DEPARTMENT OF CHEMISTRY

B.Sc (Chemistry)-SYLLABUS

Effective from the Academic Year 2008-2009

Loyola College *(Autonomous)*

Chennai - 34

CONTENTS

ALLIED OPTIONAL (AO)

Subject	Sem-I (Hrs/Cr)	Sem-II (Hrs/Cr)	Sem-III (Hrs/Cr)	Sem-IV (Hrs/Cr)	Sem-V (Hrs/Cr)	Sem-VI (Hrs/Cr)	Hr	Cr
Allied required **AR**(Two)		PH-2103: Phys for Chem 4 /3 **PH-2104: Phys for Chem (Pract) 2/1**	MT-3103: Math.for Chem 6/4				12	8
Allied optional **AO** (Two)			One AO from other Dept. 6/4	One AO from other Dept. 6/4			12	8
General Elective **EG** (Two)		One EG from other Dept. 3/2		One EG from other Dept 3/2			6	4
Subject Elective **ES**(Any Two)					**CH-5402 Polym Chem. 3/2** **(OR)** **CH-5403 Forensic Sci. 3/2** **CH-5404 Biochem. 3/2** **(OR)** **CH-5405 Agri.Chem. 3/2**		6	4
Major Core **MC**	CH-1502: Anal Chem. 3/3 CH-1503: Concepts in Inorg. Chem. 3/3 **CH-1504: Inorg. Qual. Analis- 3/3**	CH-2504: Hydrocarbons & Stereochem. 3/3 **CH-2505 Org.Qual. Analysis 3/3**	CH-3502: Organic Func. Groups–I 3/3 CH-3503: Main Group Ele.Solid State Chem. 3/3 CH-3504: Thermo dynamics 3/3 **CH-3505: Vol. Anal. Inorg. Prepn.-Pract 3/3**	CH-4502 Electrochem. 3/3 **CH-4503 Phy.Chem Pract 3/3** CH-4020 Comp. Appl. 3/2	CH-5505 Organic Func. Gr.-II 5/5 CH-5506 Trans Ele.& Nucl. Chem 5/5 CH-5507 Phase Equ. and Kinetics 5/5 CH-5508 Fund. Spect 5/5 **CH-5509 Gra.Anal. Org.Prep Pract 4/4**		60	59
Major Special **MS** **Package-A or B** **CH-6608 & 6609** **or** **CH-6610 & 6611**						CH-6606 Molecular Dynamics 3/4 CH-6607 Coord. Chem. 3/4 **CH-6608 Chem. Mat(Pack-A) 4/6** **CH-6609 Syn.Org. (Pack-A) 5/6** **(OR)** **CH-6610 Chem. Nat Pro (Pack-B) 4/6** **CH-6611 Ind Chem.(Package B) 5/6**	15	20
Skill Based **SK** **CH – 6650** **or** **CH – 6651**						**CH-6650 Food Chem. Tech 13/13** **(OR)** **CH-6651Chem. Consu. Prod.13/13** CH-6652 Seminar (Sem.V &VI) 2/2	15	15
	9 Hrs / 9 Cr	15 Hrs / 12 Cr	24 Hrs / 20 Cr	18 Hrs / 14 Cr	30 Hrs / 28 Cr	30 Hrs / 35 Cr	126	**118**

DETAILS OF THE CREDITS

PART-I (Language) : **6 Credits** (12Hrs)

PART-II (English) : **12 Credits** (24 Hrs)

PART-III (Major & Allied) : **118 Credits**

MC = 59 (60 Hrs)
MS = 20 (15 Hrs)
SK = 15 (15 Hrs)
AR = 8 (12 Hrs)
AO = 8 (12 Hrs)
ES = 2+2 (6 Hrs)
EG = 2+2 (6 Hrs)

PART-IV (Soft skills) : **8 Credits**

Total : **140 Credits**

COURSES OFFERED TO OTHER DEPARTMENTS

Allied Required (AR):

CH: 2102: General Chemistry for Maths & Physics	4/3
CH: 2103: General Chemistry Practical for Maths & Physics	2/1
CH-3104: Chemistry for Biologists-I	4/3
CH-3105: Chemistry Practical for Biologists-I	2/1

Allied Optional (AO):

CH-3202: Advanced General Chemistry for Maths & Physics	4/3
CH- 3203: Advanced General Chemistry Practical for Maths & Physics	2/1
CH-4204: Chemistry for Biologists-II	4/3
CH-4205: Chemistry Practical for Biologists-II	2/1

Elective General (EG):

CH-2300 Applied Chemistry	3/2
CH-4301 Basic Clinical and Pharmaceutical Chemistry	3/2

SEM	CODE	MAJOR CORE (MC) SUBJECTS	Hours	Credit
I	CH – 1502	Analytical Chemistry	3	3
	CH – 1503	Concepts in Inorganic Chemistry	3	3
	CH – 1504	**Inorg. Qual. Analysis - lab**	**3**	**3**
II	CH – 2504	Hydrocarbons & stereochemistry	3	3
	CH – 2505	**Org. Qual. Analysis - lab**	**3**	**3**
III	CH – 3502	Organic Functional Groups-I	3	3
	CH – 3503	Main Group Elements& Solid state Chemistry	3	3
	CH – 3504	Thermodynamics	3	3
	CH – 3505	**Vol. Anal. and Inorg. Prepn. - lab**	**3**	**3**
IV	CH – 4502	Electrochemistry	3	3
	CH – 4503	**Physical Chemistry Practicals-lab**	**3**	**3**
	CH – 4020	Computer applications	3	2
V	CH – 5505	Organic Functional Groups-II	5	5
	CH – 5506	Transition Elements & Nuclear Chemistry	5	5
	CH – 5507	Phase Equilibria & Kinetics	5	5
	CH – 5508	Fundamentals of Spectroscopy + Seminar	5	5
	CH – 5509	**Gra. Anal. and Org. Prepn. - lab**	**4**	**4**
	ELECTIVE – SUBJECT(ES) – Any Two			
	CH – 5402	Polymer Chemistry (OR)	3	2
	CH – 5403	Forensic science	3	2
	CH – 5404	Biochemistry (OR)	3	2
	CH – 5405	Agricultural Chemistry	3	2
VI	CH – 6606	Molecular Dynamics	3	4
	CH – 6607	Coordination Chemistry	3	4
	CH – 6608	Chem. of materials (**Package – A)**	4	6
	CH – 6609	Syn. Org. Chemistry & Spect. (**Package – A**)	5	6
	CH – 6610	Chemistry of Natural Products (**Package – B**)	4	6
	CH – 6611	Industrial Chemistry (**Package – B**)	5	6
	SKILL-BASED (CH – 6650 or CH – 6651)			
	CH – 6650	Food Chem and Technology (Skill-based)	13	13
	CH – 6651	Chem. Cons. Products (Skill-based)	13	13
	CH – 6652	Seminar	2	2
II IV		**ELECTIVE – GENERAL (EG)**		
	CH – 2300	Applied Chemistry	3	2
	CH – 4301	Basic Clinical and Pharm. Chem.	3	2
II		**Allied – Required (AR)**		
	CH – 2102	Gen. Chem. For Maths and Physics	4	3
	CH – 2103	**Gen. Chem. Lab For Maths and Phys**	**2**	**1**
III	CH – 3104	Chem. For Bilogists-I	4	3
	CH –3105	**Chem. Practical for Biologists-I**	**2**	**1**
III		**Allied – Optional(AO)**		
	CH – 3202	Adv.Gen.Chem. For Maths and Phy	4	3
	CH – 3203	**Adv.Gen. Chem. Lab For Maths &Phy**	**2**	**1**
IV	CH – 4204	Chem. For Biologists-II	4	3
	CH – 4205	**Chem. Practical for Biologists-II**	**2**	**1**

SEMESTER-I (MC)

CH - 1502: ANALYTICAL CHEMISTRY

B.Sc. Chemistry
Semester – I — No. of Credits : 3
Course : Major core(MC) — No. of hours per week : 3

Objectives

1. *To help the student to develop the habit of accurate manipulation and an attitude of critical thinking.*
2. *To learn the basic analytical methods and appreciate what is involved in an analysis.*

UNIT 1: HANDLING OF CHEMICALS AND ANALYSIS (8 h)

1.1 **Safety and hygiene in the Chemistry Lab**

Storage and handling of chemicals, handling of acids, ethers, toxic and poisonous chemicals, antidotes, threshold vapour concentration and first aid procedure. Heating methods, stirring methods filtration techniques. Calibration of pipette, standard measuring flask and burette. Weighing principle in chemical balance and single pan balance.

1.2 **Error in chemical analysis**

Accuracy, precision, Types of error-absolute and relative error, methods of eliminating or minimizing errors. Methods of expressing precision: mean, median, deviation, average deviation and coefficient of variation. Significant figures and its application with respect to the glassware used. Normal error curve and its importance.

UNIT 2: SEPARATION AND PURIFICATION TECHNIQUES (10 h)

2.1 **General purification techniques**

Purification of solid organic compounds, recrystallisation, use of miscible solvents, use of drying agents and their properties, sublimation. Purification of liquids. Experimental techniques of distillation, fractional distillation, distillation under reduced pressure. Extraction, use of immiscible solvents, solvent extraction. Chemical methods of purification and test of purity.

2.2 **Chromatography**

Principle of adsorption and partition chromatography. Column chromatography: adsorbents, classification of adsorbents, solvents, preparation of column, adsorption and applications. Thin Layer Chromatography: choice of adsorbent, choice of solvent, preparation of chromatogram, sample, R_f value and its applications. Paper chromatography, solvent used, R_f value, factors which affect R_f value. Ion exchange chromatography, resins used, experimental techniques, applications. Gas Chromatography, principle, detector (FID, TCD, ECD), Applications.

UNIT 3: TITRIMETRIC METHODS OF ANALYSIS (12 h)

3.1 **General Introduction**

General principle. Types of titrations. Requirements for titrimetric analysis.
Concentration systems: Molarity, formality, normality, wt% ppm, milliequalence and millimoles-problems. Primary and secondary standards, criteria for primary standards,

preparation of standard solutions, standardization of solutions. Limitation of volumetric analysis, endpoint and equivalence point.3.2 **Acid-base Equilibria**
pH of strong and weak acid solutions. Buffer solutions. Henderson equations. Preparation of acidic and basic buffers. Relative strength of acids and bases from K_a and K_b values. Neutralisation-titration curve, theory of indicators, choice of indicators. Use of phenolphthalein and methyl orange.

3.3 **Complexometric titrations**
Stability of complexes, titration involving EDTA. Metal ion indicators and characteristics.

3.4 Problems based on titrimetric analysis.

UNIT 4: SOLUBILITY EQUILIBRIA (10 h)

4.1 **General Separation Techniques**
Solubility and solubility products, expressions for solubility products. Determination of solubility from solubility products.

4.2 **Precipitation titrations**
Argentometric titrations, indicators for precipitation titrations involving silver.
Determination of chloride by Volhard's method. Adsorption indicators.

4.3 **Gravimetric methods of analysis**
Separation by precipitation, factors affecting solubility, gravimetric factor. Purity of precipitates, von Weiman ratio. Co-precipitation, post precipitation.

UNIT 5: THERMAL ANALYSIS (5 h)

Thermal analytical methods, principle involved in thermogravimetric analysis and differential gravimetric analysis, discussion of various components with block diagram, characteristics of TG and DTA, Factors affecting TG and DTA curves.

Text Books

1. D.A. Skoog, D.M. West and F.J. Holler, *Analytical Chemistry: An Introduction*, 5th edition, Saunders college publishing, Philadelphia, 1990.
2. U.N. Dash, *Analytical Chemistry: Theory and Practice*, Sultan Chand and sons Educational Publishers, New Delhi, 1995.
3. R.A. Day Jr. A.L. Underwood, *Quantitatives Analysis*, 5th edition, Prentice Hall of India Private Ltd., New Delhi, 1988.
4. R. Gopalan, *Analytical Chemistry*, S. Chand and Co., New Delhi

Reference books

1. *Elementary Organic Spectroscopy: Principles and Chemical Applications*, S.Chand and company Ltd., Ram Nagar, New Delhi, 1990.
2. V.K. Srivastava, K.K. Srivastava, *Introduction to Chromatography: Theory and Practice*, S. Chand and company, New Delhi, 1987.
3. R.M. Roberts, J.C. Gilbert, L.B. Rodewald, A.S. Wingrove, *Modern Experimental Organic Chemistry*, 4th edition, Holt Saunders international editions.
4. A.K. Srivastava, P.C. Jain, *Chemical Analysis: An Instrumental Approach* for B.Sc. Hons. and M.Sc. Classes, S. Chand and company Ltd., Ram Nagar, New Delhi.

CH - 1503 : CONCEPTS IN INORGANIC CHEMISTRY

B.Sc. Chemistry

Semester – I	No. of Credits	:	3
Course : Major core(MC)	No. of hours per week	:	3

Objectives

1. *To know the arrangement of elements in the periodic table and the periodic properties.*
2. *To understand the different kinds of chemical forces in molecules.*
3. *To identify the nature of chemical bond in a given inorganic compound.*
4. *To know the existence of special types of compounds through weak chemical forces.*

UNIT 1: Atomic Structure, the Elements, and the Periodic Table (10 h)

1.1 Electronic configuration: Bohr theory, duel nature of electrons, Heisenberg uncertainty principle, the Schrodinger equation, significance of wave functions, normalization of wave function, radial and angular wave functions, Pauli's exclusion principle, Hund's rule, sequence of energy levels (aufbau principle).

1.2 Periodicity: periodic law and arrangement of elements in the periodic table, IUPAC nomenclature and group number, horizontal, vertical, and diagonal relationships in the periodic table.

1.3 General properties of atoms: size of atoms and ions-atomic radii, ionic radii, covalent radii; trend in ionic radii, ionization potential, electron affinity; electronegativity-Pauling, Mulliken-Jaffe, Allred-Rochow definitions; oxidation states and variable valency; isoelectronic relationship; inert-pair effect; standard reduction potentials, electrochemical series.

1.4 The occurrence and isolation of elements: occurrence of elements; factors influencing the choice of extraction process; mineral benefication-pretreatment, dense medium separation, flotation process, solution methods, magnetic separation, electrostatic precipitation; thermal decomposition methods; displacement of one metal by another; high temperature chemical reduction methods-reduction by carbon, reduction by metal, self-reduction, reduction of oxides with hydrogen; electrolytic reduction-in aqueous solution, in nonaqueous solvents, in fused melts; thermodynamics of reduction processes-the Ellingham diagram.

Self study

(a) Electronic configuration of polyelectronic atoms.
(b) Common oxidation states of metals and their electronic configurations.

UNIT 2: Ionic bond (8 h)

2.1 Properties of ionic compounds, factors favoring the formation of ionic compounds-ionization potential, electron affinity, and electronegativity.

2.2 Lattice energy: definition, Born-Lande equation (derivation not required), factors affecting lattice energy, Born-Haber cycle-enthalpy of formation of ionic compound and stability.

2.3 Covalent character in ionic compounds-polarization and Fajan's rules; effects of polarization-solubility, melting points, and thermal stability of typical ionic compounds.

Self study

(a) Stability of ionic compounds in terms of ΔH_f and U_o.
(b) Solubility and thermal stability of ionic compounds of alkali- and alkaline earth metals.

UNIT 3: The Covalent Bond (11 h)

3.1 Lewis theory-the octet rule and its exception, electron dot structural formula; Sidgwick-Powell theory-prediction of molecular shapes; Valance Bond theory-arrangement of electrons in molecules, hybridization of atomic orbitals and geometry of molecules.

3.2 VSEPR model-effect of bonding and nonbonding electrons on the structure of molecules, effect of electronegativity, isoelectronic principle, illustration of structures by VESPR model-NH_3, SF_4, ICl_4^-, ICl_2^-, XeF_4, XeF_6.

3.3 MO theory: LCAO method, criteria of orbital overlap, types of molecular orbitals-σ, π- and δ-MOs; combination of atomic orbitals to give σ- and π-MOs and their schematic illustration; qualitative MO energy level diagram of homo- and heterodiatomic molecules-H_2 to Ne_2, CO, NO, HCl; bond order and stability of molecules.

Self study

(a) Calculation of bond order and determining stability of homo- and heterodiatomic molecules.

(b) The importance of lone pair-lone pair and lone pair-bond pair electron interactions in determining structure of molecules and illustration.

UNIT 4: Metallic and Weak Bonds (8 h)

4.1 The Metallic bond: crystal structure of metals-*ccp*, *hcp*, metallic properties, band theory of metals.

4.2 Alloys-mixture, interstitial- and substitutional solid solutions, Hume-Rothery rules, interstitial compounds.

4.3 Weak bonds: hydrogen bonding-intra- and intermolecular hydrogen bonding, influence on the physical properties of molecules, comparison of hydrogen bond strength and properties of hydrogen bonded N, O and F compounds; associated molecules-ethanol and acetic acid; crystalline hydrates and clathrates; van der waals forces, ion dipole-dipole interactions.

Self study

(a) Examples of interstitial and substitutional alloys-composition and uses.

(b) Compounds formed by London dispersive forces and van der Waals radii.

UNIT 5: Acids and Bases (8 h)

5.1 Types of chemical reactions: acid-base, oxidation-reduction, electron transfer, and double decomposition reactions; balancing chemical reactions by oxidation number and ion-electron method.

5.2 Theories of acids and bases: Arrhenius theory, acids and bases in protic solvents, Bronsted-Lowry theory, Lewis theory, the solvent system, Lux-Flood definition, Usanovich definition; hard and soft acids and bases-HSAB principle.

5.3 Nonaqueous solvents: classification-protonic and aprotic solvents, liquid ammonia as solvent-solutions of alkali and alkaline earth metals in ammonia.

Self study

(a) Classification of acids and bases as hard and soft.

(b) Typical reactions in sulfuric acid.

Text Books

1. J. D. Lee, *Concise Inorganic Chemistry*, 5th ed., Blackwell Science, London, 1996.
2. F. A. Cotton, G. Wilkinson and P. L. Guas, *Basic Inorganic Chemistry*, 3rd ed., John Wiley, 1994.

3. B. Douglas, D. McDaniel and J. Alexander, *Concepts and Models of Inorganic Chemistry*, 3rd ed., John Wiley, 1994.
4. B. R. Puri, L. R. Sharma, K. C. Kalia, *Principles of Inorganic Chemistry*, Shoban Lal Nagin Chand and Co., 1996.

Reference Books

1. J. E. Huheey, E. A. Kieter and R. L. Keiter, *Inorganic Chemistry*, 4th ed., Harper Collins, New York, 1993.
2. D. F. Shriver and P. W. Atkins, *Inorganic Chemistry*, 3rd ed., W. H. Freeman and Co, London, 1999.
3. T. Moeller, *Inorganic Chemistry: A Modern Introduction*, Wiley, New York, 1990.

CH - 1504: INORGANIC QUALITATIVE ANALYSIS

B.Sc. Chemistry			
Semester – I	No. of Credits	:	3
Course : Major core(MC)	No. of hours per week	:	3

Objectives

1. *To enable the students to develop analytical skills in inorganic qualitative analysis.*
2. *To appreciate the various colored chemical reactions of metal ions.*

Semi micro qualitative analysis:

1. Training sessions for three classes:
   Mixture of anions containing an interfering anion and its elimination technique.
   Mixture of cations of simple radicals to familiarize with the inter group separation techniques.
2. Semi micro qualitative analysis of inorganic salt mixtures containing one interfering acid radical.
3. Simple anions:
   Carbonate, nitrate, sulphate, sulphide, sulphite, chloride and bromide.
4. Interfering anions:
   Borate, fluoride, oxalate, phosphate, arsenite and chromate.
5. Cations:

Group I cations:	Lead, silver, mercurous.
Group II cations:	Mercuric, copper, cadmium, bismuth, antimony, tin.
Group III cations:	Aluminium, ferrous, ferric, chromium.
Group IV cations:	Cobalt, nickel, manganese, zinc.
Group V cations:	Barium, strontium, calcium
Group VI cations:	Magnesium, ammonium.

References

1. V.V. Ramanujam, *Inorganic Semi Micro Qualitative Analysis*, 3rd edition, The National Publishing Company, Chennai, 1974.
2. *Vogel's Text Book of Inorganic Qualitative Analysis*, 4th edition, ELBS, London, 1974.

SEMESTER-II (MC)

CH - 2504: HYDROCARBONS AND STEREOCHEMISTRY

B.Sc. Chemistry
Semester – II — No. of Credits : 3
Course : Major core(MC) — No. of hours per week : 3

Objectives

1. *To understand the basic properties of organic compounds*
2. *To know the method of naming organic compounds*
3. *To learn various methods of preparation of hydrocarbons*
4. *To understand the mechanism of reactions of hydrocarbons.*
5. *To understand the stereochemistry of aliphatic and aromatic hydrocarbons*

Unit 1: Nomenclature, Classification and Basic Properties (10 h)

1.1 Trivial, IUPAC nomenclature, Classification, Geometry of molecules, Hybridization.
1.2 Cleavage of bonds: homolytic and heterolytic cleavages.
1.3 Bond energy, bond length and bond angle.
1.4 Aromaticity and resonance structures, Huckel's rule.
1.5 Inductive, inductomeric, electromeric, mesomeric, resonance, hyperconjugation and steric effects.
1.6 Tautomerism: Definition, keto-enol tautomerism (identification, acid and base catalysed interconversion mechanism), amido-imidol and nitro acinitro forms.
1.7 Stability of reaction intermediates, carbocation, carbanion, and free radicals.

Self Study:

Electron displacement effect applications, tautomerism in selected compounds, comparison of stability of reaction intermediates

Unit 2: Alkanes and Cycloalkanes (8 h)

2.1 Preparation of alkanes: Wurtz reaction, reduction or hydrogenation of alkenes, Corey-House method, petroleum refining
2.2 Reactions: Mechanism of halogenation, free radical substitution, sulphonation, nitration, oxidation, cracking and aromatisation.
2.3 Cycloalkanes: Preparation using Wurtz reaction, Dieckmann's ring closure and reduction of aromatic hydrocarbons.
2.4 Reactions: Mechanism of substitution and ring-opening reactions.
2.5 Baeyer's strain theory and theory of strainless rings.

Self Study:

Properties of alkanes and cycloalkanes, comparison of stability of ring compounds

Unit 3: Alkenes and Alkynes (11 h)

3.1 Alkenes: General methods of preparation, dehydrogenation, dehydrohalogenation, dehydration, Hoffmann and Saytzeff rules, cis and trans eliminations.
3.2 Reactions: Mechanism of electrophilic and free radical addition, addition of hydrogen, halogen, hydrogen halide (Markownikoff's rule), hydrogen bromide (peroxide effect),

sulphuric acid, water, hydroboration, ozonolysis, dihydroxylation with $KMnO_4$, allylic bromination by NBS.

3.3 Dienes: Stability of dienes (conjugated, isolated and cumulative dienes)

3.4 General methods of preparation, mechanism of dehydrohalogenation.

3.5 Reactions: Mechanism of 1,2- and 1,4-additions, Diels-Alder reactions. Polymerization: addition polymerization, Ziegler Natta catalysed polymerization.

3.6 Alkynes: Preparation: Mechanism of dehydrohalogenation and dehydrogenation.

3.7 Reactions: Acidity of alkynes, formation of acetylides, Mechanism of addition of water, hydrogen halides and halogens, oxidation, ozonolysis and hydroboration/oxidation.

Self study:

Preparation and properties of higher order alkenes, dienes and alkynes, examples of polymerization reactions

Unit 4: Homocyclic Aromatic Hydrocarbons (8 h)

4.1 Benzene: Extraction, industrial and laboratory preparations, purification.

4.2 Properties: Electrophilic substitution reactions, Nitration, sulphonation, halogenation, Friedel Crafts alkylation and acylation with mechanisms.

4.3 Disubstitution reactions of aromatic compounds, orientation and reactivity.

4.4 Polynuclear aromatic hydrocarbons: Preparation and properties of naphthalene, anthracene and phenanthrene. Synthetic uses.

Self study:

Preparation of disubstituted benzenes, extraction of polynuclear aromatic hydrocarbons

Unit 5: Stereochemistry-I (8 h)

5.1 Conformational isomerism: Conformers, dihedral angle, torsional strain.

5.2 Conformational analysis of ethane and n-butane, conformers of cyclohexane (Chair, boat and skew boat forms), axial-equatorial positions and their interconversions, conformers of mono and disubstituted cyclohexanes, 1,2 and 1,3 interactions.

5.3 Geometrical isomerism: Cis-trans, syn-anti and E-Z notations, methods of distinguishing geometrical isomers using melting point, dipole moment, dehydration, cyclisation and heat of hydrogenation.

Self study:

Examples of geometrical isomerism and mono, di-substituted cyclohexanes

Text books

01. R. T. Morrison and R. N. Boyd, *Organic Chemistry*, 6th Edition, Printice-Hall Of India Limited, New Delhi, 1992.

02. B. Y. Paula, *Organic Chemistry*, 3rd Edition, Pearson Education, Inc.(Singapore), New Delhi, reprint, 2002.

03. T. W. Graham Solomons, *Organic Chemistry*, 6th edition, John Wiley and sons, 1996.

Reference books

01. Jerry March, *Advanced Organic Chemistry*, 4th Edition, John Wiley And Sons, New York, 1992.

02. S. H. Pine, *Organic Chemistry*, 5th Edition, Mcgraw Hill International Edition, Chemistry Series, New York, 1987.

03. Sehan. N. Ege, *Organic Chemistry, Structure And Reactivity*, 3rd Edition, A.I.T.B.S., New Delhi, 1998.

04. Hendrickson, Cram and Hammond, *Organic Chemistry* (3rd Edition), Mcgraw-Hill Kogakusha, Limited, 1970.
05. Francis A. Carey, *Organic Chemistry*, 3rd edition, Tata-McGraw Hill Publications, New Delhi, 1999.
06. E. L. Eliel and S. H. Wilers, *Stereochemistry of Organic Compounds*, John Wiley and Sons, New York, 2004.
07. P. S. Kalsi, *Stereochemistry: Conformation and Mechanism*, 2nd edition, Wiley Eastern Ltd, 1993.

CH - 2505 : ORGANIC QUALITATIVE ANALYSIS

B.Sc. Chemistry
Semester – II — No. of Credits : 3
Course : Major core(MC) — No. of hours per week : 3

Objectives

1. *To enable the students to develop analytical skills in organic qualitative analysis and preparative skills in organic preparations.*
2. *To enable the students to check the purity of organic compounds by determining the melting or boiling points.*
3. *At the end of the course, the students should be able to plan the experimental projects and execute* them.

Practicals

1. Determination of melting and boiling points of organic substances for two sessions.
2. Organic analysis:
   a. Identification of acidic, basic, phenolic, and neutral organic substances.
   b. Detection of N, S and halogens.
   c. Test for aliphatic and aromatic nature of substances.
   d. Test for saturation and unsaturation.
   e. Identification of functional groups:
      i) Carboxylic acids ii) Phenols iii) Aldehydes iv) Ketones
      v) Esters vi) Carbohydrates vii) Amines viii) Amides
      ix) Halogen compounds
   f. Preparation of derivatives for the functional groups.

References

1. N.S. Gnanapragasam and G. Ramamurthy, *Organic Chemistry – Lab manual*, S. Viswanathan Co. Pvt., 1998.
2. J.N. Gurthu and R. Kapoor, *Advanced Experimental Chemistry* (Organic), S. Chand and Co., 1987.
3. B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, *Vogel's Text Book of Practical Organic Chemistry*. 5th Edn., Pearson Education, 2005.

SEMESTER-III (MC)

CH - 3502 : ORGANIC FUNCTIONAL GROUPS-1

B.Sc. Chemistry
Semester – III — No. of Credits : 3
Course : Major core(MC) — No. of hours per week : 3

Objectives

1. *To learn the chemistry of functional groups of organic compounds.*
2. *To learn the preparation of organic compounds of halide and oxygen based functional groups.*
3. *To understand the physical and chemical properties of above functionalised organic compounds.*
4. *To learn and practice the mechanism of above such reactions.*

Unit 1: Aliphatic and aromatic halides (8 h)

1.1 Nomenclature and classification

1.2 Preparation of aliphatic and aromatic halides: Free radical mechanism, addition and Substitution reactions.

1.3 Reactions: Nucleophilic substitutions, S_N1, S_N2 and S_NAr mechanisms, stereochemistry and reactivity, effects of structure, substrate, solvent, nucleophile and leaving groups.

1.4 Eliminations: E1 and E2 mechanisms, evidences, orientations and stereochemistry.

Self study:

Competition between elimination and substitution reactions, application of Hoffmann and Saytzeff rules.

Unit 2: Hydroxy derivatives (8 h)

2.1 Aliphatic alcohols: Preparation by hydroboration, oxidation, Reduction of carbonyl compounds, epoxidation, and Grignard synthesis.

2.2 Reactions with reference to C-OH bond cleavage and O-H bond cleavage, iodoform test.

2.3 Phenols: Nomenclature, physical properties, hydrogen bonding.

2.4 Preparation: Industrial source, preparation from diazonium salts and sulphonic acids.

2.5 Reactions: acidity, ether formation, ester formation, mechanism of ring substitution, nitration, sulphonation, halogenation, Friedel-Craft's reaction, nitrosation, coupling reactions, Kolbe's reaction and Riemer-Tiemen reaction.

Self study:

Classification and nomenclature, hydrolysis of alkyl halides, reduction of carbonyl compounds and hydroxylation of alkenes, preparation and properties of catechol, resorcinol and phloroglucinol.

Unit 3: Ethers and Epoxides (oxiranes) (6 h)

3.1 Nomenclature and classification.

3.2 Preparation by Williamson's synthesis and alkoxy mercuration-demercuration methods.

3.3 Reactions: cleavage by acids.
3.4 Preparation and reactions of epoxides.

Self Study:

Properties of simple and mixed ethers.

Unit 4: Aldehydes and Ketones (10 h)

4.1 Nomenclature and classification
4.2 Preparation of aldehydes and ketones.
4.3 Reactivity of carbonyl groups, acidity of alpha hydrogen.
4.4 Reactions: Mechanism of enolization reactions, nucleophilic addition, oxidation and reduction reactions, addition reactions with Grignard reagents, cyanide, and bisulphate, preparation of derivatives of ammonia and alcohols, Cannizaro reaction and Aldol condensation.
4.5 Mechnism of aldol, Perkin, Knoevenagel reactions and benzoin condensation, Claisen, Wittig, Cannizarro and Reformatsky reactions.
4.6 Mechanism of reductions with $NaBH_4$, $LiAlH_4$, Wolf-kishner and MPV reaction. Mechanism of haloform and Michael addition.
4.7 Basic principles of photochemistry, Jablonskii diagram, photochemical reactions of carbonyl compounds: Norrish type I and II reactions.

Self Study:

Electrophilic substitution reactions of aromatic aldehydes and ketones.

Unit 5: Carboxylic acids and their Functional Derivatives. (13 h)

5.1 Nomenclature and classification of aliphatic and aromatic carboxylic acids.
5.2 Preparation and reactions. Acidity (effect of substituents on acidity) and salt formation
5.3 Reactions: Mechanism of reduction, substitution in alkyl or aryl group. Preparation and properties of dicarboxylic acids such as oxalic, malonic, succinic, glutaric, adipic and phthalic acids and unsaturated carboxylic acids such as acrylic, crotonic and cinnamic acids
5.4 Reactions: Action of heat on hydroxy and amino acids, and saturated dicarboxylic acids, stereospecific addition to maleic and fumaric acids.
5.6 Preparation and reactions of acid chlorides, acid anhydrides, amides and esters, acid and alkaline hydrolysis of esters, trans-esterification.

Self study:

Physical properties, industrial source. Acetic acid and phthalic acid. Halogenated acids, cyano acids, lactic, pyruvic and tartaric acids.

Text Books

01. R. T. Morrison And R. N. Boyd, *Organic Chemistry*, 6th Edition, Printice-Hall Of India Limited, New Delhi, 1992.
02. T. W. Graham Solomons, *Organic Chemistry*, 6th edition, John Wiley and Sons, 1996.
03. B. Y. Paula, *Organic Chemistry*, 3rd Edition, Pearson Education, Inc.(Singapore), New Delhi, reprint, 2002.
04. Bahl and Arun Bahl, *Organic Chemistry*, S. Chand and Sons, New Delhi, 2005.

Reference Books

01. Jerry March, *Advanced Organic Chemistry*, 4th Edition, John Wiley And Sons, New York, 1992.

02. S. H. Pine, *Organic Chemistry*, 5th Edition, McGraw Hill International Edition, Chemistry Series, New York, 1987.
03. Sehan. N. Ege, *Organic Chemistry, Structure And Reactivity*, 3rd Edition, A.I.T.B.S., New Delhi, 1998.
04. Hendrickson, Cram And Hammond, *Organic Chemistry,* 3rd Edition, McGraw-Hill Kogakusha, Limited, 1970.
05. Francis A. Carey, *Organic Chemistry*, 3rd edition, Tata-McGraw Hill Publications, New Delhi, 1999.

CH - 3503: MAIN GROUP ELEMENTS AND SOLID STATE CHEMISTRY

B.Sc. Chemistry
Semester – III — No. of Credits : 3
Course : Major core (MC) — No. of hours per week : 3

Objectives

1. *To know the nature of compounds formed by s- and p-block elements.*
2. *To know the various reagents of main group elements used in synthetic chemistry.*
3. *To understand the crystal structures of ionic compounds.*

UNIT 1: *s*-Block Elements (8 h)

1.1 Chemical properties of the metals: reaction with water, air, nitrogen; uses of *s*-block metals and their compounds.
1.2 Compounds of *s*-block metals: oxides, hydroxides, peroxides, superoxides-preparation and properties; oxo salts-carbonates, bicarbonates, nitrates; halides and polyhalides; anomalous behavior of Li and Be, extraction of beryllium.
1.3 Complexes of *s*-block metals: complexes with crown ethers, biological importance, organometallic compounds of Li and Be.

Self study

(a) The factors favoring the formation of ionic compounds by *s*-block elements.
(b) Uses of *s*-block metals.

UNIT 2: Boron and Carbon Group Elements (8 h)

2.1 Group 13 (boron group): extraction of B and Si; types of compounds; reaction of B with other elements, water, air, acids, and alkali.
2.2 Compounds of boron with oxygen: boron sesquioxide, borates, borax, sodium peroxoborates.
2.3 Boronhydrides-reaction with ammonia, hydroboration, structure of boranes; borohydrides and their uses.
2.4 Aluminium-amphoteric behavior, aluminates.
2.5 Group 14 (carbon group): catenation and heterocatenation, allotropy of carbon; carbides-salt-like carbides, interstitial carbides, covalent carbides.
2.6 Silicates-ortho-, pyro-, cyclic-, chain-, sheet-, three dimensional silicates and their properties and structures; silicates in technology-alkali silicates, ceramics, glass.

Self study

(a) Differences between boron and other members of the group.
(b) Important borides and carbides and their uses.

UNIT 3: Nitrogen and Oxygen Group Elements (8 h)

3.1 Group 15 (nitrogen group): metallic and nonmetallic character of group 15 elements; hydrides and halides of group 15 elements-hydrazine, hydroxylamine, phosphene; ammonium nitrate, sodium bismuthate-properties and uses; sulphides of phosphorus (P_4S_3 and P_4S_{10}).

3.2 Oxides of group 15 elements: oxides of nitrogen-dinitrogen tetroxide, dinitrogen pentoxide; oxides of phosphorus, arsenic, and bismuth-trioxides, pentoxides.

3.3 Oxoacids of nitrogen: nitrous acid, nitric acid, hyponitrous acid, hydrazoic acid, pernitric acid; oxoacids of phosphorus-orthophosphorous acid, metaphosphorous acid, hypophosphorous acid; orthophosphoric acid, di-, tri-, and tetrapolyphosphoric acids; salts of phosphorus acids-dihydrogen- and monohydrogen phosphites, hypophosphites; salts of phosphoric acids- dihydrogen- and monohydrogen phosphates, normal phosphates, polyphosphates, metaphosphates; properties and uses of phosphites and phosphates; phosphate fertilizers.

3.4 Group 16 (oxygen group): structure and allotropy of elements, ozone, oxides-normal oxides, peroxides, suboxides, basic oxides, amphoteric oxides, acidic oxides, neutral oxides.

3.5 Oxides of sulphur-S_2O, SO_3; oxoacids of sulphur-thionic acid series, peroxoacid series, oxohalides-thionyl compounds, sulfuryl compounds (methods of preparation and properties).

Self study

(a) Structures of oxoacids of sulfur and phosphorus.
(b) Uses of the salts of oxoacids of sulfur.

UNIT 4: Halogens (6 h)

4.1 Group 17 (halogens): ionic-, covalent-, bridging halides, reactivity of halogens, reduction of halogens by thiosulfate.

4.2 Halogen oxides: oxygen difluoride, dioxygen difluoride, dichlorine monoxide, chlorine dioxide, dichlorine hexoxide, dichlorine heptoxide; bleaching powder-estimation of available chlorine; bromine dioxide, iodine pentoxide.

4.3 Oxoacids of halogens: hypohalous acid HOX, halous acid HXO_2, halic oxide HXO_3, perhalic acid HXO_4, strength of oxoacids.

4.4 Interhalogen compounds: ClF, ICl; ClF_3, BrF_3, IF_3; ClF_5, BrF_5, IF_5; poly halides.

4.5 Psuedohalogens:cyanide, thiocyanate, and azide-structure and properties.

Self study

(a) Structures of interhalogen compounds with the help of VSEPR model.
(b) Uses of interhalogen compounds.

UNIT 5: Structure of Solids (10 h)

5.1 Classification: amorphous and crystalline solids; types of solids-metals, ionic crystals, van der Waals crystals, covalent crystals.

5.2 Weiss and Miller indices-drawing various planes in a cubic lattice.

5.3 Crystal systems and Bravais lattices.

5.4 X-ray diffraction: Bragg's equation, principle of X-ray diffraction.

5.5 Structure of ionic solids: packing of ions in solids, radius ratio, coordination number in ionic crystals, crystal structures-sodium chloride, zinc blende, wurtzite, rutile, cesium chloride, fluorite, antifluorite (unit cell diagrams); identification of simple cubic, *bcc*, *fcc* lattices and indexing of X-ray lines.

5.6 Crystal defects: Schottky and Frenkel defects.

Self study

(a) Coordination numbers of cations and anions in ionic crystals from radius ratio.
(b) Unit cell diagrams of crystal structures.

Text Books

01. J. D. Lee, *Concise Inorganic Chemistry*, 5th Ed., Blackwell Science, London, 1996.
02. D. F. Shriver and P. W. Atkins, *Inorganic Chemistry*, 3rd Ed., W. H. Freeman and Co, London, 1999.
03. B. R. Puri, L. R. Sharma, K. C. Kalia, *Principles of Inorganic Chemistry,* Shoban Lal Nagin Chand and Co., Delhi, 1996.

Reference Books

01. J. E. Huheey, E. A. Kieter and R. L. Keiter, *Inorganic Chemistry*, 4th ed., Harper Collins, 1993.
02. F. A. Cotton, G. Wilkinson, C. Murillo and M. Bochman, *Advanced Inorganic Chemistry*, 6th ed., John Wiley, New York, 1999.
03. T. Moeller, *Inorganic Chemistry: A Modern Indroduction*, Wiley, New York, 1990.

CH - 3504: THERMODYNAMICS

B.Sc. Chemistry			
Semester – III	No. of Credits	:	3
Course : Major core(MC)	No. of hours per week	:	3

Objectives:

To understand the concepts of thermodynamics and apply it to physical and chemical systems.

Unit-1: First Law of Thermodynamics and its Applications (10 h)

1.1 First law of thermodynamics: Exact differentials, state functions E and H. Concept of ideal gas: Gas laws, Kinetic theory of gases – postulates and derivation. Deviation from ideal behavior, Van der Walls equation of state - derivation.

1.2 Applications of the laws of thermodynamics to ideal gases : Heat capacity, relation between C_P and C_V. Isothermal process: Change in internal energy, work done, $W_{(rev)}$ and $W_{(irrev)}$. Adiabatic process: work done, and entropy changes.

1.3 Application of the laws of thermodynamics to real(van der Walls) gases: Isothermal process- Work done, change in internal energy, heat absorbed. Adiabatic process: Work done- Joule- Thomson effect- Joule- Thomson coefficient and its significance, inversion temperatures. Variation of enthalpy change of reaction with temperature (Kirchoff's equation).

Self-study:

Derivation of critical constants in terms of Vander walls constants

Unit-2: Thermochemistry (8 h)

2.1 Measurements of thermal changes. Heats of reaction. Calculation of change in internal energy from the enthalpy change, standard states and standard heats of formation;

2.2 Heat of combustion; integral heat of solution and dilution, heat of neutralization, heat of hydration; heat of transition.

2.3 Bond energy and heat of reaction.

Self-study:

Determination of calorific value using Bomb calorimeter

Unit-3: Second Law of Thermodynamics and its Applications (8 h)

3.1 Second law of thermodynamics:

Limitations of first law and the need for the second law. Formulation of the second law of thermodynamics on the basis of Cannot cycle. Thermodynamic principle of the working of refrigerator.

3.2 Criteria of spontaneity. Changes in S, G and A as criteria for spontaneous process, dS, dG and dA – exact differentials.

Evaluation of ΔG and ΔS for the mixing, Maxwell's equations and thermodynamic equation of state. Gibbs-Helmholtz equation.

Self-study:

Trouton's rule and its significance

Unit-4: Thermodynamics of Equilibrium Processes: (9 h)

4.1 Law of mass action. Various forms of equilibrium constants. Relationships between K_P and K_C; properties of equilibrium constants. Vant Hoff isotherm. Derivation of thermodynamic equilibrium constant, and its relationship with free energy changes under standard conditions. Vant Hoff isochore. Le-Chatelier-Braun principle: Formation of ammonia.

4.2 Application of law of mass action and Le-Chatelier-Braun principle to homogeneous gaseous reactions: dissociation of nitrogen tetroxide and ammonia.

Self-study: Formation of HI, dissociation of PCl_5.

Unit-5: Third Law of thermodynamics: (5 h)

Nernst heat theorem- Planck and Lewis Randall formulation of third law. Absolute entropy of solids, liquids and gases. Evaluation of the standard entropy of oxygen, on the basis of heat capacity. Exceptions to third law of thermodynamics.

Self study:

Calculation of absolute entropies.

Text Books

01. S.H. Maron and J.B. Lando, *Fundamentals of Physical Chemistry*, Macmillan limited, New York, 1966.
02. B.R. Puri and L.R. Sharma, *Principles of Physical Chemistry*, Shoban Lal Nagin chand and Co. 33rd edition, 1992.
03. P.W. Atkins, *Physical Chemistry*, 7th edition, Oxford university press, 2001.
04. S.K. Dogra and S. Dogra, *Physical Chemistry Through Problems*, New age international, 4th edition 1996.

Reference Books

01. Gilbert. W. Castellan, *Physical Chemistry*, Narosa publishing house, third edition 1985.
02. Irving M. Klotz and Robert M. Rosenberg, *Chemical Thermodynamics*, John Wiley and sons, Inc. 1994.
03. J. Rajaram and J.C. Kuriacose, *Thermodynamics*, Shoban Lal Nagin Chand and CO. 1986.
04. K. L. Kapoor, *A Textbook of Physical chemistry*, (volume-2 and 3) Macmillan, India Ltd, 1994.

CH - 3505 : VOLUMETRIC ANALYSIS AND INORGANIC PREPARATIONS

B.Sc. Chemistry
Semester – III — No. of Credits : 3
Course : Major core(MC) — No. of hours per week : 3

Objectives

1. *To enable the students to acquire the quantitative skills in volumetric analysis.*
2. *At the end of the course, the students should be able to plan experimental projects and execute them.*

A. Volumetric Practicals

1. Calibration of volumetric kits: burette, pipettes and standard flasks.
2. Acid – base titrations:
   a. Estimation of HCl.
   b. Estimation of oxalic acid.
3. Redox titrations:
   a. Estimation of Ferrous ammonium sulphates (Permanganometry).
   b. Estimation of calcium(Permanganometry).
   c. Estimation of $KMnO_4$(Iodometry).
   d. Estimation of phenol(Iodometry).
   e. Estimation of copper(Iodometry).
   f. Estimation of Fe^{2+}-Fe^{3+} mixture using diphenyl amine(Dichrometry)
3. Complexometric titrations:
   a. Estimation of calcium.
   b. Estimation of magnesium.

B. Inorganic preparations

Preparation of FAS
Preparation of tetraamminecopper(II) sulphate.
Preparation of potassium trioxalatoaluminate.
Preparation of potassium trioxalatochromate

Reference books

01. Sundaram, Krishnan, Raghavan, *Practical Chemistry* (Part II), S. Viswanathan Co. Pvt., 1996.
02. B.S. Furniss, A.J. Hannaford, P.W. G. Smith, A.R. Tatchell, *Vogel's Text Book of Practical Organic Chemistry*. 5th Edn., Pearson Education, 2005.
03. N.S. Ganapragasam and G. Ramamurthy, *Organic Chemistry – Lab manual*, S. Viswanathan Co. Pvt., 1998.

SEMESTER-IV (MC)

CH - 4502 : ELECTROCHEMISTRY

B.Sc. Chemistry
Semester – IV — No. of Credits : 3
Course : Major core(MC) — No. of hours per week : 3

Objectives

1. *To understand the inter conversion of chemical and electrical energy and to link thermodynamics with electrochemistry.*
2. *To apply the concepts of kinetics, catalysis and photochemistry to different chemical processes.*

UNIT 1: Equilibrium Electrochemistry (10 h)

1.1 **Electrode potential**

Single and standard electrode potentials. Reference electrodes: (i) Primary reference electrode: Standard hydrogen electrode (ii) Secondary reference electrode: Saturated calomel electrode. Determination of standard electrode potentials of zinc and copper electrodes.

Calculation of cell EMF from single electrode potentials. Definition and applications of electromotive series.

1.2 **Different types of electrodes**

(i) Metal-Metal ion electrodes (ii) Amalgam electrodes (iii) Gas electrodes (iv) Metal insoluble salt electrodes (v) Oxidation –reduction electrodes (definition and derivation of EMF for each electrode).

1.3 **Electromotive force**

Definition. Measurement using potentiometer. Construction and working of Weston saturated and unsaturated standard cells Conventions regarding sign of EMF.

Self-study

Definition and derivation of EMF for different types of electrodes.

UNIT-2: Electrochemical Reactions (10 h)

2.1 **Thermodynamics of electrochemical reactions**

Derivation of Nernst equation and its use in calculating EMF of cells at different activities of the individual electrodes. Relationship between EMF and (i) free energy changes (ii) enthalpies changes (iii) entropy changes occurring in electrochemical reactions. Equilibrium constants for electrochemical reactions.

2.2 **Classification of electrochemical cells**

Chemical cells and concentration cells with and without transference. Definition and derivation of EMF for each cell-liquid junction potential.

2.3 **Applications of EMF**

Calculation of (i) Valency of ions in doubtful cases(ii) free energy, enthalpy and entropy changes in electrochemical reactions, (iii)solubility product of sparingly soluble salt

pH and its determination using hydrogen, quinhydrone and glass electrodes; Potentiometric acid-base, redox and precipitation titrations.

Self-study

Commercial cells: Dry cell, lead storage, alkali (Na-S) and H_2-O_2 fuel cells

UNIT 3: Non-Equilibrium Electrochemistry (8 h)

3.1 Faraday's laws of electrolysis. Electrolysis of aqueous NaCl and $CuSO_4$ solutions using the corresponding metal or inert electrodes.

3.2 Properties of electrolytes**:** Ionic strength of solutions. Vant Hoff factor.

3.3 Electrolytic conductance: Determination – variation of conductance with concentration. Equal conductance at infinite dilution.

3.4 Transference and transference numbers: Absolute velocity of ions and ionic mobilities. Hittorf's rule, determination of transference numbers – Hittorf's method and moving boundary method.

Self-study

Arrhenius theory of electrolytic dissociation. Evidences in favour of the theory. Limitations.

UNIT-4: Ions in solution (6 h)

4.1 **Activities and activity coefficients of strong electrolytes.**

Determination. Debye-Huckel theory of activity coefficients. Mention of Debye-Huckel-Onsager equation. Effect of concentration, solvent dielectric constant and temperature on conductance.

4.2 **Ionization**

Extent of ionization, relationship to conductance. Applications of conductance measurements – determination of K_a and K_{sp}

Self-study

Conductometric titrations

UNIT-5: Over voltage and polarisation (6 h)

5.1 **Over-voltage**

Decomposition potential, Hydrogen over-voltage, anodic process. Metal deposition, electrolytic separation of metals. Simultaneous deposition.

5.2 **Polarization**

Concentration polarization of electrodes. Principle of polarography.

Self-study

Electrochemical theory of corrosion.

Text Books

01. S.H. Maron and J.B. Lando, *Fundamentals of physical chemistry*, Macmillan limited, New York, 1966.

02. B.R. Puri and L.R. Sharma, *Principles of physical chemistry*, Shoban Lal Nagin Chand and Co. 33rd edition, 1992.

Reference Books

01. S.K. Dogra and S. Dogra, *Physical chemistry through problems*, New age international, 4th edition 1996.

02. Gilbert. W. Castellan, *Physical chemistry*, Narosa publishing house, third edition 1985.

03. P.W. Atkins, *Physical chemistry*, Oxford university press, 1978.

04. K. L. Kapoor, *A textbook of Physical chemistry*, (volume-2 and 3) Macmillan, India Ltd, 1994.

CH - 4503 : PHYSICAL CHEMISTRY PRACTICALS

B.Sc. Chemistry
Semester – IV — No. of Credits : 3
Course : Major core(MC) — No. of hours per week : 3

Objectives

1. *To enable the students to acquire analytical (both qualitative and quantitative) and psychomotor skills.*
2. *At the end of the course, the students should be able to plan the experimental projects and execute them.*

Experiments

1. Determination of partition coefficient of iodine between water and carbon tetrachloride and determination equilibrium constant for the formation of potassium triiodide from iodine and KI.
2. Phase diagram of a simple eutectic system and determination of unknown composition.
3. Phenol – water system: Phase diagram, CST, and effect of impurities on CST.
4. Transition temperature of a salt hydrate – determination of molecular weight.
5. Kinetics of acid catalyzed hydrolysis of methyl acetate and comparison of rate constants.
6. Kinetics of persulphate - iodide reaction: Determination of pseudo first order rate constant.
7. Conductometry - Acid – base titration (HCl *vs* NaOH).
8. Conductometry – Determination of limiting molar conductance of a strong electrolyte (KCl).
9. Potentiometry – Determination of solubility product of a sparingly soluble substance.
10. Potentiometry – Redox titration of ferrous *vs* dichromate.
11. Verification of Beer-Lambert's law and determination of concentration of metal ions spectrophotometrically.

References

01. J.N. Gurthu and R. Kapoor, *Advanced Experimental Chemistry*, S. Chand and Co., 1987.
02. Sundaram, Krishnan, Raghavan, *Practical Chemistry* (Part II), S. Viswanathan Co. Pvt., 1996.
03. David P. Shoemaker, Carl W. Garland, Joseph W. Nibler, *Experiments in Physical Chemistry*, 5th Edi., McGraw- Hill Book company, 1989.

CH - 4020 : COMPUTER APPLICATIONS

B.Sc. Chemistry
Semester – IV — No. of Credits : 2
Course : Major core(MC) — No. of hours per week : 3

Objectives

1. *To enable a student to learn an application-software that is easily available in the market and apply it to solve problems in quantitative chemical analysis and present the results graphically.*

2. *At the end of this course the students will be in a position to take a given set of data, theoretical or experimental, enter into a standard program and carry out either a calculation-routine, plot it as a graph or chart and if needed print it out to get a hard copy of the results.*

01. General Introduction to Microsoft 2000 and Excel 2000 (10 h)

1.1 Starting, Getting Help and Quitting.
1.2 Excell Environment: rows, columns, cell, workbook, worksheet, toolbar, menubar, formula bar, etc.
1.3 Details about standard toolbar and formatting toolbar buttons.

02. Building Worksheets (10 h)

2.1 Entering, copying, importing and editing data.
2.2 Saving and opening files.

03. Calculations (5 h)

3.1 Simple calculations, use of standard mathematical functions.
3.2 Complex calculations involving user-made functions and statistical function.

04. Plotting DATA (10 h)

4.1 Standard and customized charts and graphs.
4.2 Editing and annotating and pasting.

05. Printing and Transfer (10 h)

5.1 Previewing and printing spreadsheet data and graph
3.2 Transferring data and graphs interactively.

Note: All examples and problems for illustration as well as for assignments will be taken from the areas of chemistry, which the students are familiar with.

Text Book

01. Handouts and notes prepared by the staff of chemistry dept., Loyola College

Reference Books

01. Gini Courter and Annette Marquis, *Microsoft Office 2000*, BPB Publications, New Delhi, 1999.
02. Julia Kelly, *Using Microsoft Excel 2000*, Prentice-Hall of India, New Delhi, 1999.
03. Robert de Lavie, *A spreadsheet workbook for Quantitative chemical analysis*, McGraw-Hill, Inc. New Delhi, 1997.
04. K.V. Raman, *Computers in Chemistry*, Tata McGraw-Hill Ltd., New Delhi, 1993.

SEMESTER-V (MC)

CH - 5505 : ORGANIC FUNCTIONAL GROUPS-II

B.Sc. Chemistry
Semester – V — No. of Credits : 5
Course : Major core(MC) — No. of hours per week : 5

Objectives

1. *To learn the chemistry of nitrogen containing compounds.*
2. *To understand the stereochemistry of optically active compounds.*
3. *To learn and practice the molecular rearrangements and the reaction mechanisms.*
4. *To learn the basic aspects of heterocyclic compounds and natural products.*

UNIT 1: Nitrogen Containing Compounds (15 h)

1.1 Nomenclature and classification.
1.2 Nitrocompounds: aliphatic and aromatic nitro compounds, classification, general properties,
1.3 Preparation by nitration
1.4 Reactions: reduction by chemical and electrolytic methods.
1.5 Di- and tri-substitution of aromatic nitro compounds: synthesis of o-, m-, p-dinitrobenzenes and trinitrobenzene.
1.6 Aromatic amines. Preparation of primary, secondary and tertiary amines.
1.7 Reactions: basicity of amines, effect of substituents on basicity of aromatic amines. Some sulpha drugs.
1.8 Diazonium salts: Preparation, diazotisation reactions, replacement reactions (Sandmeyer, Gatterman and Gomberg reactions), coupling reactions.

Self study

Hinsberg test, separation of primary, secondary and tertiary amines.

UNIT 2: Stereochemistry-II (12 h)

2.1 Optical isomerism, optical activity, optical and specific rotations, conditions for optical activity, asymmetric center, chirality, achiral molecules, meaning of (+) and (-) and D and L notations, elements of symmetry, racemization, methods of racemization (by substitution and tautomerism), methods of resolution (mechanical, seeding, biochemical and conversion to diasteromers), asymmetric synthesis (partial and absolute synthesis), Walden inversion.
2.2 Projection Formula, Fischer, flying wedge, sawhorse and Newmann projection formulae – notation of optical isomers - Cahn-Ingold-Prelog rules, R and S notations for optical isomers with one and two asymmetric carbon atoms, erythro and threo representations.
2.3 Optical activity in compounds not containing asymmetric carbon atoms namely biphenyls, allenes and spiranes.

Self study

Examples on optically active compounds having various functional groups, resolution of optically active compounds.

UNIT 3: Synthesis involving active methylene group (8 h)

3.1 Malonic and acetoacetic esters: Characteristic reactions of active methylene group, synthetic uses of malonic, acetoacetic and cynaoacetic ester.

3.2 Diazomethane and diazoacetic ester: Preparation, structure and synthetic applications.

Self Study

Specific examples on preparation of synthetically important compounds from diazomethane and diazoacetic esters.

UNIT 4: Molecular Rearrangements (10 h)

4.1 Classification as anionotropoic, cationotropic, free radical, inter and intramolecular.

4.2 Pinacol-pinacolone rearrangement (mechanism, evidence for carbonium ion intermediate formation-migratory aptitude)

4.3 Beckmann, Hoffmann, Curtius and Benzilic acid rearrangements.

4.4 Claisen rearrangement (sigmatropic-evidence for inramolecular nature and allylic carbon attachment)-para Claisen, Cope and oxycope rearrangements, and Fries rearrangement.

Self study

Specific examples applying the rearrangement reactions.

UNIT 5: Heterocyclic compounds and Natural Products (15 h)

5.1 Classification: Five membered ring compounds: Preparation of Furan, pyrrole and thiophene. Reactions: electrophilic and nucleophilic substitutions, oxidation and reduction reactions. Six membered rings: Pyridine, Quinoline and isoquinoline: Preparation by ring closing reactions. Reactions: Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions.

5.2 Alkaloids: Definition, occurrence, extraction of alkaloids from plants, general properties, determination of the chemical constitution of the alkaloids, functional group analysis, estimation of groups, degradation and synthesis. Mention of the structures of Coniine, Piperine and nicotine.

5.3 Terpenoids: Classification, isoprene rule, isolation and general properties, Occurrence, general structure and physical properties of geraniol, citral, menthol, α-pinene and camphor.

Self Study

Extraction, resonance structures of heterocyclic compounds, applications. Exercises on application of isoprene rule,

Text books

01. R. T. Morrison and R. N. Boyd, *Organic Chemistry*, 6th Edition, Printice-Hall Of India Limited., New Delhi, 1992.

02. B. Y. Paula, *Organic Chemistry*, 3rd Edition, Pearson Education, Inc.(Singapore), New Delhi, reprint, 2002.

03. I. L. Finar, *Organic ChWemistry*, 6th edn, ELBS, 1990.

04. O. P. Agarwal, *Chemistry of Organic Natural Products,* Vol 1 and 2, Goel Pub. House, 2002.

05. Gurdeep Chatwal, *Chemistry of Organic Natural Products,* Vol 1 and 2, Goel Pub. House, 2002.

06. Bahl and Arun Bahl, *Organic Chemistry*, S. Chand and Sons, New Delhi, 2005.

Reference Books

01. Jerry March, *Advanced Organic Chemistry*, 4th Edition, John Wiley And Sons, New York, 1992.
02. S. H. Pine, *Organic Chemistry*, 5th Edition, Mcgraw Hill International Edition, Chemistry Series, New York, 1987.
03. Sehan. N. Ege, *Organic Chemistry, Structure And Reactivity*, 3rd Edition, A.I.T.B.S., New Delhi, 1998.
04. Hendrickson, Cram and Hammond, *Organic Chemistry* (3rd Edition), Mcgraw-Hill Kogakusha, Limited, 1970.
05. E. L. Eliel and S. H. Wilers, *Stereochemistry of Organic Compounds*, John Wiley and Sons, New York, 2004.
06. P. S. Kalsi, *Stereochemistry: Conformation and Mechanism*, 2nd edition, Wiley Eastern Ltd, 1993.

CH - 5506 : TRANSITION ELEMENTS AND NUCLEAR CHEMISTRY

B.Sc. Chemistry
Semester – V — No. of Credits : 5
Course : Major core(MC) — No. of hours per week : 5

Objectives

1. *To know the tendency of transition metals to exhibit variable valency.*
2. *To know the catalytic properties of transition metals and industrial applications of their compounds.*
3. *To understand the basic concepts of coordination chemistry and early theory.*
4. *To know the occurrence of lanthanides and actinides in nature and their uses.*
5. *To* know the importance of nuclear reactions in the modern world.

UNIT 1: Transition Elements (15 h)

1.1 Overview of the abundance and occurrence of transition metals; magnetic property; reactivity and passive behavior-reactivity toward oxygen, water, halogens; standard reduction potentials; important uses of transition metals and their alloys; differences between the first and the other rows, horizontal comparison with Fe, Co, Ni groups; toxicity of Cd and Hg.

1.2 Variable oxidation states, lower oxidation states and stabilization, catalytic properties.

1.3 M-M bonding and cluster compounds; oxides, mixed oxides, halides, and oxohalides of transition metals; synthesis and reactivity of vanadates, chromates, dichromate, molybdates, tungstates, tungsten bronzes, manganate, permanganate; polycations; organometallic compounds of Ti, Fe, Co, Zn, Hg.

1.4 Metallurgy of Ti, V, W, Cr.

1.5 Interstitial compounds: nitrides, carbides, hydrides, borides of Ti, V, Cr, W, U and their industrial uses.

1.6 Biological importance of transition metals: biological roles of Cr, Mo, Mn, Fe, Co, Cu, Zn (mention of metal containing proteins and enzymes and their biological roles).

Self study

(a) The natural occurrence and ores of transition metals.
(b) The common and stable oxidation states of transition metals.

UNIT 2: Lanthanides and Actinides (10 h)

2.1 Lanthanides: lanthanide series, abundance and natural isotopes, lanthanide contraction, similarity in properties, occurrence, oxidation states, chemical properties of Ln(III) cations, magnetic properties. Color and electronic spectra of lanthanide compounds.

2.2 Separation of lanthanides: solvent extraction, ion exchange, chemical properties of Ln(III) metal ions.

2.3 Actinides: actinide series, abundance and natural isotopes, occurrence, preparation of actinides, oxidation states, general properties, the later actinide elements.

2.4 Uranium-occurrence, metallurgy; chemical properties of hydrides, oxides, and halides.

2.5 Complexes of lanthanides and actinides.

Self study

(a) The minerals of lanthanides and actinides and their occurrence in India.
(b) The electronic configurations of lanthanides and their positions in the periodic table.

UNIT 3: Coordination Chemistry (15 h)

3.1 Introduction: ligands-monodentate, bidentate, and polydentate ligands; coordination sphere; coordination number; nomenclature of mononuclear and dinuclear complexes; chelate effect.

3.2 Isomerism: linkage-, ionization-, hydrate-, coordination-, coordination position isomerism, geometrical- (*cis*- and *trans*-, and *fac*- and *mer*-), optical isomerism.

3.2 Theories: Sidgwick theory-EAN and stability, formation of metal-metal bond in dimers; valence bond theory-hybridization, geometry, magnetism, drawbacks of VBT.

3.3 Crystal field theory: crystal field effects, assumptions of crystal field theory, crystal field splitting in octahedral and tetrahedral geometries-qualitative crystal field splitting diagrams; high-spin and low-spin complexes; CFSP and factors affecting it; computation of CFSE; evidences of crystal field splitting; spectrochemical series.

Self study

(a) Survey of common monodentate and bidentate ligands.
(b) Illustration of the failure of EAN rule and the limitations of VB theory with examples.

UNIT 4: The Nucleus and Radiochemistry (10 h)

4.1 The nucleus: subatomic particles, structure of the nucleus-shell model, liquid drop model; forces in the nucleus-mesons; stability of nucleus-n/p ratio, binding energy; radioactive elements.

4.2 Radiochemistry: natural and induced radioactivity; radioactive decay-α-decay, β-decay, γ-decay; neutrom emission, positrom emission, electron capture; unit of radioactivity (Curie); half life period; Geiger-Nuttal rule, radioactive displacement law, readioactive series.

4.3 Measurement of radioactivity: ionization chamber, Geiger counters, scintillation counters.

Self study

(a) Nature of subatomic particles.
(b) Radioactive isotopes.

UNIT 5: Nuclear Reactions (10 h)

5.1 Nuclear reactions: types of nuclear reactions, nuclear cross section, spallation, nuclear fission-theory of nuclear fission; chain reaction, critical mass; nuclear reactors-fast breeder reactors, fuels used in nuclear reactors, separation of isotopes, moderators, coolants; nuclear fusion; nuclear reactors in India.

5.2 Applications: energy tapping, dating of objects, neutron activation analysis, isotopic labeling studies, nuclear medicine-^{99m}Tc radiopharmaceuticals.

Self study

(a) Isotopes used in nuclear fission reactions.

(b) Radioisotopes used in noninvasive imaging techniques in nuclear medicine.

Text Books

01. J. D. Lee, *Concise Inorganic Chemistry*, 5th ed., Blackwell Science, London, 1996.
02. D. F. Shriver and P. W. Atkins, *Inorganic Chemistry*, 3rd ed., W. H. Freeman and Co, London, 1999.
03. H. J. Arnikar, *Essentials of Nuclear Chemistry*, 4th ed., New Age International, New Delhi, 1995.
04. B. R. Puri, L. R. Sharma, K. C. Kalia, *Principles of Inorganic Chemistry*, Shoban Lal Nagin Chand and Co., Delhi, 1996.

Reference Books

01. J. E. Huheey, E. A. Kieter and R. L. Keiter, *Inorganic Chemistry*, 4th ed., Harper Collins, New York, 1993.
02. F. A. Cotton, G. Wilkinson, C. Murillo and M. Bochman, *Advanced Inorganic Chemistry*, 6th ed., John Wiley, New York, 1999.
03. T. Moeller, *Inorganic Chemistry: A Modern Introduction*, Wiley, New York, 1990.

CH - 5507: PHASE EQUILIBRIA AND KINETICS

B.Sc. Chemistry
Semester – V — No. of Credits : 5
Course : Major core(MC) — No. of hours per week : 5

Objectives

1. *To enable the students to understand the effect of pressure and temperature on phase equilibrium.*
2. *To know the relation between collegiate properties and molecular weight of solutes*
3. *To relate nthe rates of chemical reactions with different temperatures.*

UNIT-I: Phase Equilibria (15 h)

1.1 Phase Rule: Concepts of phase, component and degrees of freedom, with examples. Gibb's phase rule – derivation. Clapeyron and Clausius-Clapeyron equations and their applications to equilibria in phase transitions. (solid – liquid, liquid – vapour, solid – vapour)

1.2 One-component system: Phase diagrams: Water and sulphur systems.

1.3 Two component system: (i) Simple eutectic: Lead-silver system. (ii) Formation of compound with congruent melting point: Ferric chloride – water system.

1.4 Three component systems : General account of graphical representation of three component systems, examples of three component systems having one, two partially miscible pairs.

Self study

Formation of compound with incongruent melting point.

UNIT-2: Colligative Properties of solutions (10 h)

2.1 Ideal solutions: Vapour pressure- Composition diagrams of solutions. Raoults law, positive and negative deviations from the law.

2.2 Principle of fractional distillation: Binary systems. Vapour diagram and azeotropic distillation, Partially miscible binary systems (CST-UCST, LCST, and both UCST and LCST). Effect of addition of solute on CST. Steam distillation. Solubility of gases in liquids; Henry's law, its relationship with Raoults law.

2.3 Lowering of vapour pressure: Thermodynamics derivation for elevation of boiling point and depression of freezing point. Relationship between osmotic pressure and V.P. Vant Hoff's theory of dilute solutions. Analogy between solute particles and gas molecules.

2.4 Distribution law: Thermodynamic derivation; limitation of the law, application in studying association, dissociation and solvation. Study of formation of complex ions. Extraction with solvents; efficiency of extraction.

Self-study

Determination of molecular weight by Cottrell's, Beckmann's and Berkeley and Hartley method.

UNIT 3: Chemical kinetics- kinetic parameters (5 h)

Rate, order, rate law, rate constants. Simple reactions involving zero, first, second and third – order reactions. Derivation of rate equations for zero, first and second order reactions. Pseudo-first – order reactions. Determinations of rate, rate constant and order by different methods. Simple mechanisms and molecularity of reactions (S_N1 and S_N2).

Self-study

Study of kinetics of pesudo-first-order reactions – acid and base catalyzed hydrolysis of ester and inversion of cane sugar.

UNIT 4: Types and theories of chemical reaction rates (15 h)

4.1 Reversible or opposing, consecutive and parallel reactions (no derivation expected). Thermal chain reactions. (i) H_2 and Br_2 reaction (ii) Dissociation of acetaldehyde. Steps involved only (no kinetic expressions needed).

4.2 Factors affecting chemical reactions – nature of reactants, concentration, catalyst, solvent polarity and ionic strength (only qualitative ideas). Arrehenius theory of chemical reaction rates. Collision theory of bimolecular and unimolecular reactions. Lindemann hypothesis. Transition state or absolute reaction rate theory (ARRT) (no derivation expected).

Self-study

Comparison of thermal and photochemical chain reactions.

UNIT 5: Catalysis (15 h)

5.1 **Homogeneous catalysis**

Reactions in gases and in solutions (Acid, base and Wilkinson's catalysts). Kinetics of enzyme catalysis : Michaelis Menton equation. Factors affecting enzyme catalysis.

5.2 **Heterogeneous catalysis**

Langmuir adsorption isotherm. Its application to slightly, strongly, and moderately adsorbed systems. Theory of heterogeneous catalysis on the basis of Langmuir adsorption – Uni- and bimolecular reactions on solid surfaces.

Self-study

Enzyme catalysis in biological systems.

Text Books

01. S.H. Maron and J.B. Lando, *Fundamentals of physical chemistry*, Macmillan limited, New York, 1966.
02. B.R. Puri and L.R. Sharma, *Principles of physical chemistry*, Shoban Lal Nagin Chand and Co. 33rd edition, 1992.

Reference Books

01. S.K. Dogra and S. Dogra, *Physical chemistry through problems*, New age international, 4th edition 1996.
02. Gilbert. W. Castellan, *Physical chemistry*, Narosa publishing house, third edition 1985.
03. P.W. Atkins, *Physical chemistry*, Oxford university press, 1978.
04. K. L. Kapoor, *A textbook of Physical chemistry*, (volume-2 and 3) Macmillan, India Ltd, 1994.

CH - 5508 : FUNDAMENTALS OF SPECTROSCOPY

B.Sc. Chemistry			
Semester – V	No. of Credits	:	5
Course : Major core(MC)	No. of hours per week	:	5

Objectives

01. To help the student to develop the habit of accurate manipulation and an attitude of critical thinking.

02. To learn the basic analytical methods and appreciate what is involved in an analysis.

UNIT-1: Introduction to Spectroscopy

1.1 Interaction of low energy radiation with matter

Electromagnetic spectrum, quantisation of energy, Electronic, vibrational and rotational energy levels, and transitions in atoms and molecules. Absorption and emission spectra.

1.2 Boltzman distribution (formula only). Relative population of translational, rotational, vibrational and electronic energy levels at different temperatures.

1.3 Transition probabilities, selection rules, line widths, resolution and signal to noise ratio.

UNIT-2: Electronic Spectroscopy

2.1 Absorption laws, calculations involving Beer – Lambert's law, verification and its limitations.

2.2 Instrumentation of photocolorimeter and spectrophotometer, block diagrams with description of components, theory, types of electronic transitions, chromophores and auxochromes, absorption bands and intensity, factors governing absorption maximum and intensity.

2.3 Atomic absorption spectroscopy and Flame photometry – principles, intrumentation and applications

UNIT-3: Infrared Spectroscopy

3.1 Principle, types of stretching and bending vibrations, vibrational frequencies, instrumentation, block diagram, source, monochramator, cell sampling techniques, detector and recorders, identification of organic molecules from characteristic absorption bands.

3.2 Raman spectroscopy, Raleigh and Raman scattering, stoke's and antistoke's line, instrumentation, block diagram, differences between IR and Raman spectroscopy, mutual exclusion principle, applications, structural diagnosis.

UNIT-4: NMR Spectroscopy

4.1 Principle of nuclear magnetic resonance, basic instrumentation, shielding mechanism, chemical shift, number of signals, spin-spin coupling and coupling constants, splitting of signals, deuterium labeling.

4.2 Applications of NMR to simple organic compounds.

UNIT-5: Mass spectrometry

5.1 Basic principles of mass spectrum, molecular peak, base peak, isotopic peak, metastable peak and their uses, fragmentation – nitrogen rule.

5.2 Instrumentation, determination of molecular formulae with example, mass spectrum of simple organic compounds, identification – alcohols, aldehydes, aromatic hydrocarbons

Text Books

1. D.A. Skoog, D.M. West and F.J. Holler, *Analytical Chemistry: An Introduction*, 5th edition, Saunders college publishing, Philadelphia, 1990.
2. U.N. Dash, *Analytical Chemistry: Theory and Practice*, Sultan Chand and sons Educational Publishers, New Delhi, 1995.
3. R.A. Day Jr. A.L. Underwood, *Quantitative analysis*, 5th edition, Prentice Hall of India Private Ltd., New Delhi, 1988.
4. S. M. Khopkar, *Basic concept of Analytical Chemistry*, 2nd edition, New Age International Publishers, New Delhi, 1998.
5. R. Gopalan, *Analytical chemistry*, S. Chand and Co., New Delhi

Reference books

1. *Elementary Organic Spectroscopy: Principles and Chemical Applications*, S.Chand and company Ltd., Ram Nagar, New Delhi, 1990.
2. V.K. Srivastava and K.K. Srivastava, *Introduction to Chromatography: Theory and Practice*, S. Chand and company, New Delhi, 1987.
3. R.M. Roberts, J.C. Gilbert, L.B. Rodewald, and A.S. Wingrove, *Modern Experimental Organic Chemistry,* 4th edition, Holt Saunders international editions.
4. A.K. Srivastava and P.C. Jain, *Chemical Analysis: An Instrumental Approach* for B.Sc. Hons. and M.Sc. Classes, S. Chand and company Ltd., Ram Nagar, New Delhi.

CH - 5509 : GRAVIMETRIC ANALYSIS AND ORGANIC PREPARATIONS

B.Sc. Chemistry
Semester – V — No. of Credits : 4
Course : Major core(MC) — No. of hours per week : 4

Objectives

To enable the students to acquire the quantitative skills in gravimetric analysis and preparative skills in inorganic preparations. At the end of the course, the students should be able to plan experimental projects and execute them.

1. Gravimetric analysis

Estimation of sulphate as barium sulphate.
Estimation of barium as barium chromate.
Estimation of copper as copper as copper thiocyanate.
Estimation of nickel as Ni-DMG.
Estimation of magnesium as magnesium pyrophosphate.
Estimation of calcium as calcium oxalate.
Estimation of copper in an alloy.

2. Organic preparations

Single stage organic preparations involving bromination, hydrolysis, nitration, oxidation, and benzoylation.

References

1. Sundaram, Krishnan, Raghavan, *Practical Chemistry* (Part III), S. Viswanathan Co. Pvt., 1996.
2. *Vogel's Text Book of Quantitative Chemical Analysis*. 5th Edi., ELBS/Longman England, 1989.

SUBJECT ELECTIVE (ES)

CH - 5402 : POLYMER CHEMISTRY

B.Sc. Chemistry
Semester – V — No. of Credits : 2
Course : Subject Elective (ES) — No. of hours per week : 3

Objectives :

To give the students the importance of polymers and an exposure to polymer science.

UNIT 1 : INTRODUCTION TO POLYMER (10 hours)

1.1 Monomers, Oligomers, Polymers and their characteristics
1.2 Classification of polymers : Natural synthetic, linear, cross linked and network; plastics, elastomers, fibres, Homopolymers and Co-polymers
1.3 Bonding in polymers : Primary and secondary bond forces in polymers ; cohesive energy and decomposition of polymers.
1.4 Determination of Molecular mass of polymers: Number Average molecular mass (M_n) and Weight average molecular mass (M_w) of polymers and determination by (i) viscosity (ii) Light scattering method (iii) Gel Permeation Chromatography (iv) osmometry and ultracentrifuging.

Self study:

Molecular weight determination of high polymers by different methods.

UNIT 2 : KINETICS AND MECHANIISM FOR POLYMERIZATION : (8 hours)

2.1 Chain growth polymerization :
Cationic, anionic, free radical polymerization, Stereo regular polymers : Ziegler Natta polymers.
2.2 Polycondensation-non catalysed, acid catalysed polymerization, molecular weight distribution
Step growth polymers

Self study:

Degrees of polymerization

UNIT 3 : TECHNIQUES OF POLYMERIZATION AND POLYMER DEGRADATION (7 hours)

3.1 Bulk, Solution, Emulsion, Suspension, Melt polycondensation, solution polycondensation interfacial and gas phase polymerization
3.2 Types of Polymer Degradation, Thermal degradation, mechanical degradation, photodegradation, Photo stabilizers.

Self study:

Solid and gas phase polymerisation

UNIT 4 : INDUSTRIAL POLYMERS: (10 hours)

4.1 Raw material, preparation, fibre forming polymers, elastomeric material.
4.2 Thermoplastics : Polyethylene, Polypropylene, polystyrene, Polyacrylonitrile, Poly Vinyl Chloride, Poly tetrafluoro ethylene, nylon and polyester.
4.3 Thermosetting Plastics : Phenol formaldehyde and expoxide resin.

4.4 Elastomers : Natural rubber and synthetic rubber - Buna - N, Buna-S and neoprene.

Conducting Polymers : Elementary ideas ; examples : poly sulphur nitriles, poly phenylene, poly pyrrole and poly acetylene.

Self study:

Poly methylmethacrylate, polyimides, polyamides, polyurethanes, polyureas, polyethylene and polypropylene glycols

UNIT 5 : INTRODUCTION TO POLYMER PROCESSING : (5 hours)

5.1 Compounding:

Polymer Additives: Fillers, Plasticizers antioxidants and thermal stabilizers fire retardants and colourants.

5.2 Processing Techniques:

Calendaring, die casting, compression moulding, injection moulding, blow moulding, extrusion moulding and reinforcing.

Self study:

Film casting,Thermofofming, Foaming.

Text Books :

1. V.R. Gowariker, Polymer Science, Wiley Eastern, 1995.
2. G.S. Misra, Introductory Polymer Chemistry, New Age International (Pvt) Limited, 1996.

Reference Books

1. F. N. Billmeyer, Textbook of Polymer Science, Wiley Interscience, 1971.
2. A. Kumar and S. K. Gupta, Fundamentals and Polymer Science and Engineering, Tata McGraw-Hill, 1978.

CH - 5403 : FORENSIC CHEMISTRY

B.Sc. Chemistry			
Semester – V	No. of Credits	:	2
Course : Subject Elective (ES)	No. of hours per week	:	3

Objectives :

To give the students the importance of forensic chemistry and an exposure to find, analyse and find a suitable method to detect the crime .

UNIT 1 : FOOD ADULTRATION (10 hrs)

1.1 Contamination of wheat, rice, dhal, milk, butter, etc. With clay, sand, stone, water and toxic chemicals (e.g. Kasseri dhal with mentanil yellow).

1.2 Food poisons: natural poisons (alkaloids, nephrotoxins), pesticides (DDT, BHC, Follidol), Chemical poisons (KCN). First aid and Antidotes for poisoned persons.

1.3 Heavy metal (Hg, Pb, Cd) Contamination of Sea food. Use of neutron activation analysis in detecting poisoning (e.g., As in human hair)

UNIT 2: TRANSPORTAION (10 hrs)

2.1 Drunken driving: brath analyzer for ethanol. Incendiary and timed bombs in road and railway tracks. Defusing live bombs.

2.2 Hit -and-go traffic accidents : paint analysis by AAS. Soill of toxic and coorosive chemicals (e.g., conc.acids) from tankers.

UNIT 3: CRIME DETECTION (10 hrs)

Accidental explosions during manufacture of matches and fire-works (as in Sivakasi). Human bombs, possible explosives (gelatin sticks,RDX). Metal detector devices and other security measures for VVIP. Composition of bullets and detection of powder burns.

Scene of crime: finger prints and their matching using compuetr records. Smell tracks and police dogs. Analysis of blood and other body fluids in rape cases.Typing of blood. DNA finger printing for tissue identification in disembered bodies.Blood stains on clothing. Cranial analysis (head and teeth).

UNIT 4: FORGERY and COUNTERFEITING (10 hrs)

Detecting forgery in bank cheques / drafts and educational records (mark lists, certificates), using UV-light. Alloy analysis using AAS to detect counterfeit coins. Checking silverline wter mark in currency notes.

Jewellery : detection of gold purity in 22 carat ornaments, detecting gold plated jewels, authenticity of diamonds (natural, synthetic, glassy).

UNIT 5: MEDICAL ASPECTS (5hrs)

AIDS : Cause and prevention . Misuse of scheduled frugs. Burns and their treatment by plastic surgery.

Metabolite analysis, using mass spectrum - gas chromotography. Detecting steroid consumption among athletes and race horses.

CH - 5404 : BIOCHEMISTRY

B.Sc. Chemistry
Semester – V — No. of Credits : 2
Course : Subject Elective (ES) — No. of hours per week : 3

Objectives :

1. *To enable the student to develop a sound knowledge of fundamental concepts in biochemistry.*
2. *to enumerate the molecular motif of a living cell, structural and functional hierarchy of biomolecules.*
3. *to emphasis on the various aspects of metabolism and interrelationship of metabolic events.*

UNIT 1: Amino acids and Proteins (14 hours)

1.1 **Living Cell** – Plant and Animal cell. Cell membrane – organelles – functions of major sub-cellular components – Anabolism and catabolism and their relation to metabolism.

1.2 **Amino acids** – classification –Synthesis of α-amino acids and their identification.

1.3 Peptide bond- stereochemistry, synthesis of peptides by solution and solid phase techniques.

1.4 **Proteins** – classification – properties-3D structure-determination of amino acid sequence – denaturation and renaturation of protein molecules.

1.5 Separation and purification of proteins – dialysis – gel filtration - electrophoresis.

1.6 Catabolism of amino acids: Transamination, oxidative deamination, decarboxylation. The urea cycle and other possibilities of detoxification of ammonia.

Self study: Rare amino acids of proteins, tertiary structure of globular proteins. Plasma proteins.

UNIT 2 : Enzymes (7 hours)

Nomenclature, classification and properties-specificity, factors influencing enzyme action.

Mechanism of enzyme action – Lock and Key model and induced fit models.
Coenzymes – cofactors – prosthetic groups of enzymes (TPP, NAD, NADP, FAD, ATP). Their importance in enzyme action.
Mechanism of inhibition (competitive, non- and uncompetitive and allosteric). Immobilization of enzymes. Enzyme specificity,

Self study:

Kinetics of mono and disubstrate enzyme catalyzed reactions. Serum enzymes and isoenzymes-their diagnostic value.

UNIT 3: Lipids (7 hours)

Classification - neutral lipids, Phospho lipids (lecithines, cephalins, plasmalogens) and glycolipids – importance, synthesis and degradation.
Fatty acids – saturated, unsaturated fatty acids, EFA. Properties – Hydrolysis-acid number, saponification number. Auto-oxidation (Rancidity), addition reactions-Iodine value, Polenske number, Reichert-Meissl number, acetyl number. Hydrogenation
Cholesterol – biosynthesis. Bile salts derived from cholesterol.
Metabolism: Oxidation of glycerol – β-oxidation of fatty acids; biosynthesis of lipids – synthesis of fatty acids and synthesis of triglycerides.

Self study:

Reaction of lipases on triacylglycerols in aqueous and organic solvents. Steroid hormones, vitamin D, lipoproteins.

UNIT 4: Carbohydrates (8 hours)

4.1 Classification – reducing and non-reducing sugars. Glucose: structure-conformation – stability
4.2 Carbohydrates of the cell membrane – starch, cellulose and glycogen. (Structure and utility)
4.3 Metabolism: Glycolysis and its reversal; TCA cycle. Relation between glycolysis and respiration. Principles of bioenergetics, electron transport chain and oxidative phosphorylation.

Self study:

Gluconeogenesis, pentose phosphate pathway.

Unit 5 Nucleic Acids (9 hours)

5.1 Nucleosides and nucleotides – purine and pyrimidine bases. Nucleic acids Difference between DNA and RNA. Classification of RNA.
5.2 Biosynthesis of DNA: Replication. Biosynthesis of mRNA: Transcription.
5.3 Genetic code – mutations and mutants. DNA repair. Biosynthesis of proteins.
5.4 DNA sequencing and PCR, recombinant DNA technology, DNA polymorphism.

Self Study:

Strategies for screeing DNA libraries. Blood composition. Blood coagulation. Haemoglobin - its role in chemistry of respiration.

Text books

1. Lehninger, Principles of Biochemistry, Fourth Edition, by David L. Nelson and Michael M. Cox, Worth Publishers, New York, 2005.
2. L. Veerakumari, Biochemistry, MJP publishers, Chennai, 2004.
3. Lubert Stryer, Biochemistry, W. H. Freeman and company, New York, 1975.

Reference books

4. Robert L.Caret, Katherine J. Denniston, Joseph J. Topping, Principles and Applications of organic and biological chemistry, WBB publishers, USA, 1993.
5. J. L. Jain, Biochemistry, Sultan Chand and Co.1999
6. A. Mazur and B. Harrow, Text book of biochemistry, 10th Edition, W.B. Saunders Co., Philadelphia, 1971.
7. Paula Yurkanis Bruice, Organic chemistry, 3rd Edition, Pearson Education, Inc. (Singapore), New Delhi, reprint, 2002.
8. P. W. Kuchel and G. B. Ralston, Shaum Series, Theory and Problems of Biochemistry, McGraw-Hill Book Company, New York, 1988.

CH - 5405 : AGRICULTURAL CHEMISTRY

B.Sc. Chemistry			
Semester – V	No. of Credits	:	2
Course : Subject Elective (ES)	No. of hours per week	:	3

Objectives :

To give the students the importance of Agricultural chemistry and an exposure to find, analyse and find a suitable method to cultivate and promote agricultural methods.

UNIT 1: SOIL CHEMISTRY

Soil analysis . Composition of soil : Organic and Inorganic constituents. Soil acidity : buffering capacity of soils. Limiting of soil.

Absorption of cations and anions : availability of soil nutrients to plants

UNIT 2: FERTILIZERS

Peat and organic manures (composts). Role of humus. Effluent form gobar gas plants.

Use of fertilizers : urea, DAP, Super phosphate, Gypsum, NPK-mixed fertiizers, Optimal addition of Fertilizers to obtain estimated yields.

UNIT 3: PESTICIDES

Insecticides: stomach and contact poisons. Plant derivatives : pyrethrine, Nicotine and rotenone Synthetic organic: carbophos, carbaryl, p-DCB, dimethoate, butachlor, Endrin, Aldrin (Chemical name and uses). Rodenticdes.

Fungicides : Inorganic (Bordeaux Mixture) and organic(dithiocarbamate). Industrial fungicides: creosote fractions.

Herbicides and weedicides : Selective and non-selective, 2, 4-D and 2, 4, 5-t (structure and function)

Intenerated pest management. Sex attractants for insect control. Sustainable agriculture.

UNIT 4: PLANT FROWTH REGULATORS

3-Indole acetic acid: NAPHTHALENE ACETIC ACID: Ethepon (2-chloroethyl phosphoric acid): Alar (succinin acid-2, 2-dimethyhydrzine :) their function.

Plant hormones: Gibberlin, Cyclocel, Phosphon, dwarfing compound (CCC: 2-Chlorethyl-trimethyl ammonium chloride). Defoliants

Text books

G.T. Austin : shreve's Chemical Process Industries, 5th edition, Mc-Graw-Hill, 1984

B.A. Yagodin (Ed). Agricultural Chemistry, 2 Volumes, Mir Publishers (Moscow), 1976.

SEMESTER-VI

CH - 6606: MOLECULAR DYNAMICS

B.Sc. Chemistry
Semester – VI — No. of Credits : 4
Course : Major Special(MS) — No. of hours per week : 3

Objectives

After the study of this course, the student should be able to

1) understand the difference between classical mechanics and quantum mechanics , the modern concept of atomic structure and the applications of quantum mechanics to pi-electrons in conjugated polyenes.

2) know the statistical distribution of thermal energy among molecules.

3) understand the photochemical activation and deactivations of molecules.

SECTION – A : Quantum chemistry (16 hours)

UNIT-1: Transition from Classical mechanics to quantum mechanics

1.1 Classical mechanics: Concepts – failures. Photoelectric effect. Energy distribution in black body radiation.

1.2 Bohr's theory of atom – derivation for energy of an electron in hydrogen like species. Emission spectrum of hydrogen atom – Zeemann effect.
Self-study: Concept of orbitals and quantum numbers – Pauli's exclusion principle.

UNIT–2 : Principles of quantum chemistry

2.1 Postulates of quantum mechanics. Concepts of operators, Eigen functions, Eigen values. Schrodinger equation.

2.2 Particle in one-dimensional box - derivation for energy. Application to linear conjugated polyenes (ethylene and butadiene).

SECTION – B : Statistical thermodynamics (10 hours)

UNIT–3: Basic principles of statistical thermodynamics

3.1 Thermodynamic probability – macro and microstates, most probable distribution. Maxwell– Boltzmann statistics. Partition function – relation between partition function and energy. Separation of partition function – partition function for translation.

3.2 Entropy and probability. Translational entropy: Sackur-Tetrode equation. Residual entropy.

SECTION – C : Photochemistry (14 hours)

UNIT–4 : Photo physical processes in electronically excited molecules

4.1 Laws of photochemistry . Jablonski energy level diagram – primary and secondary photochemical processes. Radiationless transition – internal conversion and inter system crossing. Radiative transitions – fluorescence - relation to structure. Phosphorescence – conditions for phosphorescence emission (spin-orbit coupling). Chemiluminscence.

4.2 Experimental techniques of photochemical reactions – chemical actinometers–quantum yield. Mechanism of photosynthesis

UNIT–5 : Photochemical kinetics

5.1 Kinetics of photochemical reactions between hydrogen and chlorine and bromine – rate law, comparison with thermal reactions.

5.2 Bimolecular quenching – Stern-Volmer equation – photosensitization.
5.3 Kinetics of fast reactions - relaxation techniques and flash photolysis.

Text books

01. R.K. Prasad , *Quantum chemistry*, New age international(P) Ltd., 1997.
02. B.R.Puri and L.R. Sharma,*Principles of physical chemistry* ,Shoban Lal Nagin Chand and Co., 36 th edition, 1996.
03. K.K.Rohatgi Mukherjee, *Fundamentals of photochemistry (Revised edition)*, Wiley Eastern Ltd., 1996.
04. A.W. Adams, Text book of physical chemistry.

Reference books

01. D.A.McQuarrie and J. D.Simon, *Physical Chemistry-A Molecular Approach,* Viva Books (P) Ltd., 1999.
02. R. A. Alberty , *Physical Chemistry (VI edition.)* ,Wiley Eastern Ltd., 1887.
03. S.H.Maron and J.B.Lando, *Fundamentals of Physical Chemistry* , Macmillan Ltd., New york,1996.
04. P.W. Atkins, *Physical Chemistry* ,Oxford University Press,1978.
05. K.L.Kapoor, *A Textbook of Physical Chemistry*, *(Volume-4),* Macmillan India Ltd., 1992

.

CH - 6607 : COORDINATION CHEMISTRY

B.Sc. Chemistry
Semester – VI — No. of Credits : 4
Course : Major Special(MS) — No. of hours per week : 3

Objectives

1. *To understand the nature of bonding in coordination compounds.*
2. *To understand the importance and application of coordination compounds in industry and in medicine.*
3. *To understand the active roles played by metal ions and coordination compounds in biological systems.*

UNIT-1: Theory of Coordination Compounds (15 h)

1.1 Crystal field splitting of transition metal ions in tetrahedral and octahedral fields.
1.2 Jahn Teller theorem, crystal field splitting in tetragonally distorted octahedral geometry, and in square planar geometry.
1.3 Covalency in transition metal complexes: evidences for covalency-intensity of d-d transitions, spin-spin splitting, hyperfine splitting, adjusted crystal field theory
1.4 MO Theory: Metal orbitals and LGOs suitable for σ- and π-bonding in octahedral geometry, construction of qualitative MO energy level diagram for σ-bonding in octahedral geometry.

UNIT-2: Reaction Mechanisms in Coordination compounds (7 h)

2.1 Substitution reactions in octahedral complexes: dissociative and associative and interchange mechanisms.
2.2 Electron transfer reactions: inner-sphere and outer-sphere mechanisms, noncomplementary electron transfer reactions.

2.3 Inorganic photochemistry: principles, photosubstitution, photoisomerization, and photoredox reactions.
2.4 Substitution reactions in square complexes: dissociative and associative mechanisms.

UNIT-3: Synthesis of Coordination Compounds (5 h)

3.1 *Cis*- and *trans*-effects in synthesis of square planar and octahedral complexes.
3.2 Metal template synthesis-metal phthalocyanins and Schiff bases.

UNIT-4: Organometallic Compounds and Catalysis (7 h)

4.1 Nomenclature of organometallic compounds, 16- and 18-electron rule.
4.2 Structure and bonding in transition metal carbonyls: polynuclear carbonyls, bridging and terminal carbonyls, transition metal alkyls, carbenes, and carbynes, and metallocenes.
4.3 Wilkinson's catalyst and alkene hydrogenation, hydroformylation, Monsanto acetic acid process, Ziegler-Natta catalyst and polymerization of olefins.

UNIT-5: Inorganic Biochemistry (6 h)

5.1 Enzymes-apoenzymes and coenzymes, biological role of carboxypeptidase A, peroxidases and catalases; in vivo and in vitro nitrogen fixation.
5.2 Inorganic medicinal chemistry: radiopharmaceuticals, chelate therapy, and contrast agents in MRI.

Self Study

(1) Synthesis and properties of metal carbonyls, bridging and terminal carbonyls, metal alkyls, carbenes, and carbynes, and metallocenes.
(2) Essential and trace elements in biological systems.

Text books

1. Huheey, J. E.; Keiter, E. A.; Keiter, R. L. *Inorganic Chemistry, Principles of Structure and Reactivity*, 4th ed., Harper Collins, 1993.
2. Cotton, F. A.; Wilkinson, G.; Murillo, C. A.; Bochmann, M. *Advanced Inorganic Chemistry*, 6th ed., John Wiley, 1999.
3. Shriver, D. F.; Atkins, P. W.; Langford, C. H. *Inorganic Chemistry*, 3rd ed., Oxford University Press, 2000.

Reference books

1. Basalo, F.; Pearson, *Inorganic Reaction Mechanisms*, 2nd ed., Wiley Interscience, 1969.
2. Tobe, M. L.; Burgess, J. *Inorganic Reaction Mechanisms*, Addison Wesley Longman, 1999.
3. Arunachalam, S. *Inorganic Photochemistry*, Kala Publications, Trichirapalli, 2002.

CH - 6608 : CHEMISTRY OF MATERIALS

B.Sc. Chemistry
Semester – VI — No. of Credits : 6
Course : Major-Special (MS)(Package-A) — No. of hours per week : 4

Objectives

To introduce and give an insight into the fascinating area of solid state chemistry and material science. This will enable the students in pursuing higher studies.

UNIT-1: Structures of solids (12 h)

1.1 Introduction to solids – crystalline and amorphous. Unit cell, Bravais lattices and X-ray structure determination (NaCl and KCl only) – powder and single crystal- methods and applications-identification of the cubic lattice and indexing of the X-ray diffraction lines.

1.2 Radius ratio rules – coordination number. Packing arrangement -different structure types in solids – rock salt, zinc blende, wurtzite, fluorite and antifluorite, spinel and inverse-spinel and perovskite structures.

UNIT-2: Preparative methods and characterization (6 h)

2.1 Solid state reactions – ceramic method, sol-gel, hydrothermal, high pressure, zone refining, CVD, Czochralski and Bridgman and Stockbarger methods.

2.2 Physical methods – thermogravimetric and differential thermal analysis and scanning electron microscopy (only introduction and application).

UNIT-3: Electrical and optical properties (10 h)

3.1 Defects in solid state – point defects – Frenkel and Schottky defects and non-stoichiometric defects.

3.2 Conductors – variation of conductivity with temperature – semiconductors – p and n types, pn- junction, photoconduction, photo voltaic cell and photogalvanic cell – solar energy conversion, organic semiconductors.

3.3 Piezoelectric, pyro-electric and ferroelectrics (introduction and application). Photoluminescence.

UNIT-4: Magnetic properties (7 h)

4.1 Magnetic properties – classification - diamagnetic, paramagnetic, antiferromagnetic, ferro and ferri magnetic — magnetic susceptibility.

4.2 Variation with temperature – Curie-Wiess law, Curie temperature and Neel temperature. Permanent and temporary magnets.

UNIT-5: Special materials (10 h)

5.1 Superconductivity – introduction, Meissner effect – mention of Bardeen, Cooper and Schrieffer theory and Cooper pairs – examples of superconducting oxides, Chevrel phases – applications of superconducting materials.

5.2 Ionic conductors – sodium-β alumina, sodium-sulphur battery. Intercalation – layered compounds – graphitic compounds. Special applications of solid state materials. High energy battery, lithium cells.

5.3 Liquid crystals: nematic, cholesteric and smectic types and applications**.**

Text books

1. Solid State Chemistry-An Introduction by Lesley Smart and Elaine Moore, Chapman Hall, London, 1992.
2. Solid State Chemistry by M. G. Arora, Anmol Publications, New Delhi, 2001.

3. Materials Science by P. K. Palanisamy, Scitech Publications, Chennai, 2003.

Reference books

1. Modern Inorganic Chemistry by W. L. Jolly, Mc Graw Hill Book company, NY, 1989.
2. Inorganic Chemistry by D. F. Shriver and P. W. Atkins, Longford, Oxford university press, 1990.
3. Introductory Solid State Physics by H. P. Meyers, Viva Books Private Limited, 1998.
4. Solid State Chemistry and its applications by A. R. West, John-Wiley and sons,1987.
5. Modern aspects of Inorganic Chemistry by H. J. Emelius and A. G. Sharpe, Universal Book stall,1989.
6. Ionic crystals, Lattice defects and nonstoichiometry, N. N. Greenwood, Butterworths, London, 1968.
7. Solid State Physics by Charles Kittel, John-Wiley and sons, NY, 1966.

CH - 6609 : SYNTHETIC ORGANIC CHEMISTRY AND SPECTROSCOPY

B.Sc. Chemistry
Semester – VI — No. of Credits : 6
Course : Major-Special(MS)(Package-A) — No. of hours per week : 5

Objectives

The course should prepare the students for

1. *Looking at the molecule and understanding the complexity of carbon skeletons and the presence of functional groups and their relative positions.*
2. *Applying disconnection approach and identifying suitable synthons.*
3. *Identifying suitable reactions sequences to achieve the synthesis of target molecules.*
4. *Studying various synthetically important reaction with a view to appreciate their scope, limitations and potential use in synthetic sequences.*
5. *Developing and understanding UV, IR, NMR, and Mass spectra of organic molecules.*
6. *Solving simple structural problems with spectral data from one or more of these spectral techniques.*

UNIT-1: Planning an Organic Synthesis and Control elements (15 h)

1.1 Preliminary Planning – knowns and unknowns of the synthetic system studied.
1.2 Analysis of the complex and interrelated carbon framework into simple rational precursors.
1.3 Retrosynthetic analysis, alternate synthetic routes. Synthesis of organic mono bifunctional compound via disconnection approach. Key intermediates that would be formed, available starting materials and resulting yield of alternative methods.
1.4 Linear Vs convergent synthesis.Synthesis based on umpolung concepts of Seeback.
1.5 Regiospecific control elements. Use of protective groups, activating groups and bridging elements. Stereospecific control elements. Functional group alteration and transposition.

Self Study

Examples on retrosynthetic approach, calculation of yield, advantages of convergent synthesis, synthesis of stereochemistry controlled products.

UNIT-2: Organic Reactions of Importance in Synthesis: (12 h)

2.1 Catalytic hydrogenation and dehydrogenation
2.2 Reductions with LAH, $NaBH_4$ and DIBAL.
2.3 Hydroboration
2.4 Birch, Clemmenson and Wolf-Kishner reduction
2.5 Oxidation with Cr(VI) and Mn(VII) reagents
2.6 Oxidation by peracids and DMSO with oxalyl chloride

Self Study

Mechanism for each reactions, synthesis of organometallic compounds and reactions.

UNIT –3: Carbon-Carbon Bond Forming Reactions (12 h)

3.1 Alkylation of active methylene compounds.
3.2 Aldol condensation and related reactions
3.3 Diels-Alder reactions – synthesis of cyclic compounds

Self Study

Crossed aldol condensation, reactions involving active methylene groups, Diels Alder reactions under heat or light.

UNIT-4 : UV-Visible and IR spectroscopy (12 h)

4.1 Applications of UV-Woodward – Fieser rules as applied to conjugated dienes and α,β - unsaturated ketones. Elementary Problems
4.2 Characteristic IR absorption frequencies of important functional groups.
4.3 Intermolecular and Intramolecular hydrogen bonding and IR
4.4 Elementary Problems Involving only IR data.

Self Study

Working out problems based on IR and UV spectra. IR correlation chart.

UNIT-5: NMR spectroscopy and Mass spectrometry (24 h)

5.1 Problems related to shielding and deshielding of protons, chemical shifts of protons in hydrocarbons, and in simple monofunctional organic compounds; spin-spin splitting of neighbouring protons in vinyl and allyl systems. Coupling constants and their use.
5.2 Deuterium-labeling and its use in NMR.
5.3 Applications of ^{1}H and ^{13}C NMR in the structural determination of organic compounds.
5.4 Elementary problems restricted to compounds with C_{10}
5.5 Determination of molecular formula, recognition of molecular ions(M^+). Fragmentation patterns in hydrocarbons, and in simple monofunctional organic compounds.
5.6 Elementary Problems restricted to compounds with C_{10}
5.7 Combined Problem solving UV, IR, NMR, Mass Spectra (simple problems would be solved)
5.8 Visit to a spectroscopy lab

Self Study

Problems based on NMR and mass spectra only, problems based on combined spectroscopic technique.

Text books

01. H.O. House, *Modern Synthetic Reactions*, W.A. Benjamin Inc.
02. M.B. Smith, *Organic Synthesis*, McGraw Hill International Edition 1994.

03. William Kemp, *Organic Spectroscopy*, 3rd edition, Sarmaha publishers, 2002.
04. John. R. Dyer, *Applications of Absorption Spectroscopy of Organic Compounds*, Prentice Hall Inc. 1965.

Reference books

01. R. Ireland, *Organic Synthesis*, 1975.
02. D.H. Williams and Ian Fleming, *Spectroscopic Methods in Organic Chemistry*, McGraw Hill 1973.
03. Morrison and Boyd, *Organic Chemistry*, Prentice Hall Inc., 6th Edition 1992.
04. Kalsi, Spectroscopy.
05. Silverstein and Bassler, *Spectrometric Identification of Organic Compounds*, John Wiley and Sons.
06. P. H. Groggins, *Unit Processes in Organic Synthesis*, 5th edition, 1995.

CH - 6610 : CHEMISTRY OF NATURAL PRODUCTS

B.Sc. Chemistry		
Semester – VI	No. of Credits	: 6
Course : Major Special course[MS](Package-B)	No. of hours per week	: 4

Objectives

This course should prepare the students for

1) *an introduction to chemistry of natural products like alkaloids, terpenoids, etc.,*
2) *an understanding of the methods of isolation, purification and structural elucidation of natural products.*
3) *an introduction to synthesis of important natural products.*
4) *an appreciation of bio-activity of natural products*

UNIT-1: Alkaloids (15 h)

1.1 Introduction and functions of alkaloids.
1.2 General methods of structural elucidation
1.3 Structural elucidation, synthesis and biological properties of coniine, piperine, nicotine and papaverine.

Self Study

Occurrence, classification and isolation

UNIT-2: Terpenoids and Carotenoids (10 h)

2.1 *Terpenoids*: Introduction, Isoprene rule
2.2 General methods of determining structure
2.3 Structure and synthesis of citral, menthol, Geraniol and camphor.
2.4 *Carotenoids*: Introduction, geometrical isomerism
2.5 Structure determination and synthesis of β-carotene and vitamin-A

Self study

Classification, Occurrence And isolation of terpenes

UNIT-3: Anthocyanines and flavones (10 h)

3.1 *Anthocyanines*: Introduction to anthocyanines.
3.2 Structure and general methods of synthesis of anthocyanines.
3.3 Cyanidine chloride: structure and determination.
3.4 *Flavones*: Structure and determination of flavone and flavonoids.
3.5 Quercetin: Structure determination and importance.

Self study

General nature of anthocyanins, introduction and biological importance of flavones.

UNIT-4: Purines and Steroids (15 h)

4.1 *Purines*: Introduction, biological importance
4.2 Synthesis and structural elucidation of Uric acid, Xanthine, Caffeine and Theophylline.
4.3 *Steroids*: Introduction, stereochemistry and nomenclature.
4.4 Structural determination and synthesis of cholesterol.
4.5 Synthesis of (±)-oestrone.

Self study

Occurrence and isolation of purines. Classification and spectral properties of steroids.

UNIT 5: Natural Dyes (10 h)

5.1 Occurrence, colour and constitution
5.2 Structural determination and synthesis of indigoitin and alizarin.

Self study

Classification, isolation, purification and properties.

Text books

1. O. P. Agarwal, *Chemistry of Natural Products, Vol-1*, Goel Publishing House, 1997.
2. Gurdeep Chatwal and Anand, *Chemistry of Natural Products*, Himalayan Publishing Co, 2001

Reference book

1. I. L. Finar, *Organic Chemistry, Vol-2*, 5th edition, Pearson education, London, 1975.

CH - 6611 : INDUSTRIAL CHEMISTRY

B.Sc. Chemistry		
Semester – VI	No. of Credits	: 6
Course : Major Special course[MS](Package-B)	No. of hours per week	: 5

Objectives :

To enable a student to understand:

(i) The generation of energy from various types of fuels.
(ii) Use of chemicals in improvement of agricultural crops
(iii)Methods employed for purification of water for industry and home
(iv) Pollution occurring from various sources and resulting toxic effects

UNIT-1 : Industrial fuels (15 h)

1.1 **Energy**

Sources: non-renewable, classification of fuels: solid, liquid and gaseous. Calorific value of fuels and its determination.

1.2 **Solid fuels**

Coal: types – properties and uses – lignite, sub-bituminous coal, bituminous coal and anthracite. Coking and non-coking coal.

1.3 **Liquid fuels**

Refining of crude petroleum and uses of fractions. Hydrodesulphurisation. Cracking: thermal and catalytic (fixed bed and fluidised bed cataylsis). Octane number. Production and uses of tetraethyl lead, ETBE and MTBE.

1.4 **Gaseous fuels**

Natural gas and gobar gas: production, composition and uses., Gobar electric cell.

UNIT-2 : Chemistry and agriculture (15 h)

2.1 **Fertilizers**

NPK, representation,superphosphate, triple superphosphate, uses of mixed fertilizers. Micronutrients and their role, biofertilizers, plant growth harmones.

2.2 **Pesticides**

Classification of pesticides with examples.

Insectides; stomach poisons, contact insecticides, fumigants. Manufacture and uses of insecticides. DDT, BHC (gammaxane: Conformation of gamma isomer) pyrethrin. Mention of aldrin, dieldrin,endrin and pentachlorophenel (and its Na salts) and Biopesticides.

Herbicides: Manufacture of 2,4-D and 2,4,5-T

Fungicides: Preparation of Bordeaux mixture. Mention of lime-sulphur, creosote oil and formula.

2.3 **Sugar industry**

Double sulphitation process. Refining and grading of sugar. Saccharin: synthesis and use as a sugar substitute - aspartame. Ethanol: manufacture from molasses by fermentation.

UNIT-3 : Water treatment (15 h)

3.1 **Introduction**

Sources of water. Hardness of water-temporary or carbonate hardness, permanent hardness or non-carbonate hardness. Units of hardness, disadvantages of hard water – In domestic, in industry and in steam generation in boilers. Effect of iron and manganese in water. Estimation of hardness – EDTA method – Estimation of total hardness – O. Hehner's method or alkali titration method.

3.2 **Water softening methods**

Industrial purpose

Lime – soda process, Zeolite process; Ion-exchange - Demineralisation - deionisation process. Mixed – bed deionisation.

Domestic purpose

Removal of suspended impurities. Removal of microorganism – Chlorination . Break point chlorination. Reverse osmosis. Desalination.

Waste water treatment

UNIT-4 : **Pollution and chemical toxicology** (15 h)

4.1 **Pollution:** Air pollution - Acid rain. Green house effect (global warming), ozone layer depletion - photochemical oxidants. Control of air pollution. Water pollution – organic pollutants, Chemical oxygen demand (COD), Biological oxygen demand (BOD), total organic carbon. International standards for water and air quality and regulations

4.2 **Chemical toxicology:** Effect of toxic chemicals on enzymes. Lead, mercury and cyanide pollution and their biochemical effects. Carbon monoxide, sulfur dioxide, oxides of nitrogen, ozone – biochemical effects.

4.3 **Quality control:** ISI specification. Patent: Purpose and procedures

UNIT-5 : Seminar topics (15 h)

Glass, Cement, Dyes, Paints, Special paints, Lubricants and greases, Refractories, Abrasives, Plastics, Perfumes and flavoring industries, Fermentation industries, Explosives, Pulp and paper industries, Rubber industries, Pharmaceutical industries, Food and food products industries, Photographic product industries, Ceramic industries, Petrochemicals.

INDUSTRIAL CHEMISTRY PRACTICALS (20 Hr)

1. Estimation of available chlorine in bleaching powder.
2. Estimation of hardness of water.
3. Estimation of active matter content in a detergent.
4. Estimation of nitrogen in the fertilizer.
5. Estimation of phosphate in a superphosphate sample.
6. Estimation of potassium by flame photometric method.
7. Estimation of Iron (III) by colorimetry.
8. Estimation of calcium in calcium tablet.
9. Determination of viscosity and flashpoint in lubricating oil.
10. Preparation of Aspirin.
11. Preparation of a dye.
12. Preparation of polyvinylacetate or polyacrylamide.
13. Laboratory method of preparation of Iron sulphate.

Reference books

1. Norris shreve, r. And joseph a. Brink, jr. *Chemical process industries*, 4th ed.; Mc graw – hill Kogakusha, ltd: 1977.
2. George t. Austin. *Shreve's chemical process industries*, 5th ed.; Mc graw – hill: 1984.
3. Subba rao, n. S. *Biofertilizers in agriculture*; oxford and ibh publishing co.: New delhi, 1982.
4. Jain, p. C. And jain, m. *Engineering chemistry*, 10th ed.; dhanpat rai and sons: delhi, 1993
5. Kamaraj, p.; jeyalakshmi, r. And narayanan, v. *Chemistry in engineering and technology*; sudhandhira publications: chennai, 2001.
6. Kuriakose, j. C. And rajaram, j. *Chemistry in engineering and technology. Vol 2.;* tata mc graw hill: new delhi, 1988.
7. De,a.k. *Environmental chemistry* 2nd ed.; wiley eastern Ltd., 1987.
8. Stanley e. Mahanen, introduction to industrial chemistry.
9. Jugal, Kishore, Agrawal, *Practicals in Engineering Chemistry*; Oxford and IBH Publishing Co., New Delhi, 1976.

CH - 6650 : FOOD CHEMISTRY AND TECHNOLOGY

B.Sc. Chemistry
Semester – VI — No. of Credits : 13
Course : Skill Based course(SK) — No. of hours per week : 8

Objectives

This skill based course provides

1) Students the basic knowledge in Food Chemistry and modern trends in the industry.
2) To provide the practical training to the students in the food analysis

UNIT I: Introduction (7 h)

1.1 **Food:** source, functions of food – food groups – food guide – basic five food groups, usage of the food guide – food in relation to health – objectives of cooking..

1.2 **Water:** Purification processes – Ion exchangers, reverse osmosis, activated charcoal treatment. Use of chlorination, ozone, and UV light disinfection. Specification of drinking water. Water borne diseases – microbiological examination. Sources and detection.

1.3 **Milk**: Composition and effectiveness as a diet. Fat content in milk, whole and skimmed. Effect of cooking and heat processing of milk – pasteurization. Preservation of milk. Deep freeze preservation, dairy products – cheese, butter, ghee and kova. Spray drying technique – milk powder, infant food preparation. Lactose intolerance Milk substitutes – vegetable milk. Toned milk.

Self study

Different mode of cooking, and objectives of cooking.

UNIT 2: Constituents of foods (35 h)

2.1 **Proteins:** amino acids – peptides – proteins, modification of food products through heat processing.Effect of cooking – steaming or cooking under pressure of legumes. Detoxication. Analysis of proteins – principles in the determination of moisture content, ash content, nitrogen content – Kjeldahl's method.Separation of amino acids by paper chromatography, separation of proteins by electro phoresis.

Enzymes: Nomenclature, classification – Apo, holo and coenzymes. Enzymes used in food processing.Enzymic browning – mode of action, secondary reaction of o-quinones, prevention of enzymic browning – thermal inactivation, pH, antioxidants Non-enzymic browning-Maillard reaction, prevention of non-enzymic browning. Measurement of enzyme activity- principles, estimation of the activity of catalase in Chow-chow and radish (Titrimetry) – principles..

2.2 **Carbohydrates:** Classification, structure and reactions of monosaccharides, glucose, fructose, structure of sucrose, maltose, lactose and starch.Artificial sweetening agents.Effect of cooking on the nutritive value of rice and of baking of wheat – bread and biscuit, processing and storage of carbohydrates. Principles involved in the analysis of carbohydrates – analysis of glucose, starch, Benedict method, Anthrone method, Neilson–Somoyogi method, analysis of crude fibers – estimation of carbohydrates in wheat floor

2.3 **Lipids:** Nomenclature and classification.Emulsions and emulsifiers, rancidity of fats – chemistry of fat and oil processing – function and storage of fats.Heat treatment on the nutritive value of oilseeds, nuts and oil-seedmeals. Role of MUFA and PUFA in preventing heart diseases. Analysis of oils and fats – analysis of crude fats and determination of iodine number, R_M value, acid number and saponification values – principles.

2.4 **Minerals and vitamins**: Sources, functions, bioavailability and deficiency of the following minerals (calcium, iron, iodine, fluorine, sodium and potassium (elementary treatment). Vitamins - classification, sources, functions and deficiencies of fat- soluble vitamins – A, D, E and K, water-soluble vitamins – C, thiamin, niacine, riboflavin, B-complex, - B_6, Folic acid and B_{12}.Fortification with vitamins and minerals.Effect of cooking on vitamins and minerals – different methods of cooking of vegetables, fruits – dehydrated fruits, canned fruit, canned fruit juices. Estimation of thiamine and riboflavin (fluorimetry), Estimation of metals in tea dust – principles.

Self study

Classification of amino acids, proteins, lipids and vitamins.

UNIT 3: Foods and Food Additives: (25 h)

3.1 **Food additives**: Artificial sweeteners – saccharin, cyclomate, asparatame – food flavours – esters, aldehydes and heterocyclic compounds. Antioxidants. Food colours – changes in cooking..Restricted use. Spurious colours. Emulsifying agents, preservatives – leavening agents.Baking powder –Yeast. Taste enhancers – MSG-vinegar

3.2 **Modern food**: Mushroom cultivation and types, spirulina composition. Snack foods. Production of bread, bun and biscuits. Raw materials, methods and machinery required. Candy manufacturing. Caramellisation. Fast foods. Instant foods. Dehydrated foods. Oleoresin of spices. Condiments.

3.3 **Beverages:** Soft drinks, soda, fruit juices and alcoholic beverages (Types and content of alcohol).Examples, Carbonation. Addiction to alcohol. Cirrhosis of liver. Social problems.Composition of soft drinks.Excessive use leading to urinary bladder stones. Preservation of tetrapak. Nitrogen preservation and packing of fruit juices. Coconut water.

Self study

Functions and uses of food additives.

UNIT 4: Nutrition and Balanced Diet (8 h)

4.1 **Nutrition** – calorific value of food stuff – RQ of food (Respiratory quotient of food) – basal metabolic rate – factors influencing BMR, specific dynamic action (SDA) of food.

4.2 **Thermogenic effect** – energy requirements of individuals – diet and its components – the protein requirements – biological value of proteins, supplementary value of proteins. Diseases associated with protein malnutrition.

Nutritional value of carbohydrates. – Fibers in the diet, dietary sugars – nutritional aspects of lipids.

Self study

Low cost nutrient supplements and bio-fortification.

UNIT 5: Food Adulteration And Hygiene (5 h)

5.1 **Adulterants:** Common adulterants in different foods – milk and milk products, vegetable oils, and fats, spices and condiments, cereals, pulses, sweetening agents and beverages.

Contamination with toxic chemicals – pesticides and insecticides. Principles involved in the analysis of detection and prevention of food adulteration.

5.2 **Microbial growth:** growth curve of bacteria. Effect of environmental factors on growth of microorganisms. pH, water activity, oxygen availability temperature – beneficial effect of micro organisms Food borne illness – bacteria, virus, moulds and parasites. (Any two illness each).

5.3 **Food preservation and processing :** Food deterioration, methods of preservation and processing.

5.4 **Quality control:** Specifications and standards: PFA, FPO, FDA, drug license, WHO standards, ISI specifications**,** packing and label requirements, essential commodities act, consumer protection act. AGMARK.

Self study

Packaging of foods – classification of package, materials used for packing, laws related to packaging and nutrition labelling.

Reference Books

1. Swaminathan M. *Advanced Text Book on Food and Nutrition , volume I and II Printing and Publishing CO., Ltd., Bangalore.* 1993.
2. Swaminathan M. *Text Book on Food chemistry, Printing and Publishing CO., Ltd., Bangalore.* 1993.
3. Norman N. Potter , *Food science*, *CBS publishers and distributors, New Delhi.* 1994.
4. Lillian Hoagoland Meyer, *Food Chemistry*, *CBS publishers and distributors, New Delhi.* 1994.
5. Owen R Fennema, *Food Chemistry*, *Marcel Decker Inc., New York*. 1996.
6. Srilakshmi B., *Food Science*, *New age International Pvt. Ltd. Publishers, III ed.* 2003.
7. Siva Sankar B., *Food Processing and Preservation. Prentice – Hall of India Pvt. Ltd., New Delhi.* 2002.
8. Ramakrishnan S., Prasannam K.G and Rajan R –*Principles. Text book of medical biochemistry. Orient Longman* Ltd. III ed. 2001.
9. Shakuntala Manay N. and ShadaksharaswamyM. FOODS: Facts and Principles. *New age International Pvt. Ltd. Publishers, II ed*. 2002.

FOOD CHEMISTRY PRACTICALS

B.Sc. Chemistry
Semester – VI — No. of hours per week : 5
Course : Skill based course

01. Estimation of Nitrogen (protein) by Kjeldhal method.
02. Estimation of iodine value, acid value and RM value of an edible oil.
03. Estimation of food colours (by colorimetric method).
04. Estimation of available carbondioxide in baking powder.
05. Isolation of caesein and lactose from milk.
06. Preparation of oleoresin of ginger and the essential oil.
07. Steam distillation of mint.
08. Estimation of glycine.
09. Isolation of natural food colours – Soxhelet extraction of chlorophyll.
10. Flavour analysis – GC/ HPLC demonstration.
11. Isolation of caffeine from tea dust.
12. Detection of adulterants in food stuffs.
13. Estimation of hardness of water, iron content and microbiological examination.
14. Estimation of ascorbic acid.
15. Estimation of glucose.
16. Visit to food industry.

Reference book

1. N. S. Gnanapragasam, G. Ramamurthy, Organic Chemistry Lab Manual, S.Viswanathan printers and publishers LTD., 2002.

CH - 6651 : CHEMISTRY OF CONSUMER PRODUCTS

B.Sc. Chemistry
Semester – VI — No. of Credits : 13
Course : Skill based course — No. of hours per week : 8

Objectives

This skill based course provides

1) Students the basic knowledge in consumer product Chemistry and modern trends in the industry.

2) To provide the practical training to the students in consumer product analysis

UNIT 1: SOAPS

Saponification of oils and fats. Manufacture of soaps. Formulation of toilet soaps. Different ingredients used. Their functions. Medicated soaps. Herbal soaps. Mechanism of action of soap. Soft soaps. Shaving soaps and creams. ISI specifications. Testing procedures/limits.

UNIT 2: DETERGENTS

a. Anionic detergents: Manufacture of LAB (linear alkyl benzene). Sulphonation of LAB – preparation of acid slurry. Different ingredients in the formulation of detergent powders and soaps. Liquid detergents. Foam boosters. AOS (alpha olefin sulphonates.

b. cationic detergents: examples. Manufacture and applications.

c. Non-ionic detergents: examples. Manufacture of ethylene oxide condensater.

d. Mechanism of action of detergents. Comparison of soaps and detergents. Biodegradation – environmental effects. ISI specifications / limits.

UNIT 3: SHAMPOOS

Manufacture of SLS and SLES. Ingredients. Functions. Different kinds of shampoos – anti-dandruff, anti-lice, herbal and baby shampoos. Hair dye. Manufacture of conditioners. Coco betaines or coco diethanolamides – ISI specifications. Testing procedures and limits.

UNIT 4: SKIN PREPARATIONS

Face and skin powders. Ingredients, functions. Different types. Snows and face creams. Chemical ingredients used. Anti perspirants. Sun screen preparations. UV absorbers. Skin bleaching agents. Depilatories. Turmeric and Neem preparations. Vitamin oil.

Nail polishes: nail polish preparation, nail polish removers. Article removers.

Lipsticks, roughes, eyebrow pencils. Ingredients and functions – hazards. ISI specifications.

UNIT 5:

Leading firms, brand names, choosing the right product. Packing regulations. Marketing. Licensing – drug license – legal aspects. GMP – ISO 9000/12000 – consumer education. Evaluation of the product – advertisements.

Reference books

1. Gobala Rao.S , Outlines of chemical technology, Affiliated East West press,1998
2. Kafaro, Wasteless chemical processing, Mir publishers, 1995.
3. Sawyer.W, Experimental cosmetics,Dover publishers, New york, 2000.

CONSUMER PRODUCTS PRACTICALS

B.Sc. Chemistry
Semester – VI No. of hours per week : 5
Course : Skill based course

01. Determination of active content (SLS, SLES, LABS) in a detergent.
02. Estimation of iodine value and saponification value of an oil.
03. Estimation of hardness of water. Estimation of iron (III) by colorimetric method in water analysis.
04. Microbiological examination of food products. RWC of phenol.
05. Estimation of available chlorine in bleaching powder or bleach liquor.
06. Detection of food adulteration including milk. Detection of adulteration in petrol / diesel.
07. Estimation of ascorbic acid by iodimetric method.

08. Determination of nitrogen by Kjeldhal method.
09. Analysis of essential oils by gas chromatographic method.
10. Estimation of glucose by Benedict's method. Estimation of sugar by refractometric method.
11. Estimation of purity of soda ash.
12. Estimation of phenol by Winkler's method.
13. Isolation of lactose from milk.Caffeine from tea leaves, Ginger oleoresin from Ginger.
14. Visit to the analytical laboratories / ISI / FPO / Government laboratories
15. Detection of alkaloids, terpenes, flavanoids, anthocyanins, proteins, amino acids and hydrocarbons in the natural product extracts. (a herbal extraction will be carried out.)

INDUSTRIAL EXPOSURE

B.Sc. Chemistry
Semester – VI Time : one month
Course : Skill based course

CONFIDENTIAL ASSESSMENT FORM

Student name: _____ [D. No. _____]

Industry :

_____

Industrial Person-in-charge:

_____

Staff-in-charge :

_____

Attendance

Max mark: 20

Excellent	Good	Satisfactory	Not-satisfactory	

(2) Work Skill

Max mark: 40

Excellent	Good	Satisfactory	Not-satisfactory	

(3) Interpersonal Relationship Max mark: 15

Excellent	Good	Satisfactory	Not-satisfactory	

Total Marks Awarded [Out of 75]

Max mark: 75

Any other remarks:

CH - 6652 : SEMINAR AND REPORT

B.Sc. Chemistry
Semester – VI — No. of Credits : 2
Course : Major core — No. of hours per week : 2

Objectives :

To make the student to understand and present the topics in the subject related to Chemistry in a class room.

Testing :

The student will be tested both in subject matter and the mode of presentation.

The components in the subject matter include

Standard of subject and plan

Preparation and mastery

Originality and logical development

Answers to questions

Summary and references

The components in the mode of presentation include

1) Economy of time
2) Voice as a tool of communication
3) Blackboard use and teaching aids
4) Language and diction
5) Relating to the audience

ELECTIVE GENERAL (EG)

CH - 2300 : APPLIED CHEMISTRY

B.Sc. (For students other than Chemistry)
Semester – II — No. of Credits : 2
Course : Elective General (EG) — No. of hours per week : 3

Objectives

1. *To make non-chemistry graduates to get exposed to day to day chemistry related materials and science.*

2. *To learn the terms and definitions in general chemistry and use of popularly used chemicals.*

UNIT 1: Industrial Fuels

1.1 Energy sources: non-renewable, classification of fuels, solid, liquid and gaseous. Calorific value of fuels and its determination.
1.2 Solid fuels: Coal: types, properties and uses of lignite, sub-bituminous coal, bituminous coal and anthracite. Coking and non-coking coal.
1.3 Liquid fuels: Refining of crude petroleum and uses of fractions. Hydrodesulphurisation. Cracking: thermal and catalytic (fixed bed and fluidized bed catalysis). Octane number.
1.4 Gaseous fuels: Natural gas and gobar gas: production, composition and uses, Gobar electric cell.

Self study:
Extraction of petroleum, Comparison between solid, liquid and gaseous fuels.

UNIT 2: Chemistry and agriculture

2.1 Fertilizers: Discussion on ammonium nitrate, urea, superphosphate, triple superphosphate, diammonium phosphate, potassium nitrate, uses of mixed fertilizers, micronutrients and their role.
2.2 Pesticides: Classification of pesticides with examples.
2.3 Insecticides: stomach poisons, contact insecticides, fumigants, manufacture and uses of insecticides. DDT, BHC(gammexane: conformation of gamma isomer) pyrethrin mention of aldrin, dieldrin, endrin and pentachlorophenel (and its Na salt) (structures excluded)
2.4 Herbicides: 2,4-D and 2,4,5-T
2.5 Fungicides: Bordeaux mixture, mention of lime sulphur, creosote oil and formula.

Self study:
NPK fertilizers, triple superphosphate, different types of pesticides, insecticides

UNIT 3: Sugar and Paper industry

3.1 Sugar industry: Double sulphitation process, refining, and grading of sugar. Saccharin: synthesis and uses as a sugar substitute. Ethanol: manufacture from molasses by fermentation.

3.2 Paper industry: Manufacture of paper: production of sulphite pulp and conversion to paper (bleaching, filling, sizing and calendaring)

Self study:

World production of sugar and paper - survey

UNIT 4: High Polymers

4.1 Classification, types of polymerisation

4.2 Natural polymers: polysaccharides (starch and cellulose), polyhydrocarbons (natural rubber) and proteins

4.3 Synthetic polymers: Polyhydrocarbons (polythene, synthetic rubber), polychlorohydrocarbons (PVC, neoprene), polyamides (nylon) and polyphenols (phenol-formaldehyde resin)

4.4 Addition and condensation polymerization, step growth and chain growth polymers. Comparison and properties of thermoplastics and thermosetting polymers, copolymers.

4.5 Synthesis, structure and uses: a) rubber: cis-structure and elasticity, Synthetic rubber: neoprene and Buna-S, vulcanization of rubber, additives used in rubber manufacture.

4.6 Plastics: polythene, polypropene (isotactic structure), Ziegler-Nutta polymerization, PVC, PVA, Polystyrene and bakelite. Blow moulding and injection moulding.

4.7 Fibres: rayon, terylene and nylon.

Self study:

Re-enfored plastics, Zeigler-Natta polymerization in polyethylene

UNIT 5: Articles used in daily life.

5.1 Glass: composition, manufacture and uses

5.2 Cement :Manufacture: wet and dry processes, comp[osition and setting of cement

Dyes: classification based on structure and application. Synthesis of congo red and malachite green

Pharmaceuticals: Manufacture of aspirin and penicillin (fermentation process) mention of antibiotics.

Quality control: ISI specification. Patents: purpose and procedure.

Self study:

Collection of names of analgesics, antipyretics, antiseptics, antimalarial, sadaditives

Reference Books

1. Biswas, A.K., Frontiers in Applied Chemistry, Narosa publishing house, 1989
2. Vermain, O.P, Narula A.C., Applied chemistry theory and books.
3. Thiagarajan,V.T., Pharmaceutical chemistry, K.S.C. Desikan & Co, Chennai,1995.

CH - 4301: BASIC CLINICAL AND PHARMACEUTICAL CHEMISTRY

B.Sc. Chemistry
Semester – IV — No. of Credits : 2
Course : Elective General (EG) — No. of hours per week : 3

Objectives :

After going through the course the student is expected to learn about

1. *The disinfectants and antiseptics.*
2. *The important drugs and the mode of actions.*
3. *Enzymes*
4. *Body fluids*

UNIT-1: CLINICAL HYGIENE AND BIOCHEMICAL ANALYSIS (6 hrs)

Definition of health. Ryde of WHO.
Sterilization of surgical instruments. Disinfectants, antiseptics, sanitation.
Biochemical analysis of urine, serum and fecal matter.
Treatment for specific poisons-acids, alkalis, arsenic and mercury compounds.

Self study:

Different types of chemical poisons in society

UNIT-2: COMMON DRUGS (12 hrs)

Manufacture of drugs (e.g. quinine, reserpine, atopside and d – tubocurarine) from indian medicinal plants. Testing of drugs : biological variation, screening and toxicity. Use of pharmacoepia and therpeutic index.

Types of drugs and their modes of action :
Depressant drugs (special reference to sedatives and hypnotics).
Anticonvulsant drugs (sodium valproate, hydantoins).
Narcotic analgesics (only morphine compds).
Antipyretic analgesics (acetyl salicyclic acid, p – amino – phenol derivatives).
Muscle relaxants.

i. Acting at neuromuscular junction (d – tubocurarine chloride).
ii. Acting at spinal cord alone (glyceryl guaiacolate, diazepam).

Antibiotics (pencillin, streptomycin, tetracyclin, chloramphenicol)
Cardiovascular drugs-nitrates, beta blockers(propranalol and atinelol) and calcium channel blockers.
h) uclear medicine (Radiation therapy)

Self study:

Knowing names of medicines used for the above diseases

UNIT-3: ENZYMES (4 hrs)

Classification, specificity. Coenzymes, Cofactor, ATP, Mechanism of enzyme action and Immobilisation of enzymes.

Self study:

Specific action of enzymes, factors affecting enzyme activity

UNIT-4: BODY FLUID

Blood volume, blood groups, coagulation of blood. Plasma lipo protiens. Blood pressure. Arteriosclerosis, diseases afecting red cells: Hyperchromic and hypochromic anaemia. Blood tranfusion. Blood sugar and diabetes.

Self study:

Knowledge of measuring blood pressure, influence of blood pressure, blood sugar control levels and medicine used to control blood pressure and blood sugars

UNIT-5: BIOTECHLONOGY: (8 hrs)

Heredity, recombinant DNA, Genetic engineering and its possible hazards, Gene splicing, manufacture of interferon and human insulin(Humulin), Drug manufacture based on fermentation(only antibiotics)

VISITS (5 hrs)

One full day visit to a medical research laboratory and to pharmaceutical industry.

Text Books

Jayashree Ghosh, A text book of Pharmaceutical Chemistry, S.Chand and Co. Ltd, 1999.
S.C. Rastogi, Biochemistry, Tata McGraw Hill Publishing Co., 1993
Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, New Delhi, 1993.

Reference Books

1. O.Le Roy, Natural and synthetic organic medicinal compounds, Ealemi., 1976.
2. B.L. Oser, Hawk's physiological chemistry, 14th edition, Tata-McGraw - Hill Publishing Co.Ltd, 1965
3. O. Kleiner and J. Martin, Bio-Chemistry, Prentice-Hall of India(P) Ltd, New Delhi, 1974.

ALLIED REQUIRED (AR)

CH - 2102 : GENERAL CHEMISTRY FOR MATHS AND PHYSICS

(Offered to B.Sc. Physics and Mathematics)

Semester – II	No. of Credits : 3
Course : Allied Required(AR)	No. of hours per week : 4

Objectives :

To get a good exposure to the basic concepts of chemistry to enable them to pursue careers related to chemistry.

UNIT 1: INORGANIC CHEMISTRY (9 hours)

1.1 Transition elements

a) Transition Elements: Electronic structure and position in the periodic table.

b) General properties: variable valency, colour, magnetic properties and catalytic role

1.2 Coordination compounds

a) IUPAC Nomenclature of mononuclear complexes, Types of ligands including EDTA.

b) Theories: Werner's theory based on conductivity, Precipitation and isomerism (geometrical and optical) in square planar and octahedral complexes. Sidgwick's theory and EAN Principle, Pauling's Theory, explanation of shapes and magnetic nature.

c) Use of coordination compounds in qualitative analysis (Cu^{2+}/NH_3) and quantitative analysis (Ni^{2+}/DMG), Hardness of water using EDTA.

d) Mention of biologically active compounds: Haemoglobin, Chlorophyll.

UNIT 2: ORGANIC CHEMISTRY (10 hours)

2.1 Electronic displacement effects:

a) Inductive, resonance and steric effects.

b) Their effect on K_a and K_b on organic acids and bases.

2.2 Organic reaction mechanisms:

a) S_N1 bd S_N2 reaction of alkyl halides : mechanism only

b) Aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation.

2.3 Isomerisms:

a) Geometrical isomerism: molecules of alkene ofstructure R-CH=CH-R

b) Optical isomerism: compounds with one and two adjacent chiral carbons

c) Conformational isomerisms of ethane, n-butane and cyclohexane.

UNIT 3: PHYSICAL CHEMISTRY (10 hours)

3.1 Solutions:

a) Types and examples of solutions: gas in liquid and liquid in liquid (totally miscible, partially miscible and immiscible liquid pairs)

b) Henry's and Raoult's laws, ideal and real solutions, deviation from ideal behaviour. Vapour-Pressure composition diagram for a totally miscible binary liquid system obeying Raoult's laws.

c) Partially miscible liquid system (Phenol-water)

3.2 Phase Rule:

a) Definition of phase, component and degree of freedom, Phase rule (statement only).

b) Application of phase rule to a one-component system (water) and simple eutectic system (Pb-Ag)

c) Determination of pH (glass electrode)

3.3 Kinetics and catalysis:

a) Rate expression for I and II order, methods of determining order of a reaction, order and moleccularity.

b) Catalysis : homogeneous and heterogeneous, catalyst used in Contact and Haber's processes.

c) Concept of energy of activation and Arrhenius equation.

3.4 Photochemistry:

a) Comparison between thermal and photochemical reactions

b) Grotthus-Drapper's law, Einstein's law, quantum yield, photosensitisation

c) Beer-Lambert's law. Estimation of copper and nickel by spectrophotocalorimetry.

UNIT 4: BIO-ORGANIC CHEMISTRY (7 hours)

4.1 Nucleic acids:

a) Structure of DNA and RNA, Hydrogen bonding.

b) Replication of DNA. Types of RNA

c) Genetic Engineering: Mention of applications and possible risks.

4.2 Hormones:

a) Thyroxine, adrenaline and sex hormones (structure and functions only)

b) Mention of ACTH, cortisone, prostaglandins, and oxytocin.

UNIT 5: INDUSTRIAL CHEMISTRY (9 hours)

5.1 High Polymers:

a) Classification: Natural and synthetic, step growth and chain growth polymers.

b) Natural rubber: Composition, cis-structure, elasticity, manufacture and uses of synthetic rubber (neoprene, Buna-S), Vulcanization of rubber.

c) Plastic: Manufacture and uses of PVC, Bakelite, acrylates, PET, PUF, and Polystyrene.

5.2 Corrosion:

a) Causes of corrosion of metals, Electrochemical mechanism.

b) Prevention: Galvanization, electroplating and cathodic protection.

Text Books :

1. C.N.R. Rao, University General Chemistry, Macmillan Co., India Ltd, 1973.

2. M.J. Sienko and R.A. Plane, Chemistry – Principles and properties, nternational Student Edition. 1995.

3. R. Gopalan, S. Sundaram, Allied Chemistry, Sultan Chand and Sons (1995).

Reference Books :

1. G.C. Hill, J.S. Holman, Chemistry in Context, ELBS, 1998

2. W.R. Kneen, M.J.W. Rogers, P. Simpson, Chemistry – Facts, patterns and principles, ELBS., 1999.

3. Bruce H. Mahan, University Chemistry, 3rd edition, Addition-Wesley Publishing Company, 1977.

CH – 2103 : GEN.CHEM.LAB FOR MATHS AND PHYSICS

(Offered to B.Sc. Physics and Mathematics)

Semester – II	No. of Credits : 1
Course : Allied Required(AR)	No. of hours per week : 2

Objectives :

To enable the students to understand better the concepts of organic analysis and appreciate better the applications of organic chemistry towards biological systems.

Organic Analysis:

a) Identification of acidic, basic, phenolic and neutral organic substances

b) Detection of N, S and halogens

c) Test for aliphatic and aromatic nature of substances.

d) Test for saturation and unsaturation.

e) Identification of functional groups

i) Carboxylic acid
ii) Phenols
iii) Aldehydes
iv) Ketones
v) Esters
vi) Carbohydrates
vii) Primary amines
viii) Amides

Text Books :

1. N.S. Gnanapragasam and G. Ramamurthy, Organic chemistry – Lab manual, S. Viswanathan Co. Pvt. Ltd., 1998.
2. J.N. Gurtu and R. Kapoor, Advanced Experimental Chemistry(Organic), S. Chand and Co., 1987.

CH - 3104 : CHEMISTRY FOR BIOLOGISTS-I

(Offered to B.Sc. Zoology and Plant Biology)

Semester – III	No. of Credits : 3
Course : Allied Required(AR)	No. of hours per week : 4

Objectives :

1. To enable the students to understand the concepts in physical and chemical processes in living systems.
2. To know the applications of physical, inorganic and organic chemistry towards biological systems.

UNIT 1: Chemical Bonding (12 hours)

1.1 Ionic Bond: Nature of Ionic bond, structure of NaCl, KCl and CsCl, factors influencing the formation of ionic bond.

1.2 Covalent Bond: Nature of covalent bond, structure of CH_4, NH_3, H_2O, shapes of $BeCl_2$, BF_3, CH_4, PCl_5, NH_3, H_2O, IF_7, based on VSEPR theory and hybridisation.

1.3 Coordinate Bond: Nature of coordinate bond, coordination complexes, Werner's theory, geometrical and optical isomerism in square planar and octahedral complexes, mention of structure and functions of chlorophyll and hemoglobin

1.4 Hydrogen Bond: Theory of hydrogen bonding and types of hydrogen bonding (with examples of RCOOH, ROH, salicyladehyde, amides and polyamides).

1.5 van Der Waal's forces: dipole - dipole, dipole - induced dipole interactions.

Self Study:

Properties of ionic, covalent, coordinate and hydrogen bonds, formation of BF_3-NH_3, NH_4^+, IUPAC nomenclature of coordination complexes.

UNIT 2: Solutions (8 hours)

2.1 Normality, Molarity, Molality, Mole fraction, mole concept.

2.2 Primary and secondary standards - Preparation of standard solutions

2.3 Principle of volumetric analysis (with simple problems)

2.4 Strong and weak acids and bases - Ionic product of water - pH, pK_a, pK_b. Buffer solutions - pH of buffer solutions.

Self Study:

Simple problems on concentration terms, preparation of standard solutions and pH and pOH calculations

UNIT 3: Kinetics (6 hours)

3.1 Rate, rate law, order and molecularity, derivation of rate expressions for I and II order kinetics.

3.2 Catalysis, homogeneous and heterogeneous catalysis, enzyme catalysis, enzymes used in industry.

Self Study:

Characteristics of I and II order kinetics, examples of various order of the reactions.

UNIT 4: Colloids (5 hours)

4.1 Colloids, lyophilic and lyophobic colloids

4.2 Optical and Kinetic properties, electrophoresis and electro osmosis, peptisation, and coagulation.

Self study: Types with examples and applications of colloids

UNIT 5: Basic Organic Chemistry (9 hours)

5.1 Electronic displacement effects: inductive, resonance and steric effects, acidity of organic acids and bases.

5.2.1 Isomerism - Molecules with one chiral carbon and two adjacet chiral carbons - Enantiomers - Diasteromers - Separation of racemic mixture - Geometrical isomerism (maleic and fumeric acids).

5.3 Polymers, Natural and Synthetic polymers, Polymerisation and types, Elastomers, Rubber (Buna-S, neoprene, Thiokol), Plastics, types (PVC, Teflon, HDPE, LDPE), Fibres, types (nylon, terylene)

Self study:

Optical isomers of lactic and tartaric acid.

Text Books :

1. R. Gopalan, S. Sundaram, Allied Chemistry, Sultan Chand and Sons (1995).
2. Veeraiyan, Allied Chemistry,

Reference Books:

1. M. J. Sienko and R.A. Plane, Chemistry - Principles and properties, International Student Edition, 1995.
2. G.C. Hill, J.S. Holman, Chemistry in Context, ELBS, 1998
3. W.R. Kneen, M.J.W. Rogers, P. Simpson, Chemistry – Facts, patterns and principles, ELBS. 1999.
4. Misra, Introduction to Polymer Chemistry, 2002.

CH - 3105 : CHEMISTRY PRCTICAL FOR BIOLOGISTS-I

(Offered to B.Sc. Zoology and Plant Biology)

Semester – III	No. of Credits : 1
Course : Allied Required(AR)	No. of hours per week : 2

Objectives :

1. *To enable the students to understand the concepts of organic analysis.*
2. *To appreciate the chemistry of various functionalised organic compounds through analysis.*

Organic Analysis:

a) Identification of acidic, basic, phenolic and neutral organic substances

b) Detection of N, S and halogens

c) Test for aliphatic and aromatic nature of substances.

d) Test for saturation and unsaturation.

e) Identification of functional groups

i) Carboxylic acid
ii) Phenols
iii) Aldehydes
iv) Ketones
v) Carbohydrates
vi) Primary amines
vii) Amides

Text Books :

1. N.S. Gnanapragasam and G. Ramamurthy, Organic chemistry – Lab manual, S. Viswanathan Co. Pvt. Ltd., 1998.
2. J.N. Gurtu and R. Kapoor, Advanced Experimental Chemistry(Organic), S. Chand and Co., 1987.

PH2103 - PHYSICS FOR CHEMISTRY - I

B.Sc Chemistry (Offered by Department of Physics)

Semester – II	No. of Credits : 3
Course : Allied Required (AR)	No. of hours per week : 4

Objective: *This paper is offered to the students of chemistry as allied required. While the chemical properties are learnt in the major, the study of physical properties will compliment their studies.*

Unit – 1: Classical mechanics

a) Particle dynamics: Displacement, velocity and acceleration- distance –time graph-velocity – time graph – projectile motion – uniform circular motion – tangential acceleration in circular motion – relative velocity and acceleration

b) Lagrangian formulation : Generalised coordinates – holonomic and non-holonomic constraints – Lagrange's equations – simple applications- Atwood's machine – simple pendulum

Unit 2: Gravitation

a) Classical theory of gravitation : Kepler's laws, Newton's law of gravitation – G and measurement – Earth –moon system – weightlessness – earth satellites – parking orbit – earth density – mass of the Sun – gravitational potential – velocity of escape – satellite potential and kinetic energy.

b) Einstein's theory of gravitation : Introduction – the principle of equivalence – experimental tests of general theory of relativity – gravitational red shift – bending of light – preihelion of mercury.

Unit –3: Properties of matter

a) Elastic properties : Elastic limit – Hooke's law – moduli of elasticity – poission ratio – relation between q,n,k – force in a bar due to contraction or expansion – energy stored in a wire – rigidity modulus – torsion in a wire – static torsion and torsional oscillations method**.**

b) Viscosity and surface tension : Newton's formula – Stoke's formula – Poiseuille's flow – molecular theory of surface tension – excess pressure over curved surface – spherical and cylindrical drops – surface energy – capillary rise – Quincke's method for mercury.

Unit – 4: Optics

a) Diffraction: Fresnel and Fraunhofer diffractions – Fraunhofer diffraction at a single slit-diffraction at multiple slits- plane diffraction grating – determination of wavelength of a special line.

b) Polarisation: Double refraction of crystals– geometry of Nicol prism – Huygen's theory – Polaroid – circular and elliptical polarization – quarter and half wave plates – production and analysis of polarized beams – optical activity.

Unit – 5 : Crystal Physics

a) Crystal structures: Introduction – periodic array of atoms – crystal lattice – unit cell – basis – symmetry considerations – classification of crystals – Bravais lattices in three dimensions – crystal planes and Miller indices – simple crystal structures.

b) Crystal diffraction: Bragg's law – experimental X-ray diffraction methods: - Laue method – rotating crystal method – powder method – neutron diffraction.

TEXT BOOKS:-

1. Nelkon and Parker Advanced level physics — Arnold Publishers – 7th edition.
2. M.Narayanamurthy and N.Nagarathnam Dynamics – (The national publishers)
3. D.S.Mathur, properties of matter, S.Chand and Co., New Delhi
4. S.Subrahmanyam and S.Brijlal, A text book of optics, S.Chand and Co (22nd edition.
5. C.Kittel , Introduction to solid state physics – Wiley eastern 5thedition.

BOOKS FOR REFERENCE:-

1. D.Halliday and R.Resnick , Physics, Part 1 (Wiley eastern)

PH2104 - PHYSICS FOR CHEMISTRY - PRACTICAL- I

B.Sc Chemistry (Offered by Department of Physics)

Semester – II	No. of Credits : 1
Course : Allied Required (AR)	No. of hours per week : 2

LIST OF EXPERIMENTS

1. Young's modulus by stretching -vernier microscope
2. Rigidity modulus -torsional pendulum
3. Surface tension and interfacial tension - method of drops
4. Surface tension - capillary rise
5. Viscosity - capillary flow
6. Specific heat of liquid - method of mixtures (approximate radiation correction)
7. Specific heat of liquid - electrical heating
8. Sonometer -verification of laws
9. Compound bar pendulum - determination of 'g' and radius of gyration

MT - 3103 : MATHEMATICS FOR CHEMISTRY

B.Sc Chemistry (Offered by Dep. of Mathematics)

Semester – III	No. of Credits : 4
Course : Allied Required(AR)	No. of hours per week : 6

Objectives:

1. To learn the basic mathematical concepts
2. To familiarize the learner with applications of mathematics to chemistry.

Unit 1: Differentiation of standard functions-hyperbolic and inverse hyperbolic functions-differentiation of one function with respect to another-slope-tangent and normal-maxima and minima-angle of intersection of curves in cartesian and polar coordinates(20 hrs).

Unit 2: Methods of integration-integration by parts-Bernoulli's formula-properties of definite integrals-differential equations-second order differential equations with constant coefficients(20 hrs).

Unit 3: Application of binomial, exponential and logarithmic series to summation-eigenvalues and eigenvectors (differential calculus approach)-partial differential equations-all types(15 hrs).

Unit 4: Complex numbers- DeMoivre's theorem and applications-expansions of sin nθ,cos nθ,$\sin^n\theta$,$\cos^n\theta$,sinθ,cosθ-hyperbolic functions-Fourier series(10 hrs).

Unit 5: Probability-mean-standard deviation-Binomial, Poisson and normal distributions (10 hrs).

Text Books:

1. Narayanan, S. and Manickavachagam Pillai, T.K., *Calculus,* Vol.I and Vol. II, S.Viswanathan Printers & Publishers,1996.
2. Manickavachagam Pillai, T.K, Natarajan,T. and Ganapathy, K.S. *Algebra*,Vol I, S.Viswanathan Printers & Publishers,1994.
3. Narayanan, S. *Trigonometry*,S.Viswanathan Printers & Publishers,1995.
4. Gupta,S.P.,*Elements of Statistics*,S.Chand & Co,1986.
5. Venkataraman, M.K. *Engineering Mathematics*,III-A, The National Publishing Co.,1995.

Reference Books:

1. Shanthi Narayanan, *Differential Calculus*, S.Chand & Co., 1964.
2. Vittal,P.R. *Trigonometry*, Margham Publications,1988.
3. Duraipandian, P., *Vector Analysis*, Emerald Publishers, 1984.

ALLIED OPTIONAL (AO)

CH - 3202 : ADVANCED GEN.CHEM. FOR MATHS AND PHYSICS

(Offered to B.Sc. Physics and Mathematics)

Semester – III	No. of Credits : 3
Course : Allied Optional(AO)	No. of hours per week : 4

Objectives :

To get a good exposure to the basic concepts of chemistry to enable them to pursue careers related to chemistry and enable them to learn their subject better.

UNIT 1: INORGANIC CHEMISTY (6 hours)

1.1 Hydrogen bond:
a) Detection, molecular weight of acetic acid in benzene, boiling point of water
b) Strength of hydrogen bonds: Eddect of temperature (ice and water), inter and intra molecular hydrogen bonds, separation of o- and p-nitrophenols by steam distillation, solubility of polar organic compounds in water(ethanol and phenol)
c) Theory of hydrogen bond : dipole interaction.

1.2 Lanthanides:
a) Ionic radius, lanthanide contraction
b) Extraction of lanthanides - ion exchange method

UNIT 2: ORGANIC CHEMISTRY (10 hours)

2.1 Polycyclic aromatic hydrocarbons:
a) Naphthalene and anthracene: Isolation from coal tar, Haworth synthesis
b) Products of electrophilic substitution: nitration, halogenation, sulphonation, addition reactions with hydrogen and bromine, carcinogenisity of hgiher poly aromatic hydrocarbons.

2.2 Heterocyclic compounds:
a) Preparation of furan, pyrrole, thiophene and pyridine
b) Products of electrophilic aromatic substitution: nitration and Reimer-Tiemann Reaction

2.3 Dyes:
a) Classification based on structure and mode of dyeing, use of mordents
b) Preparation of congo-red and malachite green
c) Colour and constitution: chromophores and auxochromes

2.4 Medicinal chemistry:
a) Classification of drugs
b) Sulpha drugs: synthesis of sulphanilimide, structure and uses of sulphadiazine and sulphamethoxazole
c) Antibiotics: Structure of penicillin, broad spectrum antibiotics and their uses(structural elucidation is not required)
d) Antipyretics: synthesis and uses of aspirin
e) Antiinflammatry: Ibubrufan

UNIT 3: PHYSICAL CHEMISTRY (13 hours)

3.1 Energetics:
a) I law of thermodynamics: Concepts of internal energy and enthalpy.
b) Hess's law, heat of formation, combustion, neutralization, bond energy, bond dissociation energy, Kirchoff's equation

3.2 Electrochemistry: a) Determination of equivalent conductance, Kohlrausch's law, determination of K_a and K_{sp}, conductometric titrations, acid-base precipitation
b) EMF, standard reduction potentials, reference electrodes: primary(SHE) and secondary (Calomel)

3.3 Solid state chemistry:
Born-Haber cycle, lattice energy, solubility of ionic compounds.

UNIT 4: BIO-ORGANIC CHEMISTRY (9 hours)

4.1 Carbohydrates:
a) Classification, mention of structures of glucose, fructose, and sucrose
b) Photosynthesis: nature, energy transformation, CO_2 fixation

4.2 Proteins:
a) Formation of amino acids and polypeptides
b) Sequence determination : N-terminal and C-terminal amino acid analysis(Sanger's and carboxypeptidase methods)
c) Mention of primary and secondary structures.

4.3 Enzymes:
a) Classification, nature and properties
b) Factors affecting enzyme reaction
c) Lock and key model inhibition.

UNIT 5: INDUSTRIAL CHEMISTRY (7 hours)

5.1 Energy resources and applications:
a) Sources of energy: renewable(solar, wind, tidal) and non-renewable(coal, lignite, petroleum and natural gas)
b) Liquid fuels: fractional distillation of petroleum, thermal and catalytic cracking, octane number.
c) Nuclear energy: fission and fusion principles, use of radio isotopes(medicinal, agriculture and industry)

5.2 Chemistry and agriculture:
a) Types of soils, role of himus, importance of manures
b) Fertilizers: manufacture of urea, ammonium sulphate, superphosphate of lime and triple superphosphate, source of K, mixed fertilizers, role of macro and micro nutrients.
c) Pesticides: Examples of common insecticides(DDT, BHC)
d) Herbicides: 2,4-D and 2,4,5-T
e) Fungicides: Bordeaux mixture

Text books:

01. C.N.R. Rao, University General Chemistry, Macmillan Co. India, Ltd, 1973

02. M.J.Sienko and R.A.Plane, Chemistry: Principles and properties, International Student Edition, 1995
03. R.Goplaln, S.Sundaram, Allied Chemistry, Sultan Chand and sons, 1995

Referance books:

01. G.C. Hill and J.S. Holman, Chemistry in Context, ELBS, 1998
02. W.R. Kneen, M.J.W.Rogers and P.Simpson, Chemistry: Facts, patterns and Principles, ELBS, 1999
03. Bruce H.Mahan, University Chemistry, 3rd edition, Addition-Wesley Publishing companyh, 1977.

CH - 3203 : ADV. GEN.CHEM. LAB FOR MATHS AND PHYSICS

(Offered to B.Sc. Physics and Mathematics)

Semester – III	No. of Credits : 1
Course : Allied Optional(AO)	No. of hours per week : 2

Objectives :

To enable the students to understand better the concepts of organic analysis and appreciate better the applications of analytical methods in industry.

PRACTICALS:

01. Estimation of ascorbic acid
02. Estimation of HCl(Std. KHP × NaOH × HCl)
03. Estimation of mixture of Na_2CO_3 and $NaHCO_3$
04. Estimation of $KMnO_4$ using standard ferrous sulphate
05. Estimation of $KMnO_4$ using standard dichromate
06. Estimation of $FeSO_4$ using standard dichromate
07. Estimation of phenol or aniline
08. Determination of pH of soil, water, ...
09. Demonstration experiments:
    a) Column Chromatography of food dyes
    b) TLC - Separation of triglycerides
    c) Paper chromatogrsphy - separation of amino acids

Reference books

01. Experimental Chemistry, J.N. Gurtu and R. Kapoor, S.Chand and Co, 1987
02. N.S. Gnanapragasam and G. Ramamurthy, Organic chemistry – Lab manual, S. Viswanathan Co. Pvt. Ltd., 1998.

CH - 4204 : CHEMISTRY FOR BIOLOGISTS-II

(Offered to B.Sc. Zoology and Plant Biology)

Semester – IV	No. of Credits : 3
Course : Allied Optional(AO)	No. of hours per week : 4

Objectives

To get a good exposure to the basic concepts of chemistry to enable them to pursue careers related to chemistry and enable them to learn their subject better

UNIT 1: Proteins and Enzymes (8 hrs)

Amino acids: Classification, preparation and properties, isoelectric point, peptide synthesis.

Proteins: Classification based on structure and functions, primary structure, N-terminal (Sanger and Edmans method) and C-terminal analysis (enzyme), secondary structure of protein (α-helical structure), denaturation of proteins.

Enzymes: Classification, mechanism of enzymes action, kinetics of enzyme reaction, Micheles-Menton hypothesis, enzyme inhibition, cofactors.

Self Study: Reactions of amino acids, Sorenson's titration, ninhydrin test.

UNIT 2: Lipids (5 hrs)

2.1 Classification, phospholipids (lecithins, cephalins, plasmalogens)

2.2 Steroids: Cholesterol, plasma, lipo proteins, rancidity, and hydrogenation of oils, biosynthesis of cholesterol.

Self study: ifference between plant and animal fatty acids, structure and characteristics of sex hormones.

UNIT 3: Nucleic Acid

3.1 Structure of nucleic acids, DNA and RNA, Sugars, Structure of Purine and Pyrimidine bases Differences between DNA and RNA,

3.2 Replication of DNA, Protein Synthesis, regulatory metabolism, mutation, genetic engineering.

Self study: Hydrogen bonding between nitrogeneous bases in DNA, properties of DNA and RNA.

UNIT 4: Carbohydrates (6 hrs)

4.1 Classification, structure of Glucose and Fructose, interconversions, mutarotation.

4.2 Structure of sucrose, inversion of Cane Sugar

4.3 Glycolysis, TCA cycle, relationship between glycolysis and respirations, photosynthesis.

Self study: Properties of carbohydrates, Difference between reducing and non reducing sugars.

UNIT 5: Natural Products and Agricultural Chemistry (9 Hrs)

5.1 *Alkaloids*: Classification, occurrence (mention of papaverine, nicotine, coniine)
5.2 *Terpenes*: Classification, isolation (mention of Camphor, Citral, and α-Pinene) Importance and uses of anthocyanines and flavones and flavonoids.
5.3 Types of Soils, Soil analysis, Fertilizers (macro and micro nutrients, N, P, K fertilizers, Urea, Superphosphate of lime and Potassium nitrate)
5.4 Insecticides (DDT, BHC, Organophosphates, synthetic pyrethroids), herbicides (2,4-D and 2,4,5-T), fungicides (Bordeaux mixture, lime-sulphur).
5.5 *Bioenergetics*: ATP, oxidative phosphorylation, electron transport, mechanism of ATP synthesis, metabolic inter relation of proteins, lipids and carbohydrates.

Self Study:*Extraction and biological importance of alkaloids and terpenoids, spot tests in soil analysis, mechanism of Kreb's cycle.*

Text books

01. G.P. Talwar, L.M. Srivatsava, K.D. Moudgil, *Text book of Biochemistry and Human Biology*, Printice-Hall of India Pvt. Ltd. New Delhi, 1989.
02. A.V.S.S. Rama Rao, *Test Book of Biochemistry*, 5TH edition, L.K.S. Publishers, 1989.

Reference books

01. Keshav Trehan, *Biochemistry*, Wiley Eastern Ltd, 1987.
02. E.J. Wood and W.R. Piekering, *Introducing Biochemistry*, ELBS, 1984.
03. Luberty Stryer, *Biochemistry*, Freeman and Co, 1975.

CH - 4205 :CHEMISTRY PRACTICAL FOR BIOLOGISTS-II

(Offered to B.Sc. Zoology and Plant Biology)

Semester – IV	No. of Credits : 1
Course : Allied Optional(AO)	No. of hours per week : 2

Objectives :

To enable the students to understand the concepts of organic analysis

To appreciate the estimation techniques in the analysis of biologically important organic compounds.

PRACTICALS:

Estimation of vitamins(Ascorbic acid)

Estimation of Glucose(with standard $KMnO_4$)

Determination of purity of antibiotics(Penicillin)

Determination of iodine value of an Oil.

Determination of saponification value of an Oil.

Estimation of amino acid(Glycine)

Determination of pH of soil, water, ….

DEMONSTRATION EXPERIMENTS:

a) Column Chromatography of food dyes

b) TLC – Separation of triglycerides

c) Paper Chromatography – Separation of amino acids.

Text Books

1. N.S. Gnanapragasam and G. Ramamurthy, Organic chemistry–Lab manual, S. Viswanathan Co. Pvt. Ltd., 1998.

2. J.N. Gurtu and R. Kapoor, Advanced Experimental Chemistry(Organic), S. Chand and Co., 1987.