanics. Schrodinger wave equation and particle in a box, energy levels, wave functions and probability densities. Schrodinger wave equation for H-atom. radial and angular functions, hydrogen like wave functions, quantum numbers and their importance.

2. Chemical Bonding – 15 Hrs

(i) ***Ionic Bond*** – Types of ionic solids, radius ratio effect and coordination number, limitations of radius ratio, lattice defects, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability, Fajan's rules.

(ii) ***Covalent Bond*** **:** Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions such as NH_3, H_3O^+, SF_4, ClF_3 ICl_2^-,ICl^{4-}, and H_2O by valence shell electron pair repulsion (VSEPR) theory, linear combination of atomic orbitals (LCAO), bonding, nonbonding and antibonding molecular orbitals. Applications of MO theory to explain the stability of homo and hetero dinuclear diatomic molecules, multi-centre bonding in electron-deficient molecules - diborane.

(iii) ***Metallic bond***- Free electron and band theories.

iv) ***Weak Interactions***-Hydrogen bonding- Inter molecular hydrogen bonding and intra molecular hydrogen bonding, van der waal's forces.

2. Physical properties and Molecular Structure-5 Hrs

Polarisation and orientation of dipoles in an electric field. Dipole moment. Induced dipole moment . Clausius-Mossotti equation (only statement). Dipole moment and structures of molecules (planar and non-planar). Magnetic properties: paramagnetic, diamagnetic and ferromagnetic systems.

4. Nuclear chemistry-10 Hrs

N/P ratio, curves, stability belts. Nuclear binding energy. Mass defect, simple calculations involving mass defect and B.E per nucleon, half-life, radioactive equilibrium, radioactive series, magic numbers - liquid drop model - shell model. Artificial radioactivity - Induced radioactivity, Nuclear fission - nuclear energy - nuclear reactors - breeder reactor - nuclear fusion - thermonuclear reactions - energy source of the sun and stars.

Isotopes—use of radioactive isotopes in tracer technique, agriculture, medicine, food preservative and carbon and tritium dating. (Problems to be worked out).

5. Noble Gases- 3 Hrs

Properties of noble gases, Xenon; properties, structure and bonding in Xenon compounds.

Environmental Chemistry-20 Hrs

Atmosphere: Composition and structure of atmosphere, particles, ions and radicals in the atmosphere, stratospheric ozone depletion.

Air Pollution: Air Pollutants, e.g. carbon monoxide, nitrogen oxides, hydrocarbons, oxides of sulfur, photochemical smog, acid rain and particulates. Air quality standards and sampling; monitoring of CO, NO_x, and SO_2. Automobile pollution. Effect of pollutants.

Hydrosphere : Water resources, hydrologic cycle. Complexation in natural and waste water. Micro organisms.

Water Chemistry: Principles and applications of aqueous chemistry and unique properties of water. Water quality parameters and standards. Acid mine drainage, heavy metal

pollution, eutrophication, soap and detergents, pesticides, nitrates, fluorides- effect and abatement.

Lithosphere : Composition, inorganic & organic compounds in soil, Acid-base and ion exchange reaction in soil, micro and macro nutrients, nitrogen pathways and NPK in soil, waste classification & disposal. E-waste and its disposal.

Radiation hazards and disposal of nuclear wastes.

Green chemistry: Importance, principles and scope of green chemistry.

References/Text books

1."A New Concise Inorganic Chemistry", **J. D. Lee**, 5th Edition, Chapman & Hall, London, 1996.

2. "Modern Inorganic Chemistry", **R. C. Aggarwal**, 1st Edition, Kitab Mahal, Allahabad, 1987.

3. "Basic Inorganic Chemistry", **F. A. Cotton, G. Wilkinson, and Paul L. Gaus,** 3rd Edition, John Wiley & Sons, New York, 1995.

4. Advanced Inorganic Chemistry Vol-I **Satyaprakash, Tuli, Basu and Madan,**1986

5. Environmental Chemistry, **Ajay Kumar Bhagi and G.R Chatwal**, Himalaya publishing house, 2003.

6. Green Chemistry, **K.R.Desai**, Himalaya publishing house, 2005.

7. Inorganic Chemistry and analysis, **Anil Kumar de and Arnab Kumar de**, II Edition, New age international publication, 2005.

8. Essentials of Nuclear Chemistry, **Arnikar, H.J.,** John Wiley and Sons, 2nd edition, 1987.

Semester III

CHE 331- Chemistry-III- Industrial and Analytical chemistry-60Hrs

Industrial chemistry-30 Hrs

1. **Petroleum and Petrochemicals- 3 Hrs**

Origin of petroleum, composition, Octane number, Cetane number, petrol, diesel, kerosene, naphtha, lubricants, LPG (mention only), synthetic petrol, fuel additives-petrochemicals.

2 Soaps and Detergents- 3Hrs

Comparison of soaps and detergents, synthesis of detergents starting from benzene, mechanism of action of soaps and detergents. Detergents formulations, laundry detergent formulations, all purpose cleaning products, special purpose cleaners.

3.Organic Dyes - 2Hrs

Relation between colour and structure, modern views, synthesis of malachite green, congo red and methyl orange. Structure and synthesis of indigo and alizarin. Chemistry of dyeing.

4. Polymers - 5Hrs

Types of polymers and polymerisation process, Addition polymers, stereo controlled polymers, condensation polymers, radical, ionic mechanism of polymerisation. Preparation and applications of following polymers : (i) Natural and synthetic rubber, (ii) Synthetic fibers : Polyester, polyamides, polyacrylates and rayons, (iii) Plastics : Polyolefines and Polyurethanes, (iv) Foaming agents : Plasticizers (v) Biodegradable polymers and their advantages.

5. Industrial materials -15 Hrs

i) *Non-ferrous alloys*: production, applications (copper and Nickel alloys)

ii) *Refractories* :properties , classification, determination of PCE values.

iii) *Abrasives*: classification, applications, hardness, manufacture and importance of carborundum , alundum , tungsten carbide.

iv) *Glass:* Properties, types, manufacture of soda, borosilicate and optical glasses. Safety glass, fire and bullet proof glasses .

v) *Fertilizers:* Qualities of a good fertilizer; Role of N, P, K in fertilizer. Manufacture of Calcium Cyanamide ($CaCN_2$) and its characteristics.

vi) *Cement:* raw materials, grades, manufacture of Portland cement, setting process.

vii) *Paints and varnishes*: constituents of oil and emulsion paints and their role, constituents of varnishes.

viii) *Pigments* : manufacture and relative merits of white lead , lithopone and titanium white.

ix) *Fuels :* Characteristics , calorific value and its determination using bomb calorimeter . Coal - varieties, reserves and production in India. Production of coke, Gaseous fuels – advantages, constituents and their significance. Biofuels.

x) *Explosives:* Classification, preparation of dynamite and TNT.

xi) *Propellants:* characteristics, classification and their applications

6. Powder Metallurgy-2Hrs

Advantages of powder metallurgy, applications, techniques in production of metal powders, production of tungsten powder from Wolframite.

ANALYTICAL CHEMISTRY- 30 Hrs

1. Statistical evaluation of analytical data-3 Hrs

Concept, classification and minimization of errors; Average, Mean and standard deviation Accuracy and Precision, Significant figures in computation.

2. Principles involved in inorganic qualitative analysis-5 Hrs

Common ion effect, solubility product, condition for the precipitation of a cation in solution, grouping of radicals, selective precipitation of cations in basic radical analysis. Complex ion formation- instability constant, detection of Cu^{2+} and Cd^{2+} from a mixture. Interfering radicals and their elimination.

3. Solvent Extraction- 3Hrs

Nernst distribution law, Applications, Batch and continuous extraction of solids and liquids -Soxhlet extraction of phytochemicals.

4. Chromatography -6Hrs

Classification of chromatographic methods, Column chromatography- terminology, basic principles of adsorption, partition and ion exchange chromatography. Principles and applications of HPLC, GC, TLC.

5. Instrumental methods of analysis -7Hrs

Spectrochemical methods- Colorimetry and Spectrophotometry, Technique and instrumentation. Beer lambert's law and its applications, deviations, limitations. flame photometry- determination of sodium and potassium.

Electro analytical methods- estimation of copper by electrogravimetric method, Thermo analytical methods-TGA, DSC.

6. Titrimetric methods of analysis- 2 Hrs

Acid base, Redox, Precipitation and Complexometric titrations. Theory of Indicators and their classification – acid base, mixed and flourescent indicators.

7. Organic reagents in analytical chemistry- 4Hrs

Advantages of organic reagents over inorganic reagents ; use of EDTA, Oxine, DMG and o-Phenenthroline in the estimation of Mg, Ca, Zn, Ni (by gravimetry and volumetry) and Fe (by colorimetry).

References/Text books

1. Introduction to Industrial Chemistry, **B.K. Sharma**, Goel Publishing House, 1998.
2. Polymer chemistry, **M.G.Arora and M. Singh**, Anmol publications pvt ltd., 1996.
3. Instrumental Methods of Analysis, **H. H. Willard, L. L. Merritt, and J. A. Dean**, 6th Edition, CBS Publishers & Distributors, Shahdara, Delhi, 1986.
4. Analytical Chemistry, **G. D. Christian**, 4th Edition, John Wiley & Sons, New York, 1986.
5. Vogel's text book of quantitative chemical analysis 5th edition, **Ed., Jeffery** et. Al ELBS/Longman, 1989.
6. Fundamentals of analytical chemistry, 8th edition, **Skoog, West, Holler and Crouch**: Thomson Asia Pvt. Ltd, 2004.

Semester-IV

CHE 431- Chemistry IV- Organic and physical chemistry- 60 Hrs

1. Arenes and Aromaticity- 8 Hrs

Nomenclature of benzene derivatives. The aryl group- aromatic nucleus and side chain; Aromaticity- the Huckel rule, aromatic ions. Aromatic electrophilic substitution, general pattern of the mechanism- Mechanism of nitration, sulphonation and Friedel-Crafts reactions; Energy profile diagrams. Activating and deactivating substituents. Orienting and activity influence of substituents in toluene, chlorobenzene, nitrobenzene and phenol; hyperconjugation and resonance effects of these groups.

Naphthalene-structural elucidation; anthracene and phenanthrene-resonance structures; Carcinogenicity.

3. Alkyl and Aryl Halogen Compounds: 3Hrs

Relative reactivities of alkyl halides versus allyl, vinyl and aryl halides. SN_1 and SN_2 mechanisms. Elimination reactions – E_1 and E_2 mechanisms, Saytzeff elimination. Side chain chlorination of toluene. DDT and BHC. Nucleophilic aromatic substitution in aryl halides.

4. Organometallic Compounds 2 Hrs

Organo magnesium compounds: the Grignard reagents-formation, structure and chemical reactions.

Organo lithium compounds: formation and chemical reactions.

5. Alcohols 5 Hrs

Monohydric alcohols - methods of formation - reduction of aldehydes, ketones, carboxylic acids and esters, hydrogen bonding, acidic nature.

Dihydric alcohols - methods of formation, vicinal and geminal glycols - pinacol-pinacolone rearrangement, oxidation of glycols by periodic acid, lead tetra acetate.

Trihydric alcohols - methods of formation, chemical reactions of glycerol.

6. Phenols- 2 Hrs

General methods of preparation and reactions. Relative acidity of phenols, alcohols and carboxylic acids. Reimer-Tiemann and Kolbe reactions. Structure of dihydric and trihydric phenols.

7. Ethers and Epoxides-2 Hrs

Methods of formation and chemical reactions of ethers, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides.

8. Aldehydes and Ketones-5 Hrs

Synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketone using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevengel condensations. Cannizzaro's reaction. Meerwin-Pondorof- Verly, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions.

9. Organic Synthesis via Enolates -3 Hrs

Acidity of α-hydrogens, synthetic applications of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate, Claisen condensation. Keto-enol tautomerism in ethyl acetoacetate.

10. Chemical Kinetics- 8 Hrs

Chemical kinetics and its scope; rate of a reaction, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst; concentration dependence of rates, mathematical characteristics of simple reactions – zero order, first order, second order, half-life and mean life. Determination of the order of reaction – differential method, method of integration, method of half life period and isolation method.

Radioactive decay as a first order phenomenon.

Theories of chemical kinetics: Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis), Expression for the rate constant based on equilibrium constant and thermodynamic aspects. Fast reactions – Flash photolysis. Parallel and consecutive reactions – examples. Third order reactions, Expression for k (derivation not required).

11. Liquid mixtures- 8 Hrs

Completely miscible, partially miscible and immiscible pairs of liquids, Raoult's law, Ideal and non ideal solutions. Vapour pressure-composition and boiling point-composition curves. Principle of fractional distillation. Fractional distillation of completely miscible pair of mixtures, azeotropic mixtures, Lever rule.

Study of partially miscible pair of liquids. Concept of upper and lower critical solution temperature. Effect of addition of salt on C.S.T. of water and phenol. Steam distillation and applications.

Distribution law- verification and application, Henry's law of gas solubility and its applications.

12.Chemical Thermodynamics-(A macro approach) -8 Hrs

Need for the second law of thermodynamics – different ways of stating second law. Heat engines. Carnot cycle and its efficiency, calculation of entropy changes in different processes, free energy, work function and chemical potential. Criteria for equilibrium and spontaneous processes. Thermodyanmic principles in Ellingham's diagram.

Variation of free energy with pressure and temperature. Van't Hoff Isotherm. Gibbs-Helmholtz equation, Van't Hoff isochore. Clausius-Clapeyron equation and its applications. Zeroth law of thermodynamics.

Qualitative treatment of Nernst heat theorem. Third law of thermodynamics and concept of residual entropy.Partial molar properties – fugacity.

13.Crystallography -6Hrs

Definition of space lattice, unit cell. Laws of crystallography, Symmetry elements in crystals, seven crystal systems, Weiss and Miller indices, X-ray diffraction of crystals,

derivation of Braggs equation, Determination of the structure of NaCl by rotating crystal method.

Elementary discussion of the liquid crystalline state: Classification, structure and applications.

References/Text books

1. "Organic Chemistry", **R. T. Morrison and R. N. Boyd**, 6th Edition, Prentice-Hall of India (P)Ltd., New Delhi, 1992.
2. "Organic Chemistry", **S. M. Mukherji , S. P. Singh, and R. P. Kapoor**, 1st Edition (1985), 5th Reprint, New Age International (P) Ltd. Publishers, New Delhi, 1999.
3. "Organic Chemistry", **I. L. Finar,** Vol. II, 5th Edition, Reprinted in1996, ELBS and LongmanLtd., New Delhi, 1975.
4. "A Guide Book to Mechanism in Organic Chemistry", **P. Sykes,** 6th Edition, Orient Longman Ltd., New Delhi(1997).
5. "Organic Chemistry – Structure and Reactivity", **Seyhan N. Ege**, AITBS publishers, Delhi, 1998.
6. "Organic Chemistry", **Paula Y. Bruice**, 2nd Edition , Prentice-Hall International Inc, New Jersey, International Edition, 1998.
7. A Text Book Of Organic Chemistry, **Arun Bahl And B.S.Bahl**,17th Edition, S.Chand&Company, New Delhi,2005.
8. Physical chemistry **Atkins, P.W**., 5th ed., Oxford University Press 1992.
9. Physical chemistry **BarrowG.M.,** 5th ed.Mc Graw Hill,1986.
10 .Physical chemistry **Daniels,F.,and Alberty, F.A**., 4th edition,Wiley,1992.
11. Textbook of Physical Chemistry **Samuel Glasstone**, 2nd edition, Mcmillan,1998.

Semester-V

CHE 531- Chemistry-V- Organic chemistry-45 Hrs

1. Carboxylic Acids -5 Hrs.

Acidity of carboxylic acids, effects of substituents on acid strength. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction.

Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Dicarboxylic acids; methods of formation and effect of heat and dehydrating agents, hydroxy acids- Malic, tartaric & citric acid.

2. Organic Compounds of Nitrogen -5 Hrs.

Separation of a mixture of primary, secondary and tertiary amines. Hinsberg test; Structural features effecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-Phthalimide reaction, Hoffmann bromamide reaction. Reaction of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

3. **Organosulphur Compounds- 2 Hrs**

Introduction to organosulphur compounds, methods of synthesis and reactions of thiols and thioether.

4.Stereochemistry – 8 Hrs

Concept of isomerism, types of isomerism, optical isomerism, elements of symmetry, molecular chirality, enantiomers, stereogenic centers, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, distereoisomers, mesocompounds, resolution of enantiomers, racemization.

Relative and absolute configurations, sequence rules, D & L, R & S systems of assigning configuration. Geometrical isomerism; Nomenclature by E and Z system, geometrical isomerism in alicyclic compounds.

5. Heterocyclic Compounds -4 Hrs

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Nucleophilic substitution reactions in pyridine. Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and six membered heterocyclics. Preparation and reactions of Indole, quinoline and isoquinoline with special reference to Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Electrophilic substitution reactions of indole, quinoline and isoquinoline.

6. Carbohydrates- 3 Hrs

Classification and nomenclature. Monosaccharides, osazone formation; interconversion of glucose and fructose, configuration of monosaccharides. Erythro and threo diaestereomers. Determination of ring size of glucose. Cyclic structure of D(+) glucose. Mechanism of mutarotation. Structures of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

7. Applications of Spectroscopy in Organic Chemistry -6 Hrs

Ultraviolet (UV) absorption spectroscopy - presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic and hypsochromic shifts, hyperchromic and hypochromic effects. UV spectra of conjugated enes.

Molecular vibrations, IR spectra of simple organic compounds, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation.

Nuclear magnetic resonance (NMR) spectroscopy, Proton magnetic resonance(H NMR) spectroscopy. Nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals. Interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1, 2-tribromoethane, ethyl acetate, toluene and acetophenone.

Problems pertaining to spectroscopic techniques.

8. Methods of Proposing Reaction Mechanism-3Hrs

Guidelines for proposing a reasonable mechanism, product studies, bonds broken and formed, inter and intramolecular migration of groups, crossover experiments, exchange with solvents, importance of byproducts, reactive intermediates, energetics, importance of activation parameters. Isotopic substitution in a molecule, primary and secondary kinetic isotope effects - their importance in mechanistic studies.

Introduction to retrosynthetic analysis.

9. Alkaloids-3 Hrs

Occurrence, importance, general properties, structure and synthesis of nicotine and piperine. Medicinal uses of Quinine, Morphine, Strychnine, Cocaine, Atropine, Reserpine and Nicotine.

10. Terpenes-3 Hrs

Occurrence, isolation, classification, Isoprene rule, structure and synthesis of citral, geraniol and α-terpineol. Structures and uses of Menthol, Camphor, Limonene and beta-Carotene.

11. Drugs - 3Hrs

Chemotherapy. Classification, preparation and uses of the following :

(i) *Antipyretics and Analgesics* : Aspirin, Paracetamol .

(ii) *Sulpha drugs* : Sulphanilamide

(iii)*Antimalarials* : Chloroquine, Primaquine.

(iv) *Antibiotics* : Chloramphenicol.

References/Text books

1. “Organic Chemistry”, **R. T. Morrison and R. N. Boyd**, 6th Edition, Prentice-Hall of India (P)Ltd., New Delhi,1992.

2. “Organic Chemistry”, **S. M. Mukherji , S. P. Singh, and R. P. Kapoor**, 1st Edition, 5th Reprint, New Age International (P) Ltd. Publishers, New Delhi 1999.

3. “Organic Chemistry”, **I. L. Finar**, Vol. II, 5th Edition (1975), Reprinted in1996, ELBS and LongmanLtd., New Delhi.

4. “A Guide Book to Mechanism in Organic Chemistry”, **P. Sykes**, 6th Edition (1997), Orient Longman Ltd., New Delhi...

5. “Organic Chemistry – Structure and Reactivity”, **Seyhan N. Ege**, AITBS publishers, Delhi (1998).

6. “Organic Chemistry”, **Paula Y. Bruice**, 2nd Edition , Prentice-Hall International Inc, New Jersey, International Edition (1998)

7.A Text Book Of Organic Chemistry, **Arun Bahl And B.S.Bahl**,17th Edition, S.Chand&Company, New Delhi,2005.

Semester V

CHE 532 -Chemistry VI-Physical chemistry- 45 Hrs

1. Chemical and Ionic Equilibria-5 Hrs

Equilibrium constant and free energy. Ionic equilibria, common ion effect, hydrolysis of salts. Relationship between K_h, K_w, K_a and K_b **.** Effect of temperature and concentration on degree of hydrolysis. Evaluation of pH of the solutions. Solubility product and its applications. Buffer solution and mechanism of buffer action.

2. **Adsorption- 2 Hrs**

Freundlich's adsorption and Langmuir's adsorption isotherms, BET equation (derivation not required) and its applications.

3. Electrochemistry-15 Hrs

Definitions of specific, equivalent and molar conductances (κ, λ and μ).Cell constant. Methods of determination of specific conductance, evaluation of equivalent and molar conductance-problems to be set only in SI units. Variation of specific and equivalent/molar conductance with dilution. Temperature dependence of ionic conductance. Strong and weak electrolytes. Conductometric titrations (only acid-base type).

Transport number: Definition; Determination by moving boundary method. Causes of abnormal transport numbers observed in certain systems. Problems based on transport number.

Kohlrausch's law and its applications: (1) Evaluation of Λ_∞ from λ_+ and λ_- (2) Evaluation of degree of dissociation of a weak electrolyte (3) Evaluation of Λ_∞ of a weak electrolyte (4) determination of solubility from conductance of saturated solutions of sparingly soluble salts (AgCl, $BaSO_4$). Problems based on these.

***Limitations of Arrhenius theory*:** Qualitative account of Debye-Huckel theory, Debye-Huckel-Onsagar equation for aqueous solutions of 1:1 electrolytes.

Galvanic cells: Conventions of representing galvanic cells - reversible and irreversible cells, derivation of Nernst equation for single electrode potential (free energy concept).

Weston-cadmium cell.Determination of emf of a cell. Determination of E° of Zn/Zn^{2+} and Cu/Cu^{2+} electrodes. Liquid junction potentials-elimination of liquid junction potential.

Types of electrodes: Metal and gas electrodes (chlorine), redox electrodes. *Reference electrodes:* standard hydrogen electrode, calomel electrode. Quinhydrone electrode, glass electrode, Determination of pH using calomel, quin-hydrone and glass electrodes. Problems.

Concentration cells: (1) emf of concentration cells. (2) Determination of solubility of sparingly soluble salts, problems. Redox electrodes: emf of redox electrodes. Potentiometric titration involving only redox systems.

Fuel cells, solar cells and solar energy panels.

4. Chemical Spectroscopy -15Hrs

Electromagnetic spectrum and the interaction of radiation with matter. Regions of spectrum. Born-Oppenheimer approximation. Degrees of freedom.

Origin of molecular spectra: Study of rotation, vibration spectra of diatomic molecules. Expression for rotational energy. Evaluation of internuclear distance from moment of inertia- problems. Criterion for absorption of radiation - selection rule. Expression for potential energy of simple harmonic oscillator–Hooke's law. Expression for vibrational energy. Zero point energy. Concept of force constant-its evaluation-problems. Degrees of freedom-modes of vibration for CO_2 and H_2O molecules. Vibration - rotation spectra PQR bands. Harmonic bands.

Concept of Polarisability. Raman spectra-qualitative study. Stokes and anti-Stokes lines-selection rules. Advantages of Raman spectroscopy over IR spectroscopy.

Electronic spectra: Potential energy curves for bonding and antibonding orbitals. Electronic transitions, qualitative description of σ, π and non-bonding orbitals and transitions between them. Selection rules and Franck-Condon principle.

Magnetic resonance spectroscopy

NMR spectroscopy, ESR spectroscopy and their applications. NQR spectroscopy and Mossbaur spectroscopy. (Only principles to be discussed).

5. Photochemistry-8 Hrs

Laws of photochemistry: Grotthuss-Draper law, Stark-Einstein law, Differences between photophysical and photochemical processes with examples. Comparison of photochemical and thermal reactions.

Quantum yield of photochemical combination of (1) H_2 and Cl_2 (2) H_2 and Br_2 (3) dissociation of HI (4) dimerisation of anthracene. Photosensitization, photostationary equilibrium. Singlet and triplet states-Fluorescence, Phosphorescence, Luminescence, Bioluminescence, chemical sensors.

Beer-Lambert's law: Applications. Problems on absorption coefficient and molar extinction coefficient. Laser, classification and uses.

References/Text books

1. Physical chemistry by **Atkins, P.W.,** 5th ed., Oxford University Press, 1992.
2. Physical chemistry By **Barrow G.M**., 5th ed.Mc Graw Hill,1986.
3. Physical chemistry by **Daniels,F.,and Alberty, F.A.,** 4th edition,Wiley,1992.
4. Textbook of Physical Chemistry by **Samuel Glasstone** ,2nd edition,Mcmillan,1998.
5. Electrochemistry for chemists by **Samuel Glasstone,** 2nd edition, East-West.

Semester VI

CHE 631- Chemistry VII- Inorganic Chemistry-45 Hrs

1. d block Elements- 7Hrs

Characteristics of d-block elements with special reference to electronic configuration, variable valence, spectral and magnetic properties, catalytic properties and ability to form complexes. Stability of various oxidation states. Comparative treatment of second and third transition series with their 3d analogues. Study of Ti, Cr and Cu triads in respect of electronic configuration.

2. f block Elements-5Hrs

Chemistry of lanthanides – electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties, spectral properties and separation of lanthanides by ion exchange and solvent extraction methods. Chemistry of actinides – electronic configuration, oxidation states, actinide contraction, comparison with lanthanides in terms of magnetic properties, spectral properties and complex formation.

3. Coordination compounds-15 Hrs

Ligands and their classification, coordination number, nomenclature of coordination compounds. Isomerism in complexes- structural and stereoisomerism**.(4)**

Valence bond theory, its limitations, crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal field parameters. Low spin and high spin complexes. Calculation of crystal field stabilization energy for octahedral and tetrahedral complexes, factors affecting CFSE. Merits and demerits of Crystal field theory**. (6)**

Weak and strong field ligands, spectrochemical series, magnetic and spectral properties of transition metal complexes**.(3)**

Thermodynamic and kinetic stability of metal complexes. Factors affecting stability of metal complexes, chelate effect. **(2)**

Organometallic compounds-8 Hrs

Ligands, classification, hapticity. Synthesis and structure of a) K [Pt $Cl_3(-C_2H_4)$] , [Fe $(-C_6H_5)_2$] , [Cr$(-C_6H_5)_2$], [W $(CH_3)_6$]. b) Metal carbonyls :- Ni $(CO)_4$, Fe $(CO)_5$, Cr $(CO)_6$, $Co_2(CO)_8$, $Mn_2(CO)_{10}$. Eighteen electron rule as applied to the above complexes.

Applications of coordination and organometallic complexes.

1.Cis-platin in cancer therapy

2. Na_2EDTA in the treatment of heavy metal poisoning like Pb , Hg .

3. Wilkinsons catalyst in alkene hydrogenation.

4. Monsanto acetic acid process.

5. Hard and soft acids bases (HSAB)- 3Hrs

Classification, Pearson's concept of hardness and softness, application of HSAB principles – Stability of compounds / complexes, predicting the feasibility of a reaction.

6. Bio inorganic Chemistry- 4Hrs

Essential and trace elements in biological process, metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to $Ca^{2+.}$ Nitrogen fixation, vitamin B_{12}.

7. **Chemistry of materials-3 Hrs**

Introduction to nanochemistry, Carbon nanotubes, fullerenes, semiconductors, insulators, superconductors, conducting polymers, perovskite and spinels.

References/Text books

1. "A New Concise Inorganic Chemistry", **J. D. Lee**, 5th Edition, Chapman & Hall, London, 1996.

2. "Modern Inorganic Chemistry", **R. C. Aggarwal**, 1st Edition, Kitab Mahal, Allahabad,1987.

3. "Basic Inorganic Chemistry", **F. A. Cotton, G. Wilkinson, and Paul L. Gaus,** 3rd Edition, John Wiley & Sons, New York, 1995.

4. Advanced Inorganic Chemistry Vol-I by **Satyaprakash, Tuli, Basu and Madan**.

5. Advanced Inorganic Chemistry **R.Puri and L.R.Sharma,** Shoban Lal Nagin Chand and Sons. (2004).

6.Inorganic Chemistry, Principles of Structure and Reactivity, **Huheey, J.E., Keiter, E.A., and Keiter, R.L**., Prentice Hall 4th ed,1994.

Semester-VI

CHE 632 -Chemistry VIII- Biochemistry-45 Hrs

1. Introduction to Biochemistry -2 Hrs

Development of biochemistry-major functions of cell organelles- elemental and biochemical composition of living organisms-role of water in biological systems.

2.Biomolecules

a) Carbohydrates- 5Hrs

Classification (mention only)-structure and biological importance of derived monosaccharides-amino sugars, sugar acids sugar phosphates-oligosaccharides-isomaltose, cellobiose, trehalose-polysaccharides-starch, glycogen and cellulose. Heteropolysaccharides-Occurrence and composition (no structures) of Hyaluronic acid-chondroitin and its sulphates-dermatan sulphate-heparin-agar-agar.

b) Lipids- 3 Hrs

Classification-simple and compound lipids-biological importance-structure of fatty acids-triglycerides and phosphoglycerides-properties of triglycerides-biological importance of triglycerides and phosphoglycerides.

c) Proteins-6 Hrs

α-amino acids-classification based on polarity and chemical nature of R- group-ionic properties and reactions of amino acids-peptide bond and its geometry-Proteins-biological importance-classification based on solubility and composition-levels of organization-primary,secondary(α-helix and β-pleat) and tertiary structure,(forces stabilizing it)-quaternary structure.

d) Enzymes-4 Hrs

Classification-active site-specificity-Fischer and Koshland models-Enzyme kinetics-factors affecting rate of enzymatic reactions-Michaelis- Menten equation-Competitive and noncompetitive inhibition –Cofactors.

e) **Nucleic Acids- 3 Hrs**

Types-components of nucleic acids-nucleosides and nucleotides-poly nucleotides-structure of DNA-(Watson and Crick model) Structure of RNA-biological roles of DNA and RNA.

3. Biological Oxidation- 4 Hrs

Bioenergetics-ATP and other high energy molecules-energy coupling in biological reactions-stepwise process of biological oxidation-Mitochondrial electron transport chain-oxidative phosphorilation-Substrate level phosphorilation.

4. Metabolism- 7 Hrs

Catabolism and anabolism-Carbohydrate metabolism-glycolysis- fate of pyruvate-TCA cycle-Fatty acid metabolism-β-Oxidation pathway-Protein metabolism- general aspects of amino acid degradation-deamination-transamination-decarboxilation-Urea cycle.

5. Molecular Biology- 2Hrs

Central dogma of molecular biology.Replication of DNA-semiconservative mechanism-replication process-transcription and translation.

6. Nutrition biochemistry - 2Hrs

Vitamins-definition-classification and deficiency manifestations of water soluble and fat soluble vitamins-coenzyme functions of B-complex vitamins.

7. Hormones- 2 Hrs

Definition-classification into amino acid derivatives,peptide and polypeptide`hormones and steroid hormones with examples and functions.

8. **Biochemical techniques-5 Hrs**

Homogenisation- Differential centrifugation-Ultracentrifugation-Electrophoresis-Spectrophotometry-Isotropic tracer technique-chromatography.

References/Text books

1. Biochemistry **A.L.Leninger** CBS 2000
2. Fundamentals of Biochemistry **J.L.Jain** S.Chand & co. Vth Edition
3. Outlines of Biochemistry **Conn and Stumph John** Wiley & sons. inc IVth Edition
4. Biochemistry **P.C. Champe and R.A. Harvey** Lipincott&co. 1982
5. Textbook of Biochemistry Devlin A Wiley medical publication IInd edn.
6. Biochemistry **Voet and Voet**.

PRACTICALS

CHE 151: Titrimetric Analysis - 2hrs/Week

Introduction to safety measures in the laboratory

1. Calibration of glassware (i) Pipette (ii) Burette (iii) Volumetric flask.
2. Estimation of potassium permanganate using standard sodium oxalate solution.
3. Estimation of ferrous ammonium sulphate using standard potassium dichromate solution using potassium ferricyanide as external indicator.
4. Estimation of ferrous ammonium sulphate using standard potassium dichromate solution using diphenylamine as internal indicator.
5. Estimation of sodium thiosulphate using standard potassium dichromate solution.
6. Estimation of iodine using sodium thiosulphate and standard $K_2Cr_2O_7$ solution.
7. Determination of the percentage of available chlorine in the given sample of bleaching powder.
8. Determination of the percentage of manganese dioxide from pyrolusite ore.
9. Estimation of ferrous and ferric iron in a given mixture using standard $K_2Cr_2O_7$ solution.
10. Estimation of nitrogen in an ammonium salt (using NaOH solution and standard oxalic acid).
11. Estimation of carbonate and bicarbonate in a given mixture.
12. Estimation of basicity of an antacid tablet by titration against standard acid.

(Note: Standard solutions to be prepared for experiments 2 to 6).

References/Text books

1. Vogel's text book of qualitative chemical analysis, 5th edition, **J. Bassett, G.H. Jeffery and J.Mendham**, and R.C. Denny, Longman Scientific and Technical, 1999.
2. Practical inorganic chemistry, **G.Marr and B.W. Rockett, Von Nostrand Reinhold,** 1972.
3. Practical Chemistry, **O.P.Pandey, D. N. Bajpai, S.Giri,** 2005.
4. Practical Chemistry, **V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulati**, 2005.

CHE: 251 (Physical Chemistry) 2 hrs/ week

1. Determination of the density and viscosity of a liquid by time of flow method using Ostwald's viscometer.
2. Determination of the percentage composition of a binary liquid mixture by viscosity method.
3. Determination of density and surface tension of a liquid (by number of drops) using a stalagmometer.
4. Determination of the heat of neutralization of a strong acid with a strong base.
5. Determination of the heat of solution of KNO_3 or NH_4Cl in water.
6. Determination of the molar mass of a non-electrolyte by Walker – Lumsden method
7. Determination of the degree of dissociation of an electrolyte by ebulioscopic method
8. Determination of the heat of dissociation of acetic acid or a weak base by thermochemical method.
9. Determination of the critical solution temperature of phenol – water system.
10. Determination of the distribution coefficient of I_2 between H_2O and CCl_4.
11. Determination of the distribution coefficient of benzoic acid between water and benzene.

References/Text books

1. Findlay's practical physical chemistry revised by Levitt, Longman's London, 1966.
2. Experiments in physical chemistry by Shoemaker and Garland, McGraw Hill International edn., 1996.
3. Advanced practical chemistry by J.B. Yadav, Goel Publication house, Meerut, 1989.
4. Experimental physical chemistry by Daniel etal., McGraw Hill, 1962.
5. Experimental physical chemistry by Wilson, Newcombe and others, Pergamon Press, New York, 1962.
6. Practical physical chemistry by A.M. James and D.E. Pritchard, Longman Group Ltd.1968.

CHE 351 Inorganic Qualitative Analysis 2 hrs/ week

1. Systematic semimicro qualitative analysis of a mixture of two simple salts (with no interfering radicals) (10 units)
2. Determination of COD of a water sample.
3. Separation of Mg (II) and Fe (II) by solvent extraction technique
4. Separation of Mg (II) and Fe (II) by ion-exchange process.
5. Preparation of ferrous oxalate complex.
6. Preparation of cupramonium suphate.

References/Text books

1. Inorganic semi micro qualitative analysis, V.V. Ramanujam, The National Pub. Co., 1972.
2. Practical inorganic chemistry, G.Marr and B.W. Rockett, Von Nostrand Reinhold, 1972.
3. Practical Chemistry, **O.P.Pandey, D. N. Bajpai, S.Giri,** 2005.
4. Practical Chemistry, **V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulati**, 2005

CHE 451 Inorganic Quantitative Analysis 2 hrs/ week

1. Determination of percentage of iron in haematite using diphenyl benzidine as an internal indicator.
2. Determination of iron using ceric ammonium sulphate
3. Determination of calcium in limestone.
4. Determination of copper in brass.
5. Determination of zinc using EDTA
6. Determination of magnesium using EDTA
7. Determination of total hardness of water using EDTA
8. Preparation of ferrous oxalate and estimation of ferrous ion.
9. Determination of sulphate as $BaSO_4$
10. Determination nickel as dimethyl glyoximate
11. Determination of magnesium as magnesium oxinate
12. Determination of ferrous ion using ortho-phenanthroline
13. Determiantion of copper as cuprammonium sulphate
14. Electrodeposition of copper

References/Text books

1. Vogel's text book of qualitative chemical analysis, 5th edition, **J. Bassett, G.H. Jeffery and J.Mendham**, and R.C. Denny, Longman Scientific and Technical, 1999.
2. Practical inorganic chemistry, **G.Marr and B.W. Rockett, Von Nostrand Reinhold,** 1972.
3. Practical Chemistry, **O.P.Pandey, D. N. Bajpai, S.Giri,** 2005.
4. Practical Chemistry, **V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulati**, 2005.

CHE 551: Organic chemistry practicals 2 hrs/ week

Organic qualitative analysis–identification of monofunctional organic compounds through functional group analysis, determination of physical constant , preparation and characterization of a suitable derivative (8 units).

Estimation of phenol

Estimation of aniline

Preparation and purification of organic compounds

1. Recrystallisation and determination of melting point of solids (mixed melting point determination and its importance may be mentioned).
2. Simple distillation and determination of boiling point of liquids
3. Purification of solids by sublimation

One stage preparations:

4. Preparation of aspirin
5. Preparation of acetanilide from aniline
6. Preparation of 2, 4, 6 –tribromophenol
7. Preparation of m-dinitrobenzene

Two stage preparations

8. Preparation of p-bromo aniline from acetanilide
9. Preparation of p-nitro aniline from acetanilide
10. Preparation of m-nitro benzoic acid from methyl benzoate

Chromatography

11. Thin layer chromatography – separation of green leaf pigments/ separation of a mixture of two organic compounds.
12. Column chromatography – separation of a mixture of two organic compounds.

References/Text books

1. Practical Organic Chemistry, **F.G.Mann, B.C. Saunders,** 4th Ed., Orient Longmann, 2007.
2. Comprehensive practical Organic Chemistry, **V.K. Ahluwalia, Renu Aggarwal**, 1st Ed, Orient Longmann, 2007.
3. Lab Experiments in Organic Chemistry, **Arun Sethi,** New Age International Pltd, 2003.

CHE 552: Physical Chemistry practicals 2 hrs/ week

1. Velocity constant for acid hydrolysis of methyl acetate
2. Velocity constant for the saponification of ethyl acetate (a≡b method)
3. Effect of concentration and temperature on the rate of oxidation of KI by $K_2S_2O_8$.
4. Determination of the equivalent conductivity of 0.1 N NaCl
5. Determination of the dissociation constant of monochloracetic acid by conductivity method
6. conductometric titration of HCl with NaOH
7. Determination of standard redox potential of an electrode.
8. Redox titration of $K_2Cr_2O_7$ with ferrous ammonium sulphate by potentiometry.
9. Determination of the solubility of a sparingly soluble salt (AgCl) by conductivity method.
10. Determination of the percentage of NaCl by miscibility temperature method.
11. Preparation of a buffer solution and determination of its PH by potentiometry
12. Determination of Cu in aluminium and zinc based alloys using flame photometer.
13. Determination of potassium using flame photometer.
14. Determination of transition temperature of a salt hydrate by thermometric method

References/Text books

7. Findlay's practical physical chemistry revised by Levitt, Longman's London, 1966.
8. Experiments in physical chemistry by Shoemaker and Garland, McGraw Hill International edn., 1996.
9. Advanced practical chemistry by J.B. Yadav, Goel Publication house, Meerut, 1989.
10. Experimental physical chemistry by Daniel etal., McGraw Hill, 1962.
11. Experimental physical chemistry by Wilson, Newcombe and others, Pergamon Press, New York, 1962.
12. Practical physical chemistry by A.M. James and D.E. Pritchard, Longman Group Ltd.1968.

CHE 651: Project 2 hrs/ week

- Sem-VI same practical time table for two practicals.
- One to be utilised for project. The two teachers handling the batch to be the project guides.
- In a year each teacher to get roughly 10 students. They may be given 2 group projects, (in groups of 5 students). The groups for each teacher to be assigned in the beginning of V th semester so that they can slowly initiate the project through discussions.
- As per the requirement internal facilities or external services (at the students own cost) may be utilized. Nature of the project can be decided by the guide.
- At the end of the semester each student to submit a project report. Evaluation based on a presentation with one external and one internal (possibly the guide) examiner.

CHE 652: Biochemistry practicals 2hrs/week

1. Chemical tests for Carbohydrates
2. Chemical tests for amino acids and proteins
3. Estimation of reducing sugars by Hegedorn –Jensen method
4. Estimation of lactose in milk by Nelson – Somyogi's method
5. Estimation of blood sugar by Folin –Wu method.
6. Estimation of creatinine in urine by Jaffe's method
7. Estimation of inorganic phosphate in food samples by Fiske –Subbarow method.
8. Estimation of total reducing sugars in honey by DNS (Dinitrosalicyclic acid) method.
9. Estimation of protein by biurette method and lowry' s method'
10. Determination of iodine value of groundnut oil and coconut oil
11. Determination of saponification value of groundnut oil and coconut oil
12. Determination of ∝ -amylase activity in saliva / pancreatin
13. Separation of amino acids by circular / ascending paper chromatography
14. Detection of adulterants in food stuffs

References/Text books

1.An introduction to practical Biochemistry,Ist Edn.1971,**David T Plummer,**Tata McGraw-Hill publishing company.

2.Laboratory Manual in Biochemistry, **J. Jayaraman**, Wiley Eastern Ltd., 1981.

B.Sc Practical Examinations I to V1 Semester

Scheme of assessment

Total Marks for each Semester – 100

1. Continuous internal assessment of Practicals ……	20 Marks
2. Mid-term practical Test ……	20 Marks
3. Record assessment ……	10Marks
4. End-semester Practical examination ……	50Marks
(Marks for procedure writing – 10, Marks for performance in the exam – 40)	
TOTAL MARKS	**100 Marks**

Project Evaluation

The project report shall be evaluated for 75 marks and project related presentation for 25 marks.

A CERTIFICATE PROGRAMME IN FOOD CHEMISTRY

AIMS AND OBJECTIVES

In the context of the present highly competitive job/career scenario of the world, when an undergraduate student, of B.Sc with chemistry as one of the subjects leaves the educational institution, the degree certificate alone does not suffice to choose a bright career or move towards higher education in the field of science.

Hence, in order to equip our students with better opportunities and create interest in higher studies and research culture the department offers the add-on programme called "FOOD CHEMISTRY".

TOPICS to be covered in the theory **30 Hours**

1. Concept of Food Chemistry- Nutrition, Balanced diet- Nutrient etc (3 Hrs)
2. Carbohydrates – introduction and classification, role of fuel molecules, Dietary fiber, process of conversion of storage of energy. (4 Hrs)
3. Biological oxidation – combustion, role of ATP as high energy compound, Exergonic and endergonic reaction. (3 Hrs)
4. Lipids- Dietary sources, essential fatty acids and biological importance – oils, fats, digestion and metabolism etc. (3 Hrs)
5. Proteins – their role in the diet, nitrogen balance essential amino acids- complete and in complete proteins, nutritional value and energy ratio and biological value-malnutrition etc. (4 Hrs)
6. Food Additives and adulterants (4 Hrs)
7. Beverages- artificial sweeteners, flavour.antioxidants. Etc
8. Vitamins and Minerals – source, diet requirement, functions and deficiency (4 Hrs)
9. Food preservation and preservatives (3Hrs)
10. Enzymes (1 Hr)

PRACTICALS AND FACTORY VISIT (30 Hrs)

Visits to CFTRI, Mysore, Bangalore Dairy, Soft drinks factory, Oil Mill

REFERANCE BOOKS

Chemistry for changing times, **John w Hill &Doris k Kolb** prentice Hall 9th edn.2001.

Conceptual chemistry, **John Suchocki** Pearson education Inc**.** 2nd edn.2004.

A CERTIFICATE PROGRAMME IN COSMETIC CHEMISTRY AND HOUSE HOLD CHEMICALS

AIMS AND OBJECTIVES

This course is aimed at creating an awareness among the undergraduate students about the role of chemistry in day- to- day life and to know more about the cosmetics and other chemicals that they use.This will help them in selecting the appropriate products from the various products available in the market.This will also develop in them , a sense of judicious use of cosmetics and other chemicals.The programme will equip the students with better laboratory techniques,create interest in higher studies and an aptitude towards research.

The programme consists of 30 hours of theory and 30 hours of practicals.

THEORY

Introduction to cosmetic chemistry	2 Hrs
Skin creams and lotions-composition and properties	3 Hrs
Deodorants and antiperspirants-composition and how they work	3 Hrs
Tooth pastes and tooth powder- composition and cleansing action	3 Hrs
Perfumes, colognes and aftershaves-composition and properties	3 Hrs
Shampoos, hair colouring and hair removers –composition and their action	4 Hrs
Face powder and face masks –composition and function	2 Hrs
Lipsticks and Eye makeup	2 Hrs
Soaps and detergents-composition and cleansing action	4 Hrs
Special purpose cleaners-composition and working	4 Hrs

PRACTICALS

1. Preparation of a mouthwash
2. .Preparation of an aftershave lotion
3. Preparation of cold creams
4. Preparation of vanishing creams
5. Preparation of a tooth paste

6. Preparation of a tooth powder
7. Preparation of face powders
8. Preparation of shampoos
9. Preparation of lipsticks
10. Preparation of a shaving cream 10x2=20 Hrs

Industrial visits

The students will be given an exposure to the relevant industries .It is proposed to visit one cosmetic industry and one detergent industry. 10 Hrs

Text\reference books

Chemistry, **Raymond** Chang 8th Edn. Tata Mc Graw-Hill
Conceptual Chemistry **John Suchocki** 2nd Edn.Pearson Education.Inc.
Chemistry for changing times, John W. Hill, Doris K. Kolb, 9th Edn.