MADRAS CHRISTIAN COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
REGULATIONS AND SYLLABI

BACHELOR OF SCIENCE IN CHEMISTRY
(Effective from June 2008)

1. Eligibility for admission

- Candidates for the degree of Bachelor of Science shall be required to have passed the Higher Secondary School Leaving Examination (plus two) of the Tamilnadu Government or an equivalent thereto accepted by the syndicate of the University of Madras.

2. Duration of the course

- The course for the degree of B.Sc., shall consist of six semesters, two in the first, two in the second and two in the third year.

3. End of semester examinations

- For purposes of these regulations, the academic year will be divided into two semesters; the first from June to November and the second from December to May. The end of semester examination in the first semester will be conducted at the end of the first semester in Nov/Dec and the examinations in the second semester in April/May. Likewise, the examinations in the third and fifth semesters will be conducted in Nov/Dec and the fourth and sixth semester in April/May.

- A candidate who does not pass the examination in any subject or subjects of the first, second, third, fourth or fifth semester will be permitted to appear in such failed subjects alone with other subsequent semester examinations. For the failed candidates in each semester, the examinations will be held in both May/June and Nov/Dec.

- No candidate shall be permitted to take any examination on the expiry of a five-year term calculated from the date of admission to the course.

4. Choice Based Credit System (CBCS) (Refer Table on next page)

- The college is switching over to the choice based credit system from the academic year 2004. The candidate is awarded a certain number of credits on successful completion of each course.
- An UG (arts, science and commerce) student will have to obtain a minimum of 140 credits from a total of 150 credits available.
- Foundation courses, General course, Core courses (major and allied), environmental studies, physical education, and any one of the following-NSS / NCC / Sports - are mandatory.(Total-112 Credits)
- The student is required to acquire a minimum of 4 more credits from Interdisciplinary and general Electives (4); service learning programme (4); and Department Association Activities (2).

UNDERGRADUATE PROGRAMME – AN OVERVIEW (SCIENCES)
CHOICE BASED CREDIT SYSTEM

Components	**Credit points**	**Total**
Part – I (Tamil / Other Languages)	***12***	***12***
Part – II (English)	***12***	***12***
Part – III (a) **Major** (including practical & project work) (b) **Allied** [Allied I, Allied II]	 ***75 / 85*** ***20***	 ***95 / 105***
Part – IV (Non – Major Courses) (a.1) **Basic Tamil** [**BT]** (a.2) **Advanced Tamil** [**AT]** (a.3) **General course** [**GC]** (b) **Skill Based Courses** [Personality Dev.] [Inter Disciplinary] [General Elec.] [Computer Training] (c) **Environmental Studies** (d) **Value Education**	 ***4*** ***3+3+3+3*** ***2*** ***2***	 ***20***
Part – V (Extension Activities) [Service Learning, Physical Education, NCC, NSS Dept.Assn.Activity, Sports, Scrub Society]	***1***	***1***
Total		***140 / 150***

Revised CBCS for UG (semester wise)

Sem.1			Sem.3			Sem.5		
Courses	**Hours**	**Credits**	**Courses**	**Hours**	**Credits**	**Courses**	**Hours**	**Credits**
Part I Language	*4*	*3*	**Part I Language**	*4*	*3*	**Part III Major**	*24*	*20*
Part II English	*4*	*3*	**Part II English**	*4*	*3*	**Part IV (b) Computer Trn**	*2*	*3*
Part III Major	*10*	*10*	**Part III Major**	*10*	*10*			
Part III Allied I	*6*	*5*	**Part III Allied II (Elect.)**	*6*	*5*			
Part IV (a) BT1/ AT / GC	*4*	*2*	**Part IV (b) Personality Dev.**	*2*	-	**Part IV (b) Gen. Elective**	*4*	*3*
Part IV (d) Value Edu.	*2*	*1*	**Part IV (b) Inter Dis. (for Sc.)**	*4*	*3*			
			Part IV (c) Env. Stud. (for Hu)		*2*			
Total	**30**	**24**	**Total**	**30**	**23(Hu) 24(Sc)**	**Total**	**30**	**26**

Sem.2			Sem.4			Sem.6		
Courses	**Hours**	**Credits**	**Courses**	**Hours**	**Credits**	**Courses**	**Hours**	**Credits**
Part I Language	*4*	*3*	**Part I Language**	*4*	*3*	**Part III Major**	*30*	*25*
Part II English	*4*	*3*	**Part II English**	*4*	*3*			
Part III Major	*10*	*10*	**Part III Major**	*10*	*10*			
Part III Allied I	*6*	*5*	**Part III Allied II (Elect.)**	*6*	*5*			
Part IV (a) BT / AT / GC	*4*	*2*	**Part IV (b) Personality Dev.**	*2*	*3*			
Part IV (d) Value Edu.	*2*	*1*	**Part IV (b) Inter Dis. (for Hu)**	*4*	*3*			
			Part IV (c) Env. Stud. (for Sc.)		*2*			
Total	**30**	**24**	**Total**	**30**	**27(Hu) 26(Sc)**	**Total**	**30**	**25**
Part V – Extension Activities								**1**

Nature of Courses Offered

General Course:

- The course content relates to the respective Departments. It is an introductory programme providing broad based knowledge to be offered to the students of other departments.
- Each Dept. will offer the same general course in both the first and second semesters. Students will have to choose two courses, one in each semester.
- The general course offered by the Chemistry Department is "Chemistry in Everyday life"

Allied:

- For each Department, there will be two allied subjects. One is required by the Department as a compulsory subject. For Chemistry students, Mathematics is the required allied.
- The other allied is left to the choice of the students from a list of three subjects approved by the departments.
- For Chemistry students, the three approved subjects are Physics, Computer Science and Botany.

Interdisciplinary Electives:

- Environmental Studies, a one-semester programme with 4 credits is mandatory for all the UG Students. This course shall be offered in third/fourth semesters in batches.
- The other course is left to the choice of the students. The content of these courses will be interdisciplinary in nature. The departments will formulate the syllabus involving the expertise of other Departments but the electives will be implemented by the parent Department. The parent Department will specify the eligibility for this course.
- The Chemistry Department offers "Biological Chemistry" for B.Sc. (iv); B.Sc. (v) and B.Sc. (vi) students and "Advanced Smart Materials" for B.Sc. (iii) and B.Sc. (iv) students.

General Electives:

- Students are to be exposed to various avenues at a higher level of knowledge offered by all the sixteen Departments with the expertise available in the Departments.
- This will be open to all students including students of the parent Department.
- The Chemistry Department offers Environmental Chemistry.

Service Learning Programme:

- Departments will identify learning components in their respective disciplines and this will be translated into a service programme.
- The Chemistry Department offers (i) Water Quality Studies (ii) Food Adulteration Awareness.

Department Association Activities:

- Students are expected to participate in all the activities of the Department.

Computer Training:

- The Department will decide the course content and it will be offered as a core component during the course of study.
- The Department offers "Computer Aided Chemistry " in Semester V as a 3 credit course with 2 hours of theory and practical per cycle.

Madras Christian College (Autonomous)
Department of Chemistry
Revised CBCS for UG – 2008 onwards - Details of Courses and Examinations
Branch iv Chemistry

Sem	Paper Code	Title	Nature of the Course	Weekly hours	Exam hours	Marks		Credits
						CA	ESE	
I	GC01	Chemistry in Every-Day Life	General	4	3	50	50	2
	BC01	Basic Chemistry I	Core	6	3	50	50	5*
	BC02	Practical I – Volumetric analysis	Core	4	-	-	-	-
	AC01	Allied Chemistry I	Allied	4	3	50	50	3#
	AC02	Allied Chemistry Practicals	Allied	2	-	-	-	-
II	BC03	Basic Chemistry II	Core	6	3	50	50	5*
	BC02	Practical I- Volumetric analysis	Core	4	3	50	50	4*
	AC03	Allied Chemistry II	Allied	4	3	50	50	3#
	AC02	Allied Chemistry Practicals	Allied	2	3	50	50	4#
III	BC04	Organo – Oxygen Chemistry	Core	3	3	50	50	3*
	BC05	Chemistry of non-metals	Core	3	3	50	50	3*
	BC06	Practical II - Qualitative analysis	Core	4	-	-	-	-
	IC01	Biological Chemistry	Inter disciplinary	4				
	ACO1	Allied Chemistry I	Allied	4	3	50	50	3
	AC02	Allied Chemistry Practicals	Allied	4	3	50	50	3#
	ECO1	Elective Core (Nuclear Chemistry)	Elective	-	-	-	-	-
				4	3	50	50	5**
		Skill based Personality Development						
IV	BC07	Classical Thermodynamics	Core	3	3	50	50	3*
	BC08	Physical methods and Chemical Constitution	Core	3	3	50	50	3*
	BC06	Practical II - Qualitative analysis	Core	4	3	50	50	4*
	ACO3	Allied Chemistry II	Allied	4	2	50	50	3#
	ACO2	Allied Chemistry Practicals	Allied	2	3	50	50	4#
	ECO2	Elective core (Introduction to Nano Chemistry)	Elective	4	3	50	50	5**
		Environmental Chemistry (UGC)						
		Skill – based personality development						

V	BC09	Coordination Chemistry	Core	3	3	50	50	5*
	BC10	Organo - Nitrogen Chemistry	Core	3	3	50	50	5*
	BC11	Phase Rule and Electrochemistry	Core	3	3	50	50	5*
	EC03	Applied Chemistry I	Core Elective	3	3	50	50	5**
	BC12	Practical III - Organic analysis Gravimetry / preparations	Core	6	-	-		-
	BC13	Practical IV - Physical Chemistry	Core	6	-	-	--	-
	SC01	Skill based computer training (Computer Aided Chemistry)		2	3	50	50	3
	SC02	Skill based General Elective Environmental Chemistry		4	3	50	50	3
VI	BC14	Chemistry of Metals	Core	5	3	50	50	5*
	BC15	Chemistry of Natural products and Pharmaceuticals	Core	5	3	50	50	5*
	BC16	Chemical Kinetics and Surface Chemistry	Core	5	3	50	50	5*
	EC04	Applied Chemistry II	Elective	5	3	50	50	5**
	BC12	Practical III - Organic analysis Gravimetry Preparations	Core	5	6	50	50	3*
	BC13	Practical IV - Physical Chemistry	Core	5	3	50	50	2*
Part V Extension activities		Service Learning Programme						1

Nature of course	**Number of papers**	**Number of credits**
Core*	16	65
Allied[#]	6	20
Core Elective**	4	20
	Total	**105**

GC01: CHEMISTRY IN EVERY DAY LIFE
(60 hours)

Unit-I (12 hours)

1.1. General survey of chemicals used in every day life.
1.2. Air-Components and their importance; photosynthetic reaction, air pollution, green house effect and their impact on our life style.
1.3. Water – Sources of water, qualities of potable water, soft and hard water, methods of removal of hardness-water pollution.

Unit-II (12 hours)

2.1 Building materials – cement, ceramics, glass and refractories – definition, composition and application only.
2.2 Plastics – polythene, PVC, bakelite, polyesters, melamine formaldehyde resins - preparation, structures and uses only.

Unit-III (12 hours)

3.1 Food and Nutrition – Carbohydrates, Proteins, Fats – definition and their importance as food constituents- balanced diet- Calorie- minerals and vitamins (sources and their physiological importance).
3.2 Cosmetics – Tooth pastes, face powder, soaps and detergents, shampoos, nail polish, perfumes – general formulation and preparations- possible hazards of cosmetics use.

Unit-IV (12 hours)

4.1 Chemicals in food production – fertilizers – need, natural sources; urea, NPK fertilizers and super phosphate.
4.2 Fuel – classification – solid, liquid and gaseous; nuclear fuel – examples and uses; fuel cells – principle and uses only.

Unit-V (12 hours)

5.1 Pharmaceutical drugs – analgesics and antipyretics - paracetamol and aspirin.
5.2 Colour chemicals – pigments and dyes – examples and applications.
5.3 Explosives – classification and examples.

References:

1. Chemical Process Industries (4^{th} Edition) — R. Norris Shreve, Joseph A.Brink,Jr.
2. Perfumes, Cosmetics and Soaps — W.A.Poucher (Vol.3)
3. Environmental Chemistry — A.K.De.

BC01 : BASIC CHEMISTRY I

(90 hours)

Unit. I (18 hours)

1.1 Atomic weight - equivalent weight- molecular weight -mole concept- - stoichiometry.

1.2 Periodic properties- atomic radii- ionic radii- covalent radii- ionisation potential- electron affinity and electronegativity.

Unit II (18 hours)

2.1 Atomic spectra and quantum theory of energy - black body radiation - photoelectric effect - Compton effect.

2.2 Bohr model of the hydrogen atom - wave particle duality - Heisenberg uncertainity principle.

2.3 Quantum numbers - shapes of atomic orbitals - degenerate energy states.

Pauli's exclusion principle - singlet and triplet electronic states.

Aufbau principle - electronic configuration of atoms.

Unit III (18 hours)

3.1 Covalent bond - nature of covalent bond and formation of σ and π bonds- hybridisation - bond energy - bond length - bond angle - electronegativity - polarity of bonds - dipole moment.

3.2 VB and VSEPR theory - shapes of simple inorganic molecules and ions containing lone pairs and bond pairs.

3.3 MO theories- bonding and antibonding orbitals - nonbonding orbitals - MO configurations of simple diatomic molecules (H_2, He_2, N_2, O_2, C_2, B_2,F_2, CO, NO and their ions).

3.4 Comparison of VB and MO theories.

Unit IV (18 hours)

4.1 General characteristics of electrovalent compounds.

Types of ions - size effects - radius ratio and its limitations - packing of ions in crystals.

Lattice energy - Born - Haber cycle

Polarising power and polarisability - Fajan's rules - hydration energy.

Unit V (18 hours)

Qualitative ideas of free electron, valence bond and band theories - defects in solid state - p- type and n -type semiconductors.

Hydrogen bonding: Its effect on the behaviour of molecules (both physical and chemical).

References:

1. Companion	Chemical Bonding
2. P.L.Soni	Inorganic Chemistry
3. Glasstone and Lewis	Elements of Physical Chemistry
4. Maron and Lando	Fundamentals of Physical Chemistry
5. Castellan	Physical Chemistry

BC02: Practical I
Inorganic quantitative analysis (volumetric)
Semesters 1 and 2

2.1 Acidimetry - Alkalimetry:

Estimation of sodium hydroxide and sodium carbonate in a mixture.
Estimation of sodium carbonate and sodium bicarbonate in a mixture.
Estimation of borax.
Estimation of boric acid.

2.2 Permanganimetry:

Estimation of a mixture containing ferrous and ferric irons. (reduction by Zn/H_2SO_4)
Estimation of calcium.
Estimation of nitrite ion.
Estimation of H_2O_2
. Estimation of manganese dioxide in pyrolusite.

2.3 Dichrometry:

Estimation of ferrous and ferric irons in a mixture (internal indicator).

2.4 Iodometry and Iodimetry:

Estimations of copper, arsenious oxide, potassium permanganate potassium dichromate, tin and hypochlorite.
Sodium thiosulphate versus iodine titration.

2.5 Complexometric Titrations:

EDTA titrations - Estimations of calium, magnesium and zinc.

2.6 Demonstration experiments :

Argentimetry - Mohr and Volhard methods.

AC01: ALLIED CHEMISTRY I

(60 hours) (Common to groups i, iii, v and vi)

Unit I (12 hours)

1.1 Atomic structure: electronic configuration - Aufbau principle - Pauli's exclusion principle- Hund's rule.

1.2 Bonding: electrovalent, covalent, hydrogen bonds-orbital overlap - s-s, s-p - hybridization, and VESPR theory - CH_4, C_2H_4, C_2H_2- $BeCl_2$, BF_3, NH_3, H_2O, PCl_5, IF_5, IF_7.

Unit II (12 hours)

2.1 Metallurgy : General principles - ores and minerals - ore dressing - extraction methods-purification of crude metal (electrolytic refining only)- ferrous alloys only- heat treatment of steel.

2.2 Solid state: crystalline and amorphous solids-structure and properties- laws of crystallography- Miller indices - simple cube, body centered cube and face centered cube - structure of NaCl and CsCl, diamond and graphite.

Unit III (12 hours)

Coordination Chemistry: IUPAC nomenclature -Werner, Sidgwick and Pauling theories of metal-ligand bonding- stability-chelates applications of complexes in qualitative and volumetric analyses- geometrical and volumetric analyses- geometrical isomerism of four coordinated complexes.

Principles of qualitative analysis and volumetric analysis: concept of solubility product, common ion effect, its application in qualitative and volumetric analyses- principles of acid-base and redox titrations.

Unit IV (12 hours)

4.1 Fuel gases: composition-natural-water-semi water- carbonated water, producer, oil and gobar gases.

Fertilizers - preparation of urea, ammonium sulphate, ammonium nitrate, potassium nitrate-triple super phosphate-NPK ratio.

4.3 Cement and glass: Portland cement-manufacture only. Manufacture of glass types and uses borosilicate -photochromic and safety glass.

Unit V (12 hours)

Aromaticity: Concept (reference to benzene only) heterocyclic chemistry - preparation and properties of pyrrole,furan,thiophene and pyridine.

Types of reagents and reactions: Electrophile, nucleophile and free radicals - substitution -elimination-addition- oxidation-reduction-rearrangement: Pinacol-pinacolone, benzidine, ortho Claisen and Beckmann rearrangements.

Stereochemistry: optical isomerism of tartaric acid, geometrical isomerism of maleic and fumaric acids.

References:

1. R.Gopalan and S.Sundaram Allied Chemistry
2. A.Ramachandra Shastri Ancillary Chemistry

AC02: ALLIED CHEMISTRY PRACTICALS

VOLUMETRIC ANALYSIS

I. Acidimetry and alkalimetry

1. Estimation of sodium hydroxide.
2. Estimation of sodium carbonate.
3. Estimation of sodium carbonate and sodium bicarbonate in a mixture
4. Estimation of hydrochloric acid.
5. Estimation of hardness in water.

II. Permanganimetry

Estimation of ferrous sulphate (ferrous ammonium sulphate).
Estimation of oxalic acid.
Estimation of ferric iron

III. Dichrometry

1. Estimation of ferrous iron using external indicator.
2. Estimation of ferric iron (reduction by $SnCl_2$) by internal indicator.

IV. Iodometry

Estimation of copper.
Estimation of potassium dichromate.
Estimation of potassium permanganate.

V. Argentimetry

1. Estimation of chloride (Mohr's method).

VI. Complexometric Titrations

1. Estimation of zinc.
2. Estimation of magnesium.

II. QUALITATIVE ANALYSIS

Systematic analysis of a simple salt containing one acid and one basic radical. The acid radical may/may not be an interfering one.

Acid radicals: nitrate, sulphate, carbonate, oxalate, chloride, bromide, borate, phosphate, fluoride, sulphide, arsenite.

Basic radicals: lead, copper, bismuth, antimony, cadmium, iron, aluminium, zinc, manganese, cobalt, nickel, barium, calcium, strontium, magnesium and ammonium.

III. ORGANIC ANALYSIS (Only for continuous assessment tests)

Characterisation of organic compounds by their funtional groups:
Acids, carbohydrates, phenols, methylketones, amides, nitro-compounds and primary amines.

The End of Semester Examination, will consist of

a. Inorganic qualitative analysis
b. Volumetric analysis
c. Record

BC03 : BASIC CHEMISTRY II

(90 hours)

Unit I (18 hours)

Gaseous state - Gas laws - postulates of kinetic theory - collisions - gas pressure - average kinetic energy of translational- Boltzmann constant- Absolute scale of temperature - RMS velocity.

Maxwell distribution law of molecular speeds (no derivation) molecular speeds and energy distribution as a function of temperature. calculation of most probable, average, and root mean square speeds of molecules. Maxwell-Boltzmann distribution. degrees of freedom of motion - principle of equipartition energy - molecular basis of heat capacity - mean free path and collision frequencies - viscosity of gases.

Real gases, compressibility factor, deviation from ideality - van der Waals' equation - Boyle temperature - critical phenomena - critical constants - law of corresponding states and reduced equation of state - intermolecular forces and liquefaction of gases.

Unit II (18 hours)

Liquid state - Qualitative treatment of the structure of the liquid state, radial distribution functions - liquid crystals (elementary discussion on classification, structure and properties).

2.2 Solid state.Symmetry in crystals - crystal systems - crystal lattice - lattice planes and their designation - Miller indices - lattice planes in cubic crystals - assignment of atoms/ions per unit cell in a cubic lattice - diffraction of X-rays by crystals - Bragg equation - structures of NaCl and CsCl - Avogadro number from cubic lattice dimension - closest packing - packing in ionic solids.

Unit III (18 hours)

3.1 Qualitative and quantitative analysis : Principles of qualitative analysis - solubility product principle - complex formation - elimination principle - sodium carbonate extract.

Principles of volumetric analysis - acid - base, redox , precipitation and complex formation titration (by EDTA) - theories of indicators - acid-base , redox, adsorption and complexometric indicators.

3.3 Principles of gravimetric analysis - theories of precipitation - precipitation from homogenous medium - coprecipitation and post precipitation.

Unit IV (18 hours)

Aliphatic and aromatic hydrocarbons - alkanes - nomenclature (IUPAC) - general methods of formation - reactions - halogenation of alkanes in detail - free radical mechanism conformational analysis of ethane and n-butane.

Cycloalkanes - cyclopropane - cyclobutane - cyclopentane - cyclohexane - preparation , Baeyer's strain theory - conformational analysis of cyclohexane, mono and disubstituted cyclohexanes.

Alkene - nomenclature - preparation involving dehalogenation, dehydration, dehydrohalogenation and pyrolysis- reactions - electrophilic addition - radical addition - polymerisation - Dienes - preparation - 1,2 and 1,4 addition reactions.

Alkynes - nomenclature, preparation, addition and substitution reactions - polymerisation.

Aromatic hydrocarbons - benzene, toluene, xylene - preparation and properties - substitution reaction-ring and side chain - oxidation, reduction reactions - aromaticity - Huckel 4n+2 rule - resonance concept - naphthalene, anthracene, phenanthrene, diphenyl - preparation and properties.

Unit V (18 hours)

5.1 Stereoisomerism: Enantiomerism - optical activity - R and S convention - sequence rules - racemisation - diastereoisomerism - resolution of racemates - asymmetric synthesis. and Walden inversion. Geometrical isomers - linear and cyclic compounds, E-Z nomenclature.

Halogen compounds : alkyl, aryl, allyl and vinyl halides - preparation and synthetic applications

Mechanism of S_N1, S_N2, E1 and E2 reactions - aromatic nucleophilic substitution.

References:

1. Cooper — The Periodic Table
2. Walter J. Moore — Physical Chemistry
3. P.L.Soni — Inorganic Chemistry
4. I.L.Finar — Organic Chemistry Vol.I
5. Morrison and Boyd — Organic Chemistry

AC03: ALLIED CHEMISTRY II

(60 hours)

(Common to groups i, iii,v and vi)

Unit I (12 hours)

Polymer chemistry: types of polymerisation - addition and condensation- thermosetting and thermoplastics - rubber - natural and synthetic fibers - nylon-6 and 66, polyesters, PE , PVC, Poylvinyl acetate.

Amino acids, polypeptides and proteins: Classification and sources of amino acids, preparation and properties of glycine, zwitterion structure, isoelectric point, peptides - synthesis of a dipeptide, end group analysis, proteins - classification and general characteristics.

Unit II (12 hours)

Sulpha drugs: Preparation and uses of sulphanilamide, sulphaguanidine and sulphathiozole. Source and uses of penicillin, chloromycetin and streptomycin (structural elucidation not needed)

Carbohydrates: Occurrence, classification, reactions and constitution of glucose and fructose-elucidation of structures (only open chain structure) disaccharides - sucrose and maltose (reactions only).

Vitamins: Sources, deficiencies and uses.

Unit III (12 hours)

3.1 Air pollution: Pollution due to automobile fuels - green house effect - SO_2 emission and acid rain - depletion of ozone and its consequences.

3.2 Water pollution: Characteristics, BOD-COD treatment of domestic waste water.

3.3 Agricultural pollution: Pesticides-biomagnification and consequences.

3.4 Noise pollution: Pollution measurement and control.

3.5 Food pollution: Natural toxins and food additives.

3.6 Environmental pollution by plastics.

3.7 Radiation pollutants: sources and examples.

Unit IV (12 hours)

4.1 Chemical kinetics: Order and molecularity , zero, first and second order reactions - differential and integrated forms, experimental methods for determination of order of a reaction, activation energy, evaluation and significance, simple numerical problems.

Photochemistry: Laws, Grothus-Draper, Beer-Lambert, Stark- Einstein, examples of photochemical reactions, chlorination of methane, quantum yield photolysis of acetaldehyde and photopolymerisation of polythene, photosensitisation - fluorescence, phosphorescence and chemiluminescence.

Unit V (12 hours)

Electrochemistry: Specific and molar conductances, Kohlrausch's law - measurement of dissociation constant. Conductometric titration.

Galvanic cells: Standard electrode potential, electrochemical series - electroplating.

pH, buffer solutions - significance of pH and buffer solution in biological system - acid base theories and simple numerical calculations.

References:

1. R.Gopalan and S.Sundaram — Allied Chemistry
2. A.Ramachandra Shastri — Ancillary Chemistry

BC04 : ORGANO - OXYGEN CHEMISTRY

(45 hours)

Unit I (9 hours)

Alcohols : preparation and properties of simple aliphatic alcohols- monohydric alcohols- methanol, ethanol, propanol, isopropanol, butanol, isobutanol and tertiary butanol, allyl alcohol, benzyl alcohol - dihydric alcohols-1,2-diols -trihydric alcohols- glycerols

1.2 Preparation and properties of phenols, dihydric phenols, cresols, alpha and beta-naphthols.

Unit II (9 hours)

2.1 Aldehydes: aliphatic and aromatic aldehydes- methanal, ethanal, propanal, benzaldehyde, salicylaldehyde, unsaturated aldehydes-preparation and reactions.

2.2 Ketones-aliphatic and aromatic ketones - propanone-butanone - acetophenone and benzophenone, quinones, unsaturated ketones-preparation and properties.

Unit III (9 hours)

3.1 Carboxylic acids: aliphatic and aromatic, mono carboxylic acids-unsaturated acids- aliphatic and aromatic dicarboxylic acids.

3.2 Acid derivatives-preparation and reactions of esters, acid halides, acid amides and anhydrides.

3.3 Waxes and fats.

Unit IV (9 hours)

4.1 Aliphatic and aromatic ethers:

4.2 Polyfunctional compounds: hydroxy acids, hydroxy aldehydes, lactic acid and citric acid.

4.3 Acidities of phenols and carboxylic acids.

Unit V (9 hours)

Preparation and mechanism of ester hydrolysis and esterification - $B_{AC}2$ and $A_{AC}2$ mechanisms.

Rearrangement reactions-Claisen, Fries and Pinacol-Pinacolone.

Preparation and synthetic uses of acetoacetic ester and malonic ester .

Refrences:

1. I.L.Finar Organic Chemistry Vol.I

2. Morrison and Boyd Organic Chemistry

BC05: CHEMISTRY OF NON-METALS

(45 hours)

Unit I (9 hours)

1.1 Hydrides - classification - ionic, covalent, interstitial and complex hydrides - characteristics.

1.2 Water: Hardness and its estimation - use of ion exchange resin - water purification - heavy water- preparation, properties and uses.

1.3 Boron - element, diborane, borazole, halides, nitrides, oxides, oxyacids, borates, borides, and carboranes.

Unit II (9 hours)

2.1 Carbon - sub-oxide, sulphides, carbides, carbonates, peroxycarbonates.

Silicon - element - silicon dioxide - silicic acids - silanes - halides - silicates (only classification)- silicon carbide.

Unit III (9 hours)

3.1 Nitrogen - hydrides - NH_3, N_3H, N_2H_4 - halides, oxides, oxyhalides, oxyacids (HNO_3, HNO_2, $H_2N_2O_2$, HNO_4, and NH_2OH) - preparation, properties and structure - nitrogen cycle, fixation of atmospheric nitrogen, liquid ammonia as solvent, nitrides.

Unit IV (9 hours)

4.1 Phosphorus -allotropes, hydrides, halides - oxyhalides, oxides, oxyacids - preparation, properties and constitution - polyphosphates.

4.2 Arsenic, antimony and bismuth - elements, hydrides, oxides, halides and sulphides, arsenites, arsenates, antimonates and bismuthates.

Unit V (9 hours)

5.1 Sulphur - oxyacids and their salts - preparation, properties and structure - thionic acids, peroxyacids and their salts - brief account of Se and Te.

5.2 Halogens - comparative account - oxides and oxyacids - preparation, properties and structure - interhalogen compounds and pseudohalogens - astatine.

5.3 Inert gas compounds - Different modes of formation of inert gas compounds - examples.

References:

1. Liptrot — Modern Inorganic Chemistry, ELBS
2. J.D.Lee — A New Concise Inorganic Chemistry, ELBS

BC06: Practical II

Semesters 3 and 4

Inorganic Qualitative Analysis

Reactions of mercury, lead, copper, bismuth, cadmium. antimony, tin, ferrous and ferric iron, aluminium, zinc, manganese, cobalt, nickel, calcium, strontium, barium, magnesium, and ammonium; sulphide, carbonate, nitrate, sulphate, chloride, bromide, iodide, fluoride, oxalate, arsenite, phosphate, chromate and borate radicals.

Semimicro analysis of a mixture containing two cations and two anions of which one is an interfering ion.

IC01: BIOLOGICAL CHEMISTRY

(60 Hours)

Unit-I Chemistry and Metabolism of Carbohydrates

1.1 Definition , classification and biological role of carbohydrates.
Monosaccharides:Linear and ring structures (Haworth formula) of ribose, glucose, fructose and mannose (structural determination not required) – physical and chemical properties of glucose and fructose.
Disaccharides: Ring structures (Haworth formula) – occurrence, physical and chemical properties of maltose, lactose and sucrose.
Polysaccharides: Starch, glycogen and cellulose – structure and properties.

1.2 Glycolysis of carbohydrates. (12 hours)

Unit-II Chemistry and metabolism of amino acids and proteins

2.1 Aminoacids: Various classifications, essential amino acids, physical properties (amphoteric nature and isoelectric point) and reactions.
Proteins: Classifications (based on shape, composition and solubility), physical properties.
primary structure- End group analysis (N-terminal analysis – Edman's method, dansyl chloride method; C-terminal analysis- hydrazinolysis and bio-chemical methods)

2.2 Biological functions of proteins, Deamination, transamination reactions, Urea cycle.

(12 hours)

Unit-III Chemistry and Metabolism of Lipids

3.1 Definition, classification- simple lipids (fatty acids), compound lipids and derived lipids.
Properties – saponification, rancidity, oxidation, hydrogenation, halogenation reactions – Iodine number, Saponification number, Acetylnumber.
Sterols: Cholesterol (structure not needed), biological importance and chemical properties.
Bile acids- functions.

3.2 Biological functions of lipids.

(12 hours)

Unit – IV Nucleic acids

4.1 Purine and pyrimidine bases, nucleosides, nucleotides, polynucleotides, DNA structure – various types, RNA structure – various types.

4.2 Biological functions of DNA and RNA, Genetic code.

(12 hours)

Unit – V Enzymes and Vitamins

5.1 Enzymes : Definition, nomenclature, sources, classification and specificity- isoenzymes -factors affecting enzyme activity – substrate, pH, temperature, enzyme concentration .

5.2 Vitamins: Definition, classification – water soluble vitamins (B_1,B_2,B_3,B_6,B_{12} and vitamin-C) and fat soluble vitamins (A,D,E and K)– occurrence, structure, deficiency diseases, biochemical rules and daily requirements.

(12 hours)

References:

1. Elements of Bio-Chemistry — Ragunatha Rao
2. Essential of Bio-Chemistry — U.Sathyanarayana
3. Elementary Bio-Chemistry — J.L.Jain

EC01 :Nuclear Chemistry

(45 Hours)

Unit I (9 hours)

1.1. The nucleus- subatomic particles and their properties-nuclear radii- mass defect- packing fraction- binding energy- n/p ratios ins table and metastable nuclei-
1.2. Nuclear models- The shell model- The liquid drop model – The collective model

Unit II (9 hours)

2.1Natural radioactivity- laws of radioactive disintegration – radioactive equilibrium- radioactive series.
2.2. Artificial radioactivity- methods of nuclear transmutation- types of transmutations with projectiles- orbital electron capture- nuclear isomerism and internal conversion.

Unit III (9 hours)

3.1. Nuclear fission – fission fragments and their mass distribution- fission energy- fission cross section and thresholds- theory of nuclear fission
3.2 Nuclear reactor- construction and working of nuclear reactor- types of nuclear reactors. Atomic power projects in India.

Unit IV (9 hours)

4.1. Nuclear fusion – Thermonuclear reactions -stellar energy- synthetic elements.
4.2. Detection and determination of activity by proportional counter- G.M. counter- scintillation counter.

Unit V (9 hours)

5.1. Isotopes- principles of separation- uses in analytical chemistry, reaction mechanisms, and agriculture- radiocarbon dating.
5.2. Environmental and ethical aspects of nuclear technology- nuclear waste disposal.

References

S.Glasstone	Source Book on Atomic Energy
R.Gopalan	Elements of Nuclear Chemistry
Friedlander and Kennedy	Nuclear and Radiochemistry
H.J. Arnikar	Essentials of Nuclear Chemistry

BC07: CLASSICAL THERMODYNAMICS

(45 hours)

Unit I (9 hours)

1.1 Definitions of thermodynamic terms - intensive and extensive variables, isolated, closed and open systems. Thermodynamic processes, cyclic processes, reversible and irreversible processes, thermodynamic functions and their differentials, Zeroth law of thermodynamics. Concepts of heat and work.

1.2 First law of thermodynamics and internal energy (U), enthalpy (H), relation between C_P and C_V, calculations of w, q, dU and dH for expansion of ideal gas under isothermal and adiabatic conditions, for reversible and irreversible processes including free expansion, Joule's law, Joule-Thomson coefficient and inversion temperature.

Unit II (9 hours)

2.1 Application of first law of thermodynamics - standard state - standard enthalpy of formation, Hess's law of constant heat summation, Enthalpy of solution, enthalpy of dilution, enthalpy of neutralization, enthalpy of ionisation and enthalpy of formation of ions. Bond dissociation energy (calculations from thermo-chemical data), Born-Haber cycle for calculation of lattice energy, Kirchoff's equation, relation between ΔH and ΔU of a reaction.

2.2 Spontaneous processes, heat engine, Carnot cycle and its efficiency, statements of second law , refrigeration cycle, thermodynamic scale of temperature, entropy as a state function, Clausius inequality, calculation of entropy changes in different processes. Nernst heat theorem, third law of thermodynamics and concept of residual entropy,

Unit III (9 hours)

3.1 Gibb's function (G) and Helmholtz function(A), criteria for thermodynamic equilibrium and spontaneity, variation of G and A with P, V and T, Thermodynamic equations of state.

3.2 Chemical potentials of a component in an ideal mixture, thermodynamic functions of mixing of ideal gases, Gibbs - Duhem equation, variation of chemical potential with T and P.

Unit IV (9 hours)

4.1 Chemical equilibria in homogeneous and heterogeneous systems, derivation of the expression of equilibrium constant, temperature, pressure and concentration dependence of equilibrium constants K_P , K_C and K_X.

4.2 Le Chatlier-Braun principle- equilibrium constants and free energy change - reaction isotherm - van't Hoff equation - derivation of van't Hoff isochore - de Donder's concept of equilibrium.

Unit V (9 hours)

5.1 Thermodynamics of ideal solutions - Raoult's law and Henry's law.

5.2 Colligative properties - depression of freezing point - elevation of boiling point - osmotic pressure - experimental methods - laws of osmotic pressure and analogy between dilute solutions and gaseous systems - abnormal molecular weights - van't Hoff factor

References:

1. S. Glasstone Thermodynamics for Chemists
2. Kuriacose and Rajaram Thermodynamics for Students of Chemistry
3. Warn Concise Chemical Thermodynamics
4. Peter A. Rock Chemical Thermodynamics
5. Castellan Physical Chemistry

BC08: PHYSICAL METHODS AND CHEMICAL CONSTITUTION

(45 HOURS)

Unit I (9 hours)

1.1 Dipole moment - molecular polarisation

1.2 Dielectric constants and its measurement

1.3 Dipole moment and its measurements - significance of dipole moment as a vector property,

Unit II (9 hours)

2.1 Magnetic properties - diamagnetism and paramagnetism - explanation with respect to chemical constitution

2.2 Temperature- dependent and independent paramagnetism

2.3 Magnetic susceptibility determination- use of Gouy and Faraday balance- applications.

Unit III (9 hours)

3.1 Neutron diffraction - simple treatment of the principle - applications - merits and demerits.

3.2 Thermal analysis : thermogravimetric analysis and differential thermal analysis, principles and applications.

Unit IV (9 hours)

4.1 Spectroscopic techniques I: - potential energy diagrams of diatomic molecules - light absorption - Beer-Lambert's law, Franc-Condon principle- applications UV-Vis spectroscopy.

4.2 Infrared and Raman spectroscopy- theory and applications

Unit V (9 hours)

5.1 Spectroscopic techniques II: NMR - principle, chemical shift- shielding and deshielding - spin-spin splitting of signals - applications.

ESR-principles only

References:

1. Glasstone and Lewis — Elements of Physical Chemistry
2. Maron and Lando — Fundamentals of Physical Chemistry
3. Walter J. Moore — Physical Chemistry
4. R.Gopalan, P.S.Subramanian and K.Rengarajan — Elements of Analytical Chemistry

EC02: Introduction to Nano chemistry

(45 Hours)

Unit I (9 hours)

Basics of Nanochemistry

Introduction, Self assembly – Materials and molecules, Self Assembled Monolayers (SAM) and Soft lithography, Nanowires and Nanomachines, Techniques used in nanochemistry.

Unit – II (9 hours)

Nanoparticles

Types of nanoparticles, Pure metals – Gold, Silver and Cobalt; Metal oxides – Silica, Iron oxide, Alumina and Titania; Techniques to synthesize nanoparticles,- Physical methods- Physical vapour deposition(evaporation and sputtering) –chemical methods-reduction methods –sol-gel methods.

Unit – III (9 hours)

Nanosensors- characterization-Nanosensor based on optical properties- electrochemical sensors- Sensors based on physical properties.

Unit – IV (9 hours)

Biological materials- sizes of building blocks and Nanostructures- polypeptide nanowire and protein nanoparticle- multilayer films

Unit – V (9 hours)

Experimental techniques in nanochemistry

Characterizaation of nanoparticles and nanocomposites, Experimental techniques: Instrumentation and practical details of: (a) Transmission electron microscopy, (b) Field in Microscopy, (c) Scanning electron microscopy and (d) Electron microscopy

References

1. *Nanomaterials and Nanochemistry*, C. Brechigneae, P. Houdy, M. Lahmai (Eds) Springer 2007
2. *Core concepts in Supramolecular chemistry and Nanochemistry*, J. W. Steed, D. R. Turner, K. Wallace, Wiley, 2007
3. *Nanochemistry : A chemical approach to Nanomaterials*, G. A. Ozin & A. C. Arsenault, RSC publishing
4. *Interfacial nanochemistry*, H. Watarai, N. Teramae, Tsugo Sawada, Springer, 2005
5. *Nanoscale materials in chemis*try, Kenneth, J. Klabunde, Wiley Interscience, 2001
6. *Nanostructered Materials and Nanotechnology*, H.S.Nalwa, Academic Press, Sandiego,2000.
7. *Nano : The Essentials* , T. Pradeep , Tata McGraw-Hill , 2007
8. *Introduction to Nanotechnology*, Charles P.Poole and Frank J. Owens, Wiley Interscience, 2003

ENVIRONMENTAL SCIENCE (UGC)
(60 hours)

Unit I:
The multi disciplinary nature of environmental studies

Definition, scope, and importance- need for public awareness.

Unit II:
Natural resources

Renewable and non-renewable resources: Natural resources and associated problems-
(a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems.
(c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources and case studies. (d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. (e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. (f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

Unit III:
Ecosystems

Concept of an ecosystem - Structure and function of an ecosystem -Producers, consumers and decomposers -Energy flow in the ecosystem -Ecological succession - Food chains, food webs and ecological pyramids- Introduction, types and characteristic features, structure and functions of the following ecosystem:- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, stream, lakes, rivers, ocean and estuaries)

Unit IV:
Bio diversity and its conservation

Introduction- definition: genetic, species and ecosystem diversity- Biogeographical classifications of India- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values- Biodiversity at global, National and local levels- India as a mega-diversity nation- Hot-spots of biodiversity – Threats of biodiversity: Habitat loss, poaching of wildlife and man-wildlife conflicts – Endangered and endemic species of India – conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit V:
Environmental Pollution

Definition – Causes, effects and control measures of: air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards – Solid waste Management: causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: Floods, earthquake, cyclone and landslides.

Unit VI:
Social issues and the environment

From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, water shed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Environmental ethics: issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust and case studies – wasteland reclamation – Consumerism and waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act- Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

Unit VII:
Human Population and the Environment

Population growth, variation among nations – Population explosion: Family welfare programme – Environment and human health – Human rights – Value Education – HIV/AIDS – Women and Child Welfare- Role of Information Technology in Environment and human health and case studies.

Unit VIII:
Field work

Visit to a local area to document environmental assets – river/ forest/ grassland/ hill/ mountain – visit to a local polluted site – Urban/ rural/ Industrial/ Agricultural – Study of common plants, insects and birds – study of simple ecosystems- pond, river, hill slopes, etc. (Field work equal to 5 lecture hours).

References:

1. De A. K., Environmental Chemistry, Wiley Eastern Ltd.
2. Odum, E. P. 1971, Fundamentals of Ecology, W. B. Saunders co. USA
3. Sharma B.K., 2001, Environmental Chemistry, Goel Publ.House, Meerut
4. Survey of the environment, The Hindu (M)

BC09 : COORDINATION CHEMISTRY

(45 Hours)

Unit- I (9 hours)

1.1.Coordination Chemistry: Early theories, Bookstand, Jorgenson's chain theory and Werner's coordination theory. Types of ligands- chelates- preparation of complexes- detection of complex formation. Nomenclature- writing formulae and naming of mononuclear complexes.

1.2.Stability of complexes- factors affecting the stability – stepwise and overall formation constants- (determination not required) - effective atomic number rule - explanation and examples.

Unit- II (9 hours)

2.1 Isomerism in complexes- Structural isomerism – stereoisomerism.

2.2 VB theory- hybridization and shapes of complexes-magnetic properties- spin only magnetic moment- discussion on outer and inner orbital complexes- octahedral, tetrahedral and square planar geometries.

Unit- III (9 hours)

3.1. CF theory- degeneracy of d orbitals – crystal field splitting by octahedral, tetrahedral and square planar arrangement of ligands- spectrochemical series- occupancy of electrons in orbitals- measurement of 10 Dq – factors affecting 10 Dq values.

3.2 Applications of CFT – effect of ligand field on the colour of complexes- CFSE – Jahn Teller distortion.

Unit- IV (9 hours)

4.1. Inert and labile complexes- trans effect – synthesis using trans effect.

4.2. Kinetics and mechanisms of substitutions in octahedral metal complexes- water replacement- acid hydrolysis, base hydrolysis- SN_1CB mechanism.

Unit- V (9 hours)

5.1. Metal carbonyls in first transition series – preparation, properties, uses and structures.

5.2. Applications of coordination complexes – in analytical chemistry – in medicinal chemistry and in agriculture.

References

1. Concise Inorganic Chemistry, J.D. Lee, Chapman and Hall, 1992.
2. Advanced Inorganic Chemistry, F.A. Cotton and G. Wilkinson, Wiley Eastern Private Limited 1992.
3. Modern Aspects of Inorganic Chemistry, H.J. Emeleus and A.G. Sharpe, Universal Book Stall, 992.
4. Inorganic Chemistry: Principles of Structure and Reactivity, J.E. Huheey, E.A. Keiter and R.I. Keiter, Addison-Wiley Publication Company, 1993.
5. Inorganic Chemistry, D.F. Shriver, P.W. Atkins, C.H. Longford, Oxford University Press, 1996.
6. Concise Coordination Chemistry, R. Gopalan and V. Ramalingam, Vikas Publishing House Private Limited, 2001.

BC10: ORGANO - NITROGEN CHEMISTRY

(45 hours)

Unit I (9 hours)

1.1 Synthesis and reactions of Nitroalkanes, Alkyl nitrites, Cyanides and Isocyanides, Isocynates, Carbonates, Urethanes, Amides, Imides, Urea and Guanidine.

1.2 Aromatic nitro compounds - preparation and properties, nitration under different conditions, reduction under different conditions.

Unit II (9 hours)

2.1 Amino compounds: prepartion and properties, comparison of base strengths - Primary, Secondary and Tertiary amines- a comparison, Hinsberg test, Quaternary ammonium salts, Hoffmann's exhaustive methylation.

2.2 Diazo compounds- Diazotisation and its mechanism -synthetic applications of aromatic diazonium salts, diazomethane, diazoacetic ester.

Unit III (9 hours)

Molecular rearrangements - Hoffmann, Lossen, Curtius, Benzidine and Beckmann.

3.2 Heterocyclic compounds - pyrrole, thiophene, furan, pyridine, quinoline, isoquinoline, Skraup synthesis, Bischler- Napieralski synthesis.

Unit IV (9 hours)

4.1 Amino acids and peptides - Classification of amino acids - general methods of synthesis, essential amino acids, properties of amino acids.

4.2 Peptides - end group analysis, CTAA, NTAA only, synthesis of peptides

Unit V (9 hours)

5.1 Proteins - Classification, biological functions, primary and secondary structures, denaturation of proteins, isoelectric points - electrophoresis

5.2 Nucleoproteins - DNA - structure (elementary idea), heredity and replication of DNA, m RNA transcription

References:

1. Pine Organic Chemistry
2. Streitweiser Jr. Organic Chemistry
3. Morrison and Boyd Organic Chemistry

BC11 : PHASE RULE AND ELECTROCHEMISTRY

(45 hours)

Unit I (9 hours)

Derivation of phase rule; application of phase rule to one component systems - water and sulphur, CO_2.

1.2 Meaning of vapour pressure - temperature dependence of vapour pressure - Clausius - Clayperon equation

1.3 Phase equilibria of completely miscible, partially miscible and completely immiscible systems - principles of fractional and steam distillation - azeotropic mixtures.

Unit II (9 hours)

Distribution law - statement and limitations - applications to simple systems involving association, dissociation and complex formation.

Solid-liquid equilibria -Binary systems forming simple eutectic (Bi-Cd), compound formation (Zn-Mg) and solid solutions.

2.3 Theory of fractional crystallisation - Binary systems forming salt hydrates - $FeCl_3$ - freezing mixtures NaCl, $CaCl_2$.

Unit III (9 hours)

Conductance - cell constant - specific conductance and equivalent conductance - measurement.

3.2 Variations of equivalent conductance with concentration - weak and strong electrolytes - mobilities of ions - transport number - Kohlraush law.

3.3 Applications of Ostwald dilution law - conductance -titrations (acid-base, precipitation) - solubility product - dissociation constant.

Unit VI (9 hours)

4.1 Potentiometry - cells - electromotive force - electrode potential - their thermodynamic significance.

4.2 Nernst equation - standard electrode potentials and its determination

Reference electrodes - hydrogen electrode - calomel, quinhydrone and glass electrodes.

4.4 Types of cells - chemical and concentration cell - liquid junction potential - salt bridges.

4.5 Redox systems.

Unit V (9 hours)

5.1 Theory of indicators- pH - Henderson equation - determination of pH by Potentiometry.

5.2 Electrolytes - strong and weak-ionic equilibria - ionisation constant - hydrolysis of salts-hydrolysis constant and its determination by potentiometry.

5.3 Potentiometric titrations - acid-base, redox, precipitation.

References:

1. P.W.Atkins — Physical Chemistry
2. Puri.Sharma and Pathania — Physical Chemistry
3. S. Glasstone — Electrochemistry
4. Glasstone and Lewis — Elements of Physical Chemistry
5. Maron and Lando — Fundamentals of Physical Chemistry

EC03: APPLIED CHEMISTRY I

(45 hours)

Unit I (9 hours)

1.1 Petroleum - origin - inorganic, Engler and modern theories - classification - refining (simple refinery) - cracking - thermal and catalytic - knocking - octane rating - antiknock compounds - cetane rating - synthetic petrol - LPG.

1.2 Gobar gas - production - feasibility and importance of bio gas with special reference to rural India.

Unit II (9 hours)

2.1 Coal - classification by rank - proximate and ultimate analysis - low and high temperature carbonisation - Otto-Hoffmann's byproduct, oven - distillation of coal tar.

2.2 Portland cement - composition - manufacture - setting and hardening of cement.

Unit III (9 hours)

3.1 Glass manufacture - types - soda lime glass, flint glass, borosilicate glass, alumino silicate glass, vitreosil, photochromic glass and safety glass.

3.2 Ceramics - permeable and impermeable wares - whitewares - manufacture - glazing.

3.3 Abrasives - natural and artificial, grinding wheels, abrasive papers and cloth.

Unit VI (9 hours)

4.1 Explosives - primary, low and high explosives - single compound explosives, binary explosives, plastic explosives, dynamites - blasting fuses.

4.2 Photography - chemical principles - preparation of sensitive emulsion - exposure, developing,, fixing and printing - colour photography - xerographic copying

Unit V (9 hours)

5.1 Fuel cells - $H_2 - O_2$ fuel cell - applications - photovoltaic cells.

5.2 Electrodeposition - principles - deposition of copper, nickel, chromium and zinc - brass and tin alloys - electrochemical corrosion - galvanic corrosion - concentration cell-corrosion - corrosion control - improvement of characteristics of metal - cathodic protection - modification of environment - use of inhibitors - anodic and cathodic coatings.

References:

1. Riegel (ed) Handbook of Industrial Chemistry
2. Shreve Chemical Process Industries
3. L.H.Meyer Food Chemistry
4. W.A.Poucher Perfumes, Cosmetics and Soaps
5. R.Gopalan, D.Vengappya and S. Nagarajan Engineering Chemistry
6. A.K. De Enviornmental Chemistry

BC12: PRACTICAL III

Semester 5 and 6

Organic analysis, Gravimetry and Preparations

1. Organic Qualitative Analysis:
   Characterisation of organic compounds by their functional groups and confirmation by preparation of derivatives.
   Separation of simple organic mixtures - benzoic acid and toluene or glucose and benzoic acid.

2. Gravimetric analysis: (use of sintered crucible is recommended wherever possible)
   Determination of the number of water molecules present in a hydrated salt.
   Estimations of lead and barium as sulphates or chromates.
   Estimations of calcium as oxalate monohydrate, copper as cuprous thiocyanate and zinc or aluminium as oxinate.
   Analysis of limestone and brass.

3. Preparations:
   Five inorganic compounds and six organic compounds.
   Determination of boiling and melting points (micro method).

BC13: PRACTICAL IV

Semester 5 and 6

Physical Chemistry

1. Molecular weight determination by Rast's method.
2. Transition temperature of a salt hydrate.
3. Critical solution temperature of phenol-water system.
4. Effect of electrolytes on the CST of phenol-water system.
5. A study of two component system - simple eutectic only.
6. Distribution coefficient of iodine between H_2O and CCl_4.
7. Determination of equilibrium constant for the reaction:

$$KI + I_2 \longrightarrow KI_3$$

8. Determination of heat of neutralisation.
9. Kinetics of acid catalysed hydrolysis of an ester.
10. Kinetics of persulphate - iodide reaction.
11. Determination of cell constant.
12. Verification of Onsager equation.
13. A study of weak electrolytes - Ostwald's dilution law.
14. Conductometric titration - strong acid vs. strong base.
15. Determination of single electrode potential.
16. Determination of pH.

SC01: COMPUTER AIDED CHEMISTRY

Unit-I

Computer components – I/O devices, Software and Hardware, Languages, Flow charts, algorithm and Data processing Concepts.

Unit-II

Introduction to BASIC – Constants, Variable, Hierarchy of Operation, Control Statements, loops and arrays, library functions, decision making, string data and subroutines.

Unit-III

Programming in BASIC - Molecular weight, pH for strong acids, bases and buffer solutions, Rate constants for first and second order reactions, equilibrium constants, dissociation constants, Solubility product and Electrode potentials.

Unit-IV

Application of computers in scientific field - data storage, retrieval and presentation, designing of molecules and demonstrating experiments.

Unit- V (Practical)
MS-Word, Excel and PowerPoint.

References:

1. BASIC Programming self-taught — Seymour C.Hirsch
2. An Introduction to Computer Science — Saritha Balamurali.
3. General Chemistry (2nd Edition) — Ebbing
4. Schaum's Outline Series Theory & Problems of programming with BASIC (3rd Edition) — Byron S.Gottfried.

SC02:ENVIRONMENTAL CHEMISTRY

(60 Hours)

Unit-I (12 hours)

Atmospheric pollution: Structure of the atmosphere – sources of air pollution – primary pollutants – CO, hydrocarbons, particulate matter, SO_2, NO_x . Secondary pollutants-smog, acid rain, ozone destruction – CFCs - Green house effect - global warming.

Unit-II (12 hours)

Water Pollution: Quantification of pollutants-BOD, COD, DO in natural waters – wastewater treatment - aerobic AS, TF process – anaerobic process – nitrification – denitrification – thermal pollution.

Unit-III (12 hours)

Fertilizer: N and P fertilizers use in crop production – nitrate pollution and phosphorus pollution of water - Eutrophication.

Pesticide - pest control using chemicals – pollution due to organo chlorines – organo phosphours insecticides, herbicides, PCB, PAH - biomagnification.

Unit-IV (12 hours)

Heavy metal pollution : toxicity – bio-accumulation – Mercury – methyl mercury formation – toxic effect of lead in the environment- lead additives of petrol; Cadmium, Chromium and Arsenic.

Unit-V (12 hours)

Noise pollution : measurement of noise level, noise pollution hazards and control.

Pollution due to radioactive wastes - health and environment effects- management of nuclear wastes.

References:

1.Environmental Chemistry	A.K.De 3rd Edition New Age International (p) Ltd., 1996.
2.Environmental Chemistry	Peter O'Neill, George Allen un win 1985.
3. Environmental Chemistry	Colin Baird, W.H.Freeman & Co. 1995.

WATER QUALITY STUDIES

Service Learning Programme

The main objectives are:

l) To identify the sources of fresh water in a given area (e.g. village)

2) To evaluate the quality of water in terms of requirements for the maintenance of aquatic life.

3) To identify and evaluate the natural and man-made factors influencing the water quality

4) To educate the local community on water augmentation, preservation of existing aquifers and maintenance of water quality

5) To develop simple and cost effective chemical kits, and to help the people to evaluate water quality using simple tests.

The students will be trained in the following areas.

l) Survey planning

The major water sources in an area should be obtained from topographical maps or from local Government agencies. The major features of land use and sources of point discharge such as factories can be identified using this map. A series of test and sampling sites should be selected in order to assess the effect of these discharges on water quality. The sites should be checked for ease of access and suitability.

2) Field and laboratory tests

Twelve tests are suggested to be included in the survey. The list is not exclusive, but covers parameters which have an important bearing on water quality. Furthermore, the tests are relatively straightforward and can be attempted by small groups of students on large number of water samples within a reasonable time.

Four tests are conducted '*in situ*' or 'on site'.

i) Temperature, ii) DO iii) conductance, and iv) pH

Laboratory tests

v) P content, vi) BOD, vii) chlorophyll a, viii) suspended solids, ix) oil and grease in sediment, x) NH_3, xi) available chlorine, and xii) COD

Students will be trained in sample collection techniques and in storage methods.

3) Presentation of the report

Students will get training in submitting an explicit and brief report; the report should summarise numerical results and observations. There will be a discussion to cover the significance of the finding in relation to water quality.

This will help them to make a comment on the standard of water quality and to give guidelines for investigation and water management.

4) Development of kits to be used by community people

Local community will be trained in using the kit to analyse water and to evaluate its quality. They would be trained to participate in water management in their area.

5) Outcome

The possible outcomes are:

1) The students may acquire practical understanding of some of the basic chemical processes, which occur in the environment.

2) They may gain experience in the collection, collation and interpretation of data on environmental pollution.

3) They may develop skills in reporting chemical information on the environment.

4) They may lead co-ordinate and help local community in water conservation and water management.

5) There may be a general awareness among the public on cleaner water environment and hygiene.

FOOD ADULTERATION AWARENESS

The main objectives of this programme are

1) To identify the occurrence/presence of foreign substances in food which results from deliberate additions or other processes.

2) To identify the type of food additives like colour, flavouring agents etc., and to check whether these belongs to the allowed list of additives.

3) To teach simple methods of identification of these materials to the general public.

4) To identify the presence of natural toxins in stored food.

A variety of chemicals are added to foods to improve their flavour, appearance and keeping qualities. Sometimes foreign materials with lesser or no money value are added to the food with the sole aim of increasing the profit margin.

Students learn different types of food additives, their identification and regulations regarding their use. Many substances, which are not in the permitted list, are still being used in food preparation.

Two types of analysis '*in situ*' and laboratory tests are employed. Students are taught the sampling technique and spot tests are used to identify the adulterant. The quantitative determination of these adulterants is carried out in the laboratory. Food items will also include water.

BC14: CHEMISTRY OF METALS

(45 hours)

Unit I (9 hours)

1.1 General principles of metallurgy - occurrence - concentration of the ores - extraction of the metals and types of furnaces.

Unit II (9 hours)

Extraction and uses of the following metals - Li, , Al, Ca, Ti, V, Ru, Rh, Pd, Os, Ir, Pt, Sn, Pb. A study of their properties, compounds and uses.

2.2 Preparation and uses of Li_2CO_3, $Al_2(SO_4)_3$, CaF_2, TiO_2, V_2O_5, $[Ru(bipy)_3]Cl_2$, $[RhCl(PPh_3)_3]$, $K_2[PdCl_4]$, OsO_4, trans-$[IrCl(CO)(PPh_3)_2]$, $[Pt(NH_3)_2Cl_2]$, SnS_2, $Pb(C_2H_5)_4$.

Unit III (9 hours)

Group study: A comparative account of the characteristics of the following groups of elements.

3.1 Titanium group
3.2 Chromium group
3.3 Copper group
3.4 Zinc group
3.5 Platinum group

Unit IV (9 hours)

4.1 Chemistry of inner transition elements; position in the periodic table - occurrence, separation, oxidation states and compounds.

4.2 Discovery and study of synthetic elements Np and Pu.

Unit V (9 hours)

5.1 Polyacids - Definition, classification - preparation - properties - uses - structures of Polyacids of Mo and W.

References:

1. P.L.Soni Inorganic Chemistry
2. Cotton and Wilkinson Advanced Inorganic Chemistry
3. Manku Inorganic Chemistry
4. A.K.De Synthetic Elements
5. Swarup Metallurgy

BC15: CHEMISTRY OF NATURAL PRODUCTS AND PHARMACEUTICALS

(45 hours)

Unit I (9 hours)

1.1 Alkaloids: classificatioin, isolation, purification, general method of structure determination, structural elucidation of piperine, nicotine, and coniine.

1.2 Terpenoids - classification, isolation, isoprene rule, general method of structure determination, stutural elucidation of geraniol, dipentene and alpha terpineol.

Unit II (9 hours)

2.1 Carbohydrates: nomenclature and classification, glucose and fructose (properties, structure determination, configuration and interconversions), sucrose and maltose - (properties and structure), starch and cellulose (uses only).

Unit III (9 hours)

3.1 Dyes - theories of colour (Chromophore - Auxochrome theory, Molecular orbital approach to the colour), classification of dyes (based on structure and applications). Synthesis and used of Methylorange, Congored, Malachite green, Rosaniline, Phenolphthalein ,Fluorescein, Alizarin and Indigo dyes.

3.2 Vitamins - classification, sources deficiency diseases and uses (a general study), structural elucidation of vitamin A.

Unit VI (9 hours)

4.1 Sulpha drugs: synthesis and uses of sulphanilamide, sulphacetamide, sulphathiozole, sulphaguanidine and sulphapyridine - mode of action and SAR of sulphadrugs. Anti leprosy drugs - Daspones.

4.2 Antibiotics: definition, classification - chloramphenicol - penicillin - tetracyclines and streptomycin (SAR and uses only).

Unit V (9 hours)

5.1 Analgesics - synthesis and uses of aspirin, acetaminophen - nalorphin, methadone pethidine and morphine (SAR).

5.2 Antimalarials - quinine and chlorquine (synthesis and structural elucidation not required).

5.3 Sedatives and hypnotics - synthesis and uses of phenobarbitone, cyclobarbitone and thiobarbitone (SAR).

References:

1. I.L.Finar Organic Chemistry Vols. I / II
2. John Suttie Biochemistry

BC16: CHEMICAL KINETICS AND SURFACE CHEMISTRY

(45 hours)

Unit I (9 hours)

1.1 Rate of a reaction - Rate equation- Rate constant, Order and Molecularity - Methods of rate measurement.

1.2 Derivation of kinetic equation for zero, first and second order reactions – parallel, consecutive and opposing reactions.

1.3 Rate determining step and mechanism of elemental process - Arrhenius law- activation energy.

Unit II (9 hours)

2.1 Collision theory of reaction rates, collision cross section, collision number.

2.2 ARRT- qualitative treatment of equilibrium hyphothesis- rate equation- transmission coefficient. Thermodynamic formulation of reaction rate, entropy, enthalpy and volume of activation.

2.3 Effect of solvent and ionic strength on reaction rates.

2.4 Unimolecular reactions - steady state treatment - Lindemann hypothesis - Chain reaction.

Unit III (9 hours)

3.1 Homogeneous and Heterogenous Catalysis - definition - examples and differences.

3.2 Enzyme catalysis - elementary of the principle of the activated complex using steady state treatment - Michaelis - Menten kinetics. ¨

Unit VI (9 hours)

Laws of photochemistry - Grotthus Drapper law, Einstein's law of photochemical equivalence- quantum yield.

Kinetics of photochemical reactions of CH_3CHO and H_2 - Cl_2.

4.3 Photophysical processes - fluorescence and phosphorescence – sensitisation - chemiluminescence.

Unit V (9 hours)

5.1 Physisorption and chemisorption - adsorption isotherms - Freundlich and Langmuir adsorption isotherms. BET equation and its use in surface area determination.

5.2 Colloids-types, stability and electrical double layer, electrophorosis and electro-osmosis - association colloids (micelles) and critical micelle concentration.

References:

1. Glasstone and Lewis — Elements of Physical Chemistry
2. Maron and Lando — Fundamentals of Phy. Chemistry
3. Laidler K.J. — Kinetics
4. Agarwal — Kinetics
5. P.W.Atkins — Physical Chemistry

EC04 : APPLIED CHEMISTRY II

(45 hours)

Unit I (9 hours)

1.1 Pesticides- classification - insecticides - classification - natural organics - synthetic organics.
1.2 Organo chlorines - DDT, methoxychlor, BHC, chlordane.
1.3 OP insecticides - parathion, TEPP, malathion.
1.4 Fungicides - sulphur compounds - ferbam - copper compounds - Bordeaux mixture - organo mercury fungicide - ethyl mercury chloride- cerasan - quinone fungicide.
1.5 Herbicides - 2,4 D - boron compounds.
1.6 Insect attractants and repellants.

Unit II (9 hours)

2.1 Vegetable oils - classification - manufacture by expression and solvent extraction - refining - hydrogenation.
2.2 Soap and its manufacture - batch and continuous process - types - laundry, toilet, transparent soap - floating soap - soap powders.
2.3 Detergents - classification - anionic, cationic, nonionic and amphoteric detergents - builders, additives, corrosion inhibitors - cleansing action of detergents.

Unit III (9 hours)

3.1 Pulp and paper - manufacture of pulp - sulphate, soda and sulphite pulp - beating, refining, filling, sizing and colouring - manufacture of paper.
3.2 Basic chemicals of perfumes - vehicles - animal, resinous essential oil and synthetic fixatives- fragrances - synthetic and semi synthetic chemicals - cosmetic formulations.
3.3 Surface-coating industries - pigments, paints - constituents of paints, manufacture of paints, varnishes - spirit and oleoresinous - lacquers.

Unit IV (9 hours)

4.1 Plastics and fibers - polymerisation processes - PE, PVC, PVA, phenol formaldehyde and urea formaldehyde resins
4.2 Rubber - natural and synthetic - vulcanisation- SBR, neoprene, thiokol rubbers.
4.3 Silicones - nylon, decron, orlon, saran, teflon and cellulose acetate.

Unit V (9 hours)

5.1 Food-processing-principles- canning- freezing- drying - pasteurisation and sterilisation - food additives - colourands, flavouring agents and preservatives.
5.2 Pollution caused by coal and petroleum industries- SO_2 emission, acid rain- CO_2 emission- green house effect-cement industries-particulates and smog-hazardous water from electro chemical industries.
5.3 Domestic waste water-COD-BOD-primary and secondary treatment (activated sludge trickling filters) of domestic waste water.
5.4 Pollution due to pesticides and detergents - biomagnification - eutrophication.

Refrences:

1. Riegel (ed) — Handbook of Industrial Chemistry
2. Shreve — Chemical Process Industries
3. L.H.Meyer — Food Chemistry
4. W.A.Poucher — Perfumes, Cosmetics and Soaps
5. R.Gopalan, D.Vengappya and S.Nagarajan — Engineering Chemistry
6. A.K. De — Enviornmental Chemistry