

BHARATHIAR UNIVERSITY, COIMBATORE-641 046
B.Sc. CHEMISTRY COMPULSORY DIPLOMA IN TEXTILE CHEMISTRY
Scheme of Examinations (CBCS PATTERN)
(For the students admitted during the academic year 2008-2009 onwards)

Part	Study Components	Course Title	Ins. hrs / week	Exam				Credit
				Dur.	CIA	Marks	Total Marks	
Semester I								
I	Language-I		6	3	25	75	100	3
II	English-I		6	3	25	75	100	3
III	Core I – Chemistry Paper I		4	3	25	75	100	4
III	Core II – Chemistry Paper II		4	3	25	75	100	4
III	Core Chemistry Practical – I		2	3	-	-	-	-
III	Allied A - Paper I* (or) Paper I **		6	3	25	75	100	5
			4	3	20	55	75	4
III	Allied Practical**		2	3	-	-	-	-
IV	Environmental Studies #		2	3	-	50	50	2
Semester II								
I	Language-II		6	3	25	75	100	3
II	English-II		6	3	25	75	100	3
III	Core III – Chemistry Paper III		7	3	25	75	100	4
III	Core IV – Chemistry Practical I(Inorganic Quality Analysis)		3	3	40	60	100	3
III	Allied A - Paper II* (or) Paper II **		6	3	25	75	100	5
			4	3	20	55	75	4
III	Allied Practical**		2	3	20	30	50	2
IV	Value Education - Human Rights #		2	3	-	50	50	2
Semester III								
I	Language-III		6	3	25	75	100	3
II	English-III		6	3	25	75	100	3
III	Core V – Chemistry Paper IV		3	3	25	75	100	4
III	Core VI–Chemistry Paper V		3	3	25	75	100	3
III	Core Practical II		2	3	-	-	-	-
III	Allied B - Paper I* (or) Paper I**		6	3	25	75	100	5
			4	3	20	55	75	4
III	Allied Practical**		2	3	-	-	-	-
IV	Skill Based Subject 1 (Diploma) Chemistry of Natural and Synthetic Fibers		2	3	25	75	100	3
IV	Tamil @ / Advanced Tamil# (OR) Non-major elective - I (Yoga for Human Excellence)# / Women's Rights #		2	3	75	75	75	2
Semester IV								
I	Language-IV		6	3	25	75	100	3
II	English-IV		6	3	25	75	100	3
III	Core VII – Chemistry Paper VI		4	3	25	75	100	4
III	Core VIII – Chemistry Practical II (Volumetric and Organic Analysis)		3	6	40	60	100	3
III	Allied B - Paper II* (or) Paper II**		6	3	25	75	100	5
			4	3	20	55	75	4
III	Allied Practical**		2	3	20	30	50	2
IV	Skill based Subject 2 (Diploma) Technology, Processing and Dyeing		3	3	25	75	100	3
IV	Tamil @ /Advanced Tamil # (OR) Non-major elective -II (General Awareness #)		2	3	75	75	75	2

Semester V							
III	Core IX – Chemistry Paper VII	5	3	25	75	100	4
III	Core X – Chemistry Paper VIII	5	3	25	75	100	4
III	Core XI – Chemistry Paper IX	5	3	25	75	100	4
III	Core Chemistry Practical III	4	3	-	-	-	-
III	Core XII - Analytical Chemistry – I Basic Principles	4	3	25	75	100	4
III	Elective –I	4	3	25	75	100	5
IV	Skill based Subject 3 (Diploma) Water & Effluent Treatment And Pollution Control	3	3	25	75	100	3
Semester VI							
III	Core XIII – Chemistry Paper X	5	3	25	75	100	4
III	Core XIV - Chemistry Paper XI	5	3	25	75	100	4
III	Core XV - Chemistry Practical III Gravimetric And Chemistry Physical	7	6	40	60	100	4
III	Elective –II	4	3	25	75	100	5
III	Elective –III	4	3	25	75	100	5
III	Core XVI – Practical for Elective subjects	3	3	40	60	100	4
IV	Skill based Subject 4 (Diploma) Textile Chemistry Practical	2	3	40	60	100	3
V	Extension Activities @	-	-	50	-	50	1
Total						3800	140

* For subjects without practical

** For subjects with Practical

@ No University Examinations. Only Continuous Internal Assessment (CIA)

No Continuous Internal Assessment (CIA). Only University Examinations.

List of Elective papers (Colleges can choose any one of the paper as electives)		
Elective – I	A	Polymer Chemistry
	B	Agro Industrial Chemistry
	C	Pharmaceutical Chemistry
	D	Forensic Science and rime Investigatio
	E	Dairy Chemistry
Elective – II	A	Leather Chemistry
	B	Chemistry of Plant Based Products
	C	Dye Chemistry
Elective - III	A	Analytical Chemistry II Lab. Techniques
	B	Environmental Chemistry
	C	Textile Chemistry

ALLIED SUBJECTS

1. Mathematics
2. Physics
3. Botany

4. Zoology
5. Biochemistry

CORE I - CHEMISTRY PAPER I

Teaching hours : 60 hours per semester

Subject Description : This paper presents the basic principles of Chemistry.

Goals : To enable the students to learn about the basic principles of Chemistry.

Objective : To understand the important concepts of Chemistry.

CONTENTS

UNIT I

Ionic bonding - ionic crystals, NaCl and CsCl crystal structure, Lattice energy and its determination using Born-Haber cycle, factors affecting crystal lattice energy, properties of ionic crystals (high melting point, hardness, electrical conductivity in molten condition and in solution) – ion polarization - Fajan's rule-solubility of ionic compounds in polar solvent.

UNIT II

Structure and shape of molecules: VSEPR Theory and geometry of molecules. Hybridization and geometry of sp , sp^2 , sp^3 , dsp^2 , dsp^3 , d^2sp^3 , sp^3d^2 and sp^3d^3 . Bonding, shapes and structures of the following molecules: Molecules with Sigma bonds only – $BeCl_2$, $SnCl_2$, BF_3 , CH_4 , SiF_4 , XeF_4 , PCl_5 , IF_5 , SF_6 , and IF_7 .

UNIT III

Polar effects – inductive effect, mesomeric effect, electromeric effect, hyper conjugation and steric effects.

Classification of reagents: Electrophiles, Nucleophiles and Free radicals.

Types of reaction: Polar reactions involving carbonium ions and carbanions with simple examples.

UNIT IV

Aliphatic Hydrocarbons: Restricted rotation about single bond preferred rotational conformations.

Alkenes: Preparation by Wittig reaction – Mechanisms of beta elimination – E1, E2 and cis elimination – Hoffmann's rule and Saytzeff's rule. Addition reactions with hydrogen, halogen, hydrogen halide

(Markownikoff's rule) and hydrogen bromide (Peroxide effect).

UNIT V

1. Dienes: Stability of isolated and conjugated dienes-1, 2 and 1, 4 additions, Diels -Alder reaction. Free Radical addition – Polymerization – synthetic rubber.
2. Cycloalkanes: Preparation by Dickmann ring closure and by reduction of aromatic hydrocarbons – ring opening reactions of cyclopropane with H_2 , Br_2 and HI .

CORE II - CHEMISTRY PAPER II

Teaching hours: 60 hours per semester(4 hours per week)

Subject description:

This paper presents the concept of resonance and wave mechanical treatment of electrons.

Goals:

To enable the students to learn about the basic concept of resonance and wave theory.

Objectives:

To study the resonance in benzene and quantum theory.

Contents

Unit I:

Ozone and hydrogen peroxide – preparation, properties, structure, uses comparison between the two.

Selenium and Tellurium – Extraction, properties and Uses. Oxides and oxyacids of Se and Te. A comparative study of Sulphur, Selenium, Tellurium and their compounds (hydrides, oxides, halides)

Unit II:

Benzene – Resonance and resonance energy, structure – polar effects in Electrophilic substitution in benzene – mechanism of Nitration, Sulphonation, Halogenation, Friedal-Crafts alkylation and acylation-diazo coupling.

Alkynes: Acidity of Alkynes – formation of acetylides-addition of water with HgSO_4 catalyst-hydroboration.

Unit III:

Liquid crystals–the concept of mesomorphic state-typical liquid cryatalline substances and their properties.

Properties of liquids like surface tension and viscosity – Review of structural differences between solids, liquids and gases.

Condensed phases-Coefficients of thermal expansion and compressibility of liquids and solids.

Unit IV:

Failiure of classical theory in explaining black body radiation- plancks theory of quantization of energy – Einstein theory of photoelectric effect-compton effect.

De Broglie theory of wave-particle dualism-Heisenberg's uncertainty principle.

Unit V:

An elemantry treatment of Schrodinger wave equation – quantum numbers concept of orbitals-significance of ψ & ψ^2 free particles and particle in a box (one and three dimensional)

The covalent bonds-the hydrogen molecule – the vlance bond method hydrogen molecule ion-molecular orbital method-molecular orbitals for homonuclear and heteronuclear diatomic molecules.

CORE III - CHEMISTRY PAPER III

Teaching hours: 60 hours per semester

Subject description:

This paper presents the concept of coordination chemistry, aromaticity and thermodynamics.

Goals:

To enable the students to learn about aromaticity, thermodynamics and coordination chemistry.

Objectives:

To study the principles of thermodynamics and coordination chemistry.

Contents

Unit I:

Co-ordination compounds – Nomenclature – conductivity and precipitation studies – Werner Co-ordination theory – electronic interpretation of coordinate bond by Sidgwick. Isomerism: Examples of Geometrical and optical isomerism in square planar and octahedral coordination compounds – magnetic properties of coordination compounds and their interpretation by Pauling's valence bond theory and crystal field theory.

Unit II:

Chemistry of Boron family – Group discussion – Electron acceptor behaviour and electron deficiency of boron hydrides; bonding in diboranes; NaBH_4 , LiBH_4 preparation, properties, structure and uses- borozoles, borides.

Classification of silicate- simple silicates chain silicates and sheet silicates only.

Unit III:

Aromaticity-Huckel's rule Non-benzenoid aromatic compounds like cyclopentadienyl anion. Toluene and Isopropyl benzene and side chain substitution – polymerization of styrene. Vinyl chloride Relative reactivity of methyl, ethyl and vinyl chlorides. Grignard reagents and synthetic applications-Nucleophilic substitution reaction – $\text{S}_{\text{N}}1$, $\text{S}_{\text{N}}2$ and $\text{S}_{\text{N}}\text{i}$ reactions – Effect of solvent-nucleophile, structure of substrate and neighbouring group participation, elimination versus substitution-Benzene mechanism and intermediate complex mechanism.

Unit IV:

The laws of thermodynamics, generalities and Zeroth law – kinds of energy – Scope of the first and second laws of thermodynamics-thermodynamic terms-definitions – heat – work of expansion – work of compression – maximum and minimum quantities of work – Reversible and irreversible transformations – energy and first law of thermodynamics – properties of energy changes in relation to properties of system is thermal and adiabatic changes – meaning of the thermodynamic state function – properties of exact and inexact differentials – Joule Thomson experiment Relation between E and H, Cp and Cv.

Unit V:

Application of the first law of thermodynamics to chemical reactions. The heat of reaction – conventional value of H. The determination of heats of formation – sequences of reactions – Hess's law – heats of combustions – determination by Bomb Calorimeter – Bond energies – Resonance energies – Heats of solution – integral and differential dilution – Heats of reaction at constant volume – dependence of the heat of reaction on temperature and Kirchoff's equation.

TEXTBOOKS FOR REFERENCE:

1. Principles of Inorganic Chemistry, B.R. Puri L.R. Sharma, Shobanlal Nagin Chand & Co.
2. Inorganic Chemistry, P.L.Soni, Sultan Chand & Sons.
3. Organic Chemistry, Vol. 1, 2, 3, S. M. Mughgergee, S.P. Singh, R.P. Kapoor, Wiley Eastern.

4. Advanced Organic Chemistry, B.S. Bahl, Arun bahl, S.Chand & Co.
5. Essentials of Physical Chemistry, B.S. Bahl and G.D. Tuli, S.Chand & Co.
6. Text book of Physical Chemistry, P.L.Soni, D.B. Dharmarke, Sultan Chand & Sons.

CORE IV - CHEMISTRY PRACTICAL I

Inorganic Qualitative Analysis I & II Semesters (3 hours per week)

Analysis of a mixture containing two cations and two anions of which one will be an interfering ion. Semimicro methods using the conventional scheme with hydrogen sulphide may be adapted.

CATIONS TO BE STUDIED : Lead, Copper, Bismuth, Cadmium, Iron, Aluminum, Zinc, Manganese, Cobalt, Nickel, Barium, Calcium, Strontium, Magnesium and Ammonium.

ANION TO BE STUDIED : Carbonate, Sulphate, Nitrate, Chloride, Bromide, Fluoride, Borate, Oxalate, and Phosphate.

CORE V - CHEMISTRY PAPER IV (INORGANIC AND ORGANIC CHEMISTRY)

Teaching hours: 45 hours per semester (3 hours per week)

Subject description:

This paper presents the principle in the extraction of metals and mechanism of some important organic reactions.

Goals:

To enable the students to learn about the extraction principles and mechanism of some addition reaction.

Objectives:

To understand the mechanism and synthetic uses of important organic reactions.

Contents:

Unit I:

Occurrence, extraction, properties and uses of Gallium, Thallium, Germanium, Titanium and Tin - their important compounds such as GeCl_4 , GeO_2 , TiO_2 , TiCl_4 , and SnCl_2 .

Unit II:

Occurrence, extraction, properties and uses of Zirconium, Vanadium, Molybdenum and Tungsten -their important compounds such as V_2O_5 , ZrOCl_2 , ammonium molybdate, molybdenum blue, WO_2 , and tungsten bronzes.

Unit III:

Chemistry of Carbonyl Compounds – I:

Reaction mechanisms: Nucleophilic addition of Grignard reagent, NH_3 , primary amine- Aldol condensation, Cannizzaro reaction, Perkin reaction, Knoevenagel reaction and Claisen-Schmidt reaction.

Unit IV:

Chemistry of Carbonyl Compounds – II

Reaction mechanisms – Reformatsky reaction, benzoin condensation, Wittig reaction, haloform reaction – Reaction with LiAlH_4 and NaBH_4 – Clemmensen reduction, Wolff Kishner reduction, MPV reduction – reducing properties of Carbonyl compounds.

Unit V:

Malonic ester, acetoacetic ester and cyanoacetic ester-their preparation and synthetic applications Tautomerism of acetoacetic ester.

Geometrical isomerism – Cis & Trans, E & Z notations – Geometrical isomerism in maleic acid and fumaric acid - physical and chemical properties of geometrical isomers.

CORE VI - CHEMISTRY PAPER V

Teaching hours: 45 hours per semester (3 hours per week)

Subject description

This paper presents the basic things of compute, C programming and its applications in chemistry. This paper also deals with second and third law of thermodynamics.

Goals

To enable the students to understand computer, its application in chemistry and laws of thermodynamics.

Objectives

To study the applications of computer programming in chemistry and importance of second and third law of thermodynamics.

Contents

UNIT I: Introduction:

The definition of a computer. History of computers. The block diagram of a computer. Types of computers - PC and its components - programming languages - Algorithms and Flow charts.

Hardware components of a computer - Input unit, processing unit. Input unit devices - Keyboard, Mouse, Track ball, Digitizing tablet, Light pen, Touch screen, Touch pad, Digital camera and Scanner. Memory unit: 1. Primary memory 2. Secondary memory. Output unit: Monitor, Printer and Plotter.

UNIT II C Language (part I)

Introduction - Overview of Compilers and Interpreters. Structure of C program - Programming rules - Executing the program. C keywords, Identifiers, Variables in C - rules for defining variables, Data types, Declaring variables and Initializing variables. Constants in C, Operators in C, Input and Output in C language.

UNIT III some important C programs for Chemistry

Programs: To calculate the P^{H} of solution and find that it is basic, acidic or neutral. Calculation of p^{H} of a solution using Henderson equation. To compute the order of a reaction. To compute half-life period of a reaction. To compute the rate constant of a 1st order reaction. To compute the energy of activate of a reaction.

UNIT IV

Introduction to second law of thermodynamics - Carnot cycle - entropy - Definition - entropy changes in isothermal transformation - Trouton's rule. Entropy as function of T and V - Entropy as a function of T and P - Changes of entropy with T, Entropy changes in ideal gas - entropy of mixing of ideal gases.

UNIT V

General conditions of equilibrium and spontaneity - conditions of equilibrium and spontaneity under constants - definition of ΔA and ΔG -physical significance of ΔA and ΔG . Temperature and pressure dependence of ΔG - Gibbs - Helmholtz equation. Chemical equilibrium - The concept of chemical potential - chemical equilibrium in a mixture of ideal gases - Vant Hoff Isotherm and isochore - Third law of thermodynamics statement and applications exception to third law.

Ref:

Computer for Chemists - By PUNDIR BANSAL - Pragati Prakasam Pubs.

CORE VII - CHEMISTRY PAPER VI

Teaching hours : 60 Hours per semester (4 hours per week)

Subject description

This paper presents the chemistry of phenols, amines and phase rule.

Goals

To enable the students to learn about the reactions of phenol and amines .

Objectives

To study the reaction of phenol and amines and applications of phase rule.

Contents

UNIT I :

General methods of Extraction: Concentration – Gravity separation, Froth Floatations magnetic separation, Extraction – Chemical and Electrolytic methods of refining, Zone refining, Van Arkel refining and Electrolytic refining.

UNIT II :

Monohydric phenols; - preparation & properties –Reaction of monohydric phenols with mechanism – alkylation, esterification, nitration, sulphonation, halogenation coupling with diazonium salts – Kolbe, Reimer – Tiemann, Schotten – Bauman , Gattermann Reaction.

UNIT III :

Amine: Amines preparation & reaction- primary secondary and tertiary amines – their separation, comparison of their basicity – ring substitution, diazotiazation and coupling reaction of aromatic amines.

Diazomethaneand diazoacetic ester – preparation, structure and their synthetic applications.

UNIT IV :

Phase rule and phase equilibria –the equilibrium condition. Stability of phase of a pure substance. Pressure dependene of U and T curves. The claperyron and clapeyron-Clausius equations. Derivation of Gibbs phase rule. Phase equilibria in one component system. Phase

diagram for sulphur, water, carbon dioxide system, phase diagram for two component system – construction of the phase diagram/Thermal analysis method Bi-Cd; Zn-Mg and Na-K system.

UNIT V :

Solutions: ideal and non ideal – Raoult's law, Henry's law – Nernst distribution law and its applications.

Colligative properties- relative lowering of vapour pressure, elevation of boiling point depression of freezing point and osmotic pressure- their applications.

CORE VIII - CHEMISTRY PRACTICAL II Volumetric and Organic Analysis III & IV TH SEMESTERS

I. EXPERIMENTS IN VOLUMETRIC ANALYSIS:

A. Acidimetry & Alkalimetry: Estimation of Na_2CO_3

B. Permanganometry:

1. Estimation of Ferrous sulphate & Oxalic acid
2. Determination of Iron in Ferric Alum.
3. Estimation of Calcium-Direct method.

C. Dichrometry: Estimation of Ferrous iron using internal indicator.

D. Iodimetry:

1. Estimation of $\text{K}_2\text{Cr}_2\text{O}_7$.
2. Estimation of Copper.
3. Estimation of As_2O_3 .

E. Argentometry: (Demonstration experiments)

Estimation of chloride- Fajan's and Volhards method.

II. ORGANIC ANALYSIS

Systematic analysis of an organic compound Preliminary tests, detection of elements present, Aromatic or Aliphatic, Saturated or unsaturated, nature of the functional group, confirmatory tests and preparation of derivatives - Aldehydes, Ketones, Amines, Amides, Diamide, Carbohydrates, Phenols, Acids, Esters & Nitro compounds.

CORE IX - CHEMISTRY PAPER VII (INORGANIC CHEMISTRY)

Teaching hours : 60 hours per semester (4 hours per week)

Subject description

This paper presents the principle of radio activity, acids and bases and solvents.

Goals

To enable the students to know about the radio activity, acid and bases, the role of solvent in chemical reactions.

Objectives

To understand the principles of radio activity.

Contents

UNIT I :

Principle of Gravimetric analysis – Precipitation methods – conditions of precipitation – factors influencing the precipitation and solubility – Co precipitation and Post precipitation, digestion, washing and drying and ignition of the precipitate.

UNIT II :

Artificial radio activity. Artificial transmutation of new elements, synthesis of radio isotopes and. Nuclear fission and fusion. Nuclear reactors – principles of working – production of electrical energy – atomic projects in India – Safety measures; disposal of reactor wastes – pollution. Nuclear reactions, mechanisms and different types of stellar energy.

UNIT III :

Nature of isotopes and isobars – detection and isolation of isotopes – various methods – importance of discovery of isotopes – uses of isotopes in various fields. Nuclear stability n/p ratio, magic numbers C-12 atomic weight scale C-14 dating mass defect and nuclear binding energies. Radio active disintegration series.

UNIT IV :

Acids and bases; Definitions- different approaches to protonic acid – base systems – strengths of Lewis Acids and Bases-Solvolytic reactions-Hard and Soft Acids and Bases. Acid and base strength of HSABs- Applications of HSAB concept Basis of hardness and softness, Pi-bonding contribution Electro negativities of hard-soft species, limitations of HSAB concept.

UNIT V :

The solvents- solubility of compounds – effect of temperature on solubility- Role of water as solvent- chemical structure and solubility. Classifications of solvents-general behavior-properties of ionizing solvents. Types of reactions in solvents. Specific Non aqueous solvents-protonic solvents ammonia, hydrogen fluoride. Non Protonic solvents-SO₂ . BrF₃ Molten salt. Organic solvents C₂H₅OH, Ether.

CORE X - CHEMISTRY PAPER VIII (ORGANIC CHEMISTRY)

Teaching hours : 60 hours per square (4 hours per week)

Subject description

This paper presents the chemistry of carbohydrate, molecular rearrangements, amino acids and hetero cyclic compound.

Goals

To enable the students to learn about carbohydrates, amino acids and hetero cyclic compounds.

Objectives

To understand the importance of carbohydrate, amino acids in chemistry.

Contents

UNIT I :

Optical activity of compounds with asymmetric carbon- racemisation – resolution – asymmetric synthesis- configuration D,L and R,S. nomenclature.

UNIT II :

Mechanism of molecular rearrangement reaction: Pinacol Pinacolone, Beckmann, Hoffmann, Curtius, Benzilic acid, Schmidt, Lossen, Cope, Benzidine and Claisen rearrangements.

UNIT III :

Carbohydrates: Chemistry and structure of Glucose, Fructose, Sucrose and Maltose (cyclic structure as well;). Starch and Cellulose. An elementary account. (Elucidation of structure not necessary)

Inter conversion of sugars-mutarotation – Epimerisation.

UNIT IV :

Amino acids and proteins

Amino acids-Classification –Preparation and properties peptides and poly peptides-proteins classification based on physical properties and biological functions-primary secondary and tertiary structure – properties and uses.

UNIT V :

Heterocyclic compounds

Chemistry of Furan, Pyrrole, Thiophene, Quinoline, Isoquinoline, Benzofuran, Indole, Isatin and Indigo.

**CORE XI - CHEMISTRY PAPER IX
(ELECTRO CHEMISTRY)**

Teaching hours : 60 hours per semester (4 hours per week)

Subject description

This paper presents the principles of conduction Electro Motive Force, fuel cells.

Goals

To enable the students to know about electro chemistry.

Objectives

To study EMF, pH and their applications.

Contents

UNIT I :

Electrical conduction, conduction in metals and in electrolytic solutions. Measurement of conductivity in electrolytic solutions. Migration of ions-Kohlrausch's law. Arrhenius theory of electrolytic dissociation-Oswald's dilution law. Theory of strong electrolytes-Debye-Huckel-Onsagar theory (elementary account only) verification \-Debye-Falkenhagen effect-Wien effect-Transport numbers-Determination conductometric titrations.

UNIT II :

Ionic Equilibria-Solubility and solubility product-determination of solubility product-Applications of solubility product principles. Dissociation of weak acids and bases-Dissociation constants-pH scale-commonion effect-buffersolutions- Determination of pH values of Buffer mixtures-Henderson's equation-Hydrolysis of salts-Degree of hydrolysis.

UNIT III :

Electrochemical cells. Electrode potentials-The standard hydrogen electrode kinds of electrodes and their potentials-Nernst equation. EMF-computation and measurement of cell EMF single electrode potential-Determination and significance of electrode potentials- electro chemical series- temperature dependence of the cell EMF- Thermodynamic quantities of cell reactions.

UNIT IV :

Reference electrodes-Electrodes for measurement of pH-concentration cells with and without transport-liquid junction potential-applications of EMF measurements. Redox potential-Redox indicators-uses. Potentiometric titrations.

UNIT V :

Fuel cells: Hydrogen- oxygen cell and hydrocarbon oxygen cell. Storage cells. Lead storage cell and Nickel cadmium cell. Decomposition voltage-over voltage-Depositions and discharge potential.

CORE XII - ANALYTICAL CHEMISTRY I : BASIC PRINCIPLES

UNIT I :

Basic principles and applications of Analytical techniques : Such as Precipitation, filtration, sample drying, transfer of precipitates. Distillation, vacuum distillation fractional distillation and steam distillation. Sublimation, crystallization, fractional crystallization M.P., B.P., and Refractive Indices.

UNIT II :

Evaluation of Analytical data : Accuracy and precision, methods for their expression, classification of errors, detection and correction of determination and intermediate errors. The normal law of Distribution of Intermediate errors.

UNIT III :

Statistical tests and data : The F test and the T test, rejection of data the method of least squares, propagation of errors in computation, significant figures.

UNIT IV :

Theory of Quantitative Analysis ; Applications of Chemical equilibrium to analytical separations and estimations : The equilibrium constants, activity co-efficients. Acid-Base equilibria, solubility equilibria, distribution equilibria, Complex ion equilibria and stability constant Separations and estimations : illustrated with examples.

UNIT V :

Gravimetric methods : Theory of indicators, Theory of precipitation, Co-precipitation, Post-precipitation, theory of purifying the precipitates, Acid-Base, redox, Complexometric and precipitation Titrations, Volumetric analysis.

BOOKS FOR REFERENCE :

1. Quantitative Chemical Analysis, A.I. Vogel.
2. Instrumental Methods of Analysis, Skoog.
3. Instrumental Methods of Analysis, Willard, Dean, Merrit and Settle, CBS.

**CORE XIII - CHEMISTRY PAPER X
(SPECTROSCOPY AND NATURAL PRODUCTS)**

Teaching hours : 75 Hours per semester (5 hours per week)

Subject description

This paper represents the principles of spectroscopy and The chemistry of natural products.

Goals

To enable the students to know about terpenoids, vitamins, alkaloids and harmones.

Objectives

To study the spectroscopy and natural products

Contents

UNIT I :

Spectroscopy absorption spectra – fundamental concepts electromagnetic Spectrum-the various regions of the spectrum and the relative energies of the radiation in each region-type of changes induced by the interaction of radiation with matter. Theory of rotations spectra-Molecular rotation-diatomic molecule as rigid rotor-diatomic molecule as non-rigid rotor-intensities of spectral lines. Applications of rotation spectra bond length-isotopic substitution.

Theories of IR spectra-simple harmonic oscillator model-An harmonic oscillator model of diatomic molecules information on molecular constitution from IR spectra; Application of IR spectra.

NMR SPECTRA- Basic principles – chemical shift-NMR spectra of simple molecules (high resolution details not expected)

UNIT II :

Theory of Raman spectra-comparison of IR and Raman spectra Theory of UV and visible spectra-Frank Condon principle-Pre dissociation-determination of dissociation energies – Applications of UV spectra to simple molecules.

UNIT III :

Terpenoids; Introduction-Classification-General methods of isolation-isoprene rule-structural elucidation and synthesis of gennaiol, terpineol, dipentene and alpha pinene.

Vitamins-introduction-importance of vitamins-structural elucidation and synthesis of Retinol, Thiamine, Riboflavin, Ascorbic acid.

UNIT IV :

Alkaloids – introduction – classification – General characteristics – general methods of determining structures- Hoffmann's exhaustive methylation structural elucidation and synthesis of Nicotine, conine, piperine and papaverin.

Harmones; Introduction-Structural elucidation and synthesis of adrenaline and thyroxine.

UNIT V :

Chemotherapy; Introduction-Classification of drugs-applications of sulpha drugs, anti materials Ambecidal, Antiseptics, Analgesics and Antibiotics (Pencilin, Streptomycin, Chloromycetin, tetracycline-structure and uses only).

CORE XIV - CHEMISTRY PAPER XI
(PHYSICAL PROPERTIES AND CHEMICAL KINETICS)

Teaching hours : 75 Hours per semesters (5 hours per week)

Subject description

This paper presents magnetic properties of molecules and kinetics of chemical reaction.

Goals

To enable the students to learn about the kinetic of reaction.

Objectives

To study the magnetic properties of molecules, chemical kinetics and photo chemistry.

Contents

UNIT I :

Electrical properties of molecules: Molar polarization, Orientation polarization and Distortion polarization polar and non polar molecules. Determination of dipole moments of polar gases, liquids and solids-Applications of dipole moment in the study of simple molecules.

UNIT II :

Magnetic properties of molecules; Meaning of the terms magnetic susceptibility, magnetic moment, diamagnetism, paramagnetism and ferromagnetism, Determination of magnetic susceptibility by Gouy's method. Application of magnetic properties in solving structural problems involving simple and complex inos.

UNIT III :

Empirical laws and experimental aspects. Rate laws, Stoichiometry, order and molecularity of reactions setting up and solving simple differential equation for first order, second order, third order and zero order reactions. Characteristics of I,II,III and Zero order reactions . Determination of order of reactions.

UNIT IV :

Experimental techniques involved in the following kinetics of reaction. Volumetry, manometry, polarimetry and colorimetry, typical examples for each of the techniques.

Theoretical aspects. Effects of temperature on the rate constant. The activation energy. The collision theory of reaction rates and its limitation. Lindemann theory of unimolecular reactions. The theory of Absolute reaction rates. Comparison of the collision theory with the Absolute reaction rate theory.

UNIT V :

Thermal chain reaction H_2/Br_2 reaction.

Kinetics of photochemical reactions. Absorption of light and photochemical process. The Stark-Einstein law of photochemical equivalence. Photochemical chain reaction H_2/B_2 reaction. Quantum yield of photochemical reactions. Comparison of thermal & photochemical kinetics of H_2/B_2 reaction. Photosensitized reactions. Fluorescence, phosphorescence and chemiluminescence.

TEXT BOOKS AND REFERENCES

Inorganic Chemistry

1. Principles of inorganic chemistry, B.R.Puri & L.R. Sharma, Shobanlal Nagin Chand & Co.,
2. Inorganic chemistry, P.L.Soni, Sultan Chand & Sons
3. Concepts of Inorganic Chemistry, F.A.Cotton

4. Text book of inorganic chemistry – a new approach, S.Sundaram and V.S. Srinivasan, Margham publications.
5. A text book of inorganic chemistry, A.K.De, Wiley
6. Concise inorganic chemistry, J.D.Lee.
7. Inorganic chemistry, Shriver and Atkins
8. Theoretical principles of inorganic chemistry Manku, Teta McGraw Hill edition.

Organic chemistry

1. Organic chemistry, Vol. 1,2,3 S.M. Mughgergee, S.P.Sigh, R.P.Kapoor, Wiley Eastern
2. Advanced Organic Chemistry, B.S.Bahl, Arun bahl, S.Chand & Co.,
3. Text book Organic Chemistry, P.L. Soni, S.M. Chawla, Sultan Chand & Sons
4. Stereoisomerism of carbon compounds, RaviBhusanm, CBS Publishers
5. Stereochemistry, Conformation and mechanisms, Kalsi, Wiley- Eastern Ltd.,
6. Stereochemistry of Organic compounds, D. Nasipuri, Wiley-Eastern Ltd.,
7. Organic chemistry, Vol 1 and 2, I.L. Finar, Addison-Wesley Longman
8. Organic chemistry, R.T.Morrison and R.W. Boyd, Prentice –Hall.
9. Organic chemistry, P.H.Pine, McGrawHill.
10. Fundamentals of Organic Chemistry, T.W.Graham Solomen, John-Wiley & Sons
11. Introduction to Organic Chemistry. Andrew Streitwischer, Jr.C.H.Heathcock
12. Stereochemistry of Carbon compound- Eliel, Tata Mc Graw Hill.
13. Organic chemistry- Stanley H pine Fifth edition - Tata Mc Graw – Hill Publishing House, New Delhi.
14. Solution Manual for organic chemistry –Robert C.Alkins and Francis carey fifth edition - Tata Mc Graw – Hill Publishing House, New Delhi.
15. Organic reaction Mechanism - Dr.Raj Bansal third Edition Tata Mc Graw – Hill Publishing House, New Delhi.
16. Spectroscopic methods in organic chemistry – williamms & Fleming fifth edition Tata Mc Graw – Hill Publishing House, New Delhi.
17. Organic chemistry –schaum series. 300- solved problems 2003 edition. Tata Mc Graw – Hill Publishing House, New Delhi.
18. Biochemistry –SC Rastogi 2nd edition . Tata Mc Graw – Hill Publishing House, New Delhi.

Physical Chemistry

1. Essentials of Physical Chemistry, B.S.bahl and G.D. Tuli, S. Chand & Co.,
2. Text book of physical Chemistry, P.L.Soni, Dharmarke; Sultan Chand & Sons
3. Principles of Physical Chemistry, B.R.Puri, L.R.Sharma and M.S.Phathania, Shobanlal Nagin Chand & Co.,
4. Principles of Physical Chemistry, S.M.Maron and C.F.Brutton, Oxford IBH
5. Physical Chemistry, R.a.alberty, John-Wiley & Sons
6. Elements of physical Chemistry, s.Glasstone and D.Lewis, McMillan
7. Physical chemistry, G.W.Castelan, Narosa publishers
8. Physical Chemistry, P.W. Atkins, Oxford.
9. physical Chemistry – Barrow Tata McGraw H.U. editor
10. Fundamentals of molecular spectroscopy-Ban welt – Tata McGraw Hill edition.
11. Introductory Quantum chemistry A.K.Chandra fourth edition. Tata Mc Graw – Hill Publishing House, New Delhi.
12. Atomic structure and the chemical Manas Chanda fourth edition. Tata Mc Graw – Hill Publishing House, New Delhi.

Computer Application

1. Gottfried.B.G., Theory and Problems of Programming with Basic McGraw hill Co., New York (1987)
2. Rajaraman. V., Computer programming I Fortran 77 Prentice hall of India, New Delhi(1996)
3. Isenhiur, T.L.P.C. Jurs, Wilkins C.L.Kloppemstein B.E., Introduction to computer Programming for chemists Basic version Allyn & Baco London (1981)
4. Raman K.V.Computers in Chemistry Tata McGraw-Hill Co New Delhi(1993)
5. Unique features of Basic, Pascal and Raman K.V.Chemistry Education june 1996
6. P.C.Software made simple R.K.Taxali
7. V.Balsgurusamy basic programming TMH Company New Delhi (1980)
8. Ramkumar Programming in Fortran tmh company (1985)
9. Computer and their applications to chemistry- Ramesh kumari –Narosa Publishing house
10. Computer networks – Andrews Janenbaum.

CORE XV - CHEMISTRY PRACTICAL III GRAVIMETRIC ANALYSIS AND CHEMISTRY PHYSICAL V & VI TH SEMESTERS

I. GRAVIMETRIC ANALYSIS :

1. Estimation of Sulphate as Barium Sulphate.
2. Estimation of Barium as Barium Chromate.
3. Estimation of Lead as Lead Chromate.
4. Estimation of Calcium as Calcium Oxalate.
5. Estimation of Nickel as Nickel Dimethylglyoxime.

II. PHYSICAL CHEMISTRY EXPERIMENTS :

1. Determination of partition coefficient of Iodine between Benzene and Water.
2. Determination of rate constant of acid-catalysed hydrolysis of an ester (Methyl acetate or Ethyl acetate).
3. Determination of K_f / molecular weight by Rasts method-Naphthalene, Diphenyl.
4. Determination of critical solution temperature of Phenol-Water system.
5. Determination of concentration of an electrolyte (NaCl/KCl/succinic acid).
6. Phase Diagram – Simple Eutectic system.
7. Determination of cell constant, specific conductivity and equivalent conductivity of strong electrolyte.
8. Determination of dissociation constant of a weak acid (acetic acid).
9. Conductometric titrations, strong-acid-strong base.
10. Potentiometric titrations, Acid-base HCl Vs NaOH.

CORE XVI - PRACTICAL FOR ELECTIVE SUBJECTS V AND VI TH SEMESTERS (3hours per week)

1. Determination of Melting point/Boiling point of an organic substance.
2. Preparation of inorganic complexes.
 - (a) Tetramine copper (II) sulphate
 - (b) Potassium Trioxalato chromate (III)
 - (c) Prussian Blue
 - (d) Hexamine Cobalt (II) chloride
 - (e) Potassium Trioxalato Ferrate(III)
 - (f) Sodium Cuprous Thiosulphate.

3. Preparation involving Acetylation, Hydrolysis, Oxidation, Halogenation, Nitration and Benzoylation.
4. Estimation of Hardness of Water using EDTA.
5. Calorimetric experiments involving Nessler's tubes.
 - (a) Estimation of Fe⁺⁺⁺ with Ammonium thiocyanate.
 - (b) Estimation of Ni as Nickel Dimethyl glyoxime.
 - (c) Estimation of Mn⁺⁺ in Potassium permanganate
6. Paper Chromatography-Chromatographic separation of components present in commercial inks (i.e. Green ink, Red ink, Black ink etc) and in flowers like Rose, Hybiscus etc.

DIPLOMA IN TEXTILE CHEMISTRY PAPER – I
(Chemistry Of Natural and Synthetic Fibers)

Teaching Hours : 30 Hrs. Per Semester (2 Hrs per week)

UNIT: I

Natural Textile Fibers: Definition, Classification of Natural Textile Fibers - Vegetable fibers, Animal fibers. Properties, Uses and Features of Cotton, Wool, Silk and Jute fibers. Genetically Modified Cotton : its merits and demerits.

UNIT : II

Viscose Fibre: Chemical structure, chemistry of regenerated cellulose. Production of Viscose Fibre : a simple flow chart, wet spinning of viscose filaments. Properties and uses of Viscose Fibre.

UNIT : III

Synthetic Fibers: Definition of monomers, polymers and polymerization. Simple examples of Condensation and Addition Polymerization reactions. Criteria for fibre forming polymers. Acrylic fibers : Synthesis of Acrylonitrile from propylene (Sohio Process), solution polymerization of acrylonitrile. Properties and uses of acrylic fibers.

UNIT : IV

Nylon Fibres: Synthesis of caprolactum from aniline, adipic acid from cyclohexane and hexamethylene diamine from adiponitrile. Polycondensation reactions leading to the formation of Nylon 6 and Nylon 6,6. Properties and uses of Nylon fibers. Structure and uses of Kevlar fibers.

UNIT : V

Polyester Fibers : Synthesis of Dimethyl Terephthalate (DMT) from p - xylene, terephthalic acid from benzoic acid (Henkel-II process) and synthesis of ethylene glycol. Chemical reactions of Poly Ethylene Terephthalate (PET) preparation. Properties and uses of Polyester fibers.

Reference:

1. Moses, J. Jeyakodi, and M. Ramasamy. "Quality Improvement on Jute and Jute Cotton Materials Using Enzyme Treatment and Natural Dyeing". *Man-Made Textiles in India*. Vol. 47, no. 7 (Jul. 2004): 252–255. (AN 14075527)
2. "cotton". The Columbia Encyclopedia, Sixth Edition. 2001-07.
3. Stephen Yafa (2004). *Cotton: The Biography of a Revolutionary Fiber*. Penguin (Non-Classics), 16. ISBN 0-14-303722-6 .
4. Kadalph, Sara J., ed.: *Textiles*, 10th edition, Pearson/Prentice-Hall, 2007, ISBN 0-13-118769-4
5. A.A.Vidya, ed.: Production of Synthetic Fibers, Prentice-Hall of India, 1988, New-Delhi..

DIPLOMA IN TEXTILE CHEMISTRY
PAPER - II
(Technology, Processing and Dyeing)

Teaching Hours: 30 Hours per semester (2 Hrs. per week)

UNIT: I

Classification of Yarns: Definition of yarn, classification of yarns - staple yarns, continuous filament yarns and stretch yarns. Definition of twisting of yarns, direction of twist. Mechanical properties of yarns - yarn strength - single thread test.

UNIT: II

Production of fibers: Melt spinning - definition, simple flow chart, explanation and type of polymers processed. Wet spinning - definition, simple flow chart, explanation and type of polymers processed. Dry spinning - definition, simple flow chart, explanation and type of polymers processed.

UNIT: III

Functions of spin finish, desirable properties of spin finish. Major components of spin finish - lubricant antistatic agent and emulsifier - one example each with structure. Application of spin finish - dipping roller method.

UNIT: IV

Dyeing of textile fibers: Definition of dyeing, Attachment of dye molecules to the fiber - Ionic forces: hydrogen bonds, van der waals' forces and covalent linkages. Important aspects of dyeing of polyester, nylon and acrylic fibers.

UNIT: V

Carrier Dyeing of polyester fibers - characteristics of a carrier, commonly used carriers, advantages of carrier dyeing. Acid dyeing of nylon fibers - definition, two examples and use of leveling agents, examples of anionic, cationic and non-ionic leveling agents. Cationic Dyeing of acrylic fibers - definition, two examples, use of retarders in cationic dyeing.

References:

1. Production of synthetic fibers. **A.A.Vidya**. Prentice Hall of India, New Delhi.
2. Dyes and their Intermediates. **E.N.Abrahart**. Edward Arnold, London.
3. Textile Yarns. **B.C.Goswami, J.G. Martindale**. John Wiley, New York.
4. A Text Book of Fibre Science and Technology. **S.P.Mishra**. New Age International, New Delhi.
5. Synthetic Dyes. **Pop Sine**. Rajat Publications, New Delhi.

DIPLOMA IN TEXTILE CHEMISTRY PAPER – III
(WATER & EFFLUENT TREATMENT AND POLLUTION CONTROL)

Teaching hours : 30 Hours per semester (2 hours per week)

UNIT I :

Impact of man on the Environment – an over view of Urbanization and Biodiversity. Environmental pollution – classification of pollution – Effect of industrial effluents – a detailed study of effluents discharged by Soap and detergent manufacture industry and Textile processing industry (study includes origin of effluent, important characteristic and general mode of treatment). Constituents of water and their effect on Textile wet processing – Water pollution – Harmful effects of water pollution and source of water pollution.

UNIT II :

WHO, ISO standards for raw water criteria – A general study on raw water pollution and consequence of River water pollution – Effluent discharge standards for inland surface water public sewers, on land for irrigation, marine coastal areas and drinking water parameters- A general study on Boiler water requirements which includes problem caused by water and effect and feed water requirements for low and medium pressure boilers and at a pressure of 450 – 500 psi. Water softening – study includes Cation Exchange softening, lime soda softening, softening by Sequestering agents and De-mineralization with schematic diagram of removal of carbon dioxide and silica.

UNIT III :

Removal of colour and turbidity (simple Coagulation, Flocculation and Filtration methods). General study on removal of Iron and Manganese by Aeration, settling and filtration method- Water analysis – colour, pH value, dissolved solids, suspended solids, total hardness (Calcium + Magnesium). EDTA Titrimetric method, total iron- thiocyanate method, Determination of Alkalinity by Titrimetric method – thiocyanate method, Determination of Alkalinity by Titrimetric method- Determination of chlorides by silver nitrate method- Determination of dissolved oxygen by iodimetry – Determination of BOD, COD TDS and Toxicity.

UNIT IV :

Effect of effluents – General treatment procedure parameters to be determined at Sizing, Desizing, Kier boiling, Bleaching, Mercerizing, Dyeing, Printing, Combined effluent treatment of industrial wastes- Brief study on Screening, Sedimentation, Equalisation, Neutralisation, Coagulation, Secondary treatment – Trickling filtration Activated sludge process, oxidation ponds, Anaerobic Digestion, Tertiary treatment- Evaporation (solar & steam). Reverse osmosis, ion exchange, chemical precipitation and removal by Algae and activated carbon treatment.

UNIT V :

Model schematic diagram for –Waste water treatment plant for textile mills-Primary & secondary units –Effects of air pollution –Effects of Sulphur oxide on human health – Ambient air quality standards- Noise pollution –ill effects of noise-Noise level in decibels. brief study on modern methods for pollution analysis like molecular luminescence, BOD incubator, iron chromatography and HPLC.

Reference

1. Environment Pollution control Engineering by C.S.Rao. New age International Ltd & Publishers.
2. Industrial safety & Pollution control Hand Book by National safety council and Associate Data Publisher Pvt Ltd.

3. Industrial Effluents by N.Manivasakam, Sakthi Publications, Coimbatore.
4. Water used in Textile Processing by N. Manivaskam, Sakthi Publications, Coimbatore.
5. I.S.O Hand Book.
6. Tamilnadu state publications and Hand book of pollution control –Central Board of pollution control.
7. Textile Effluents by Padma Varkar, NCUTE Publications, IIT,Delhi.
8. Environmental Chemistry and pollution Control, S.S.Dhara, S.Chand & Co., Delhi.
9. Pollution in Textile Industry, K.B.Krishnakumar, SSMITT Students Cooperative Stores, Komarapalayam.

DIPLOMA IN TEXTILE CHEMISTRY PAPER – IV TEXTILE CHEMISTRY – PRACTICAL

Lab- hours : 30 Hours per semester (2 hours per week)

LIST OF EXPERIMENTS

1. Identification of textile fibres by burning test
2. Identification of textile fibres by solubility test
3. Estimation of pH- paper, digital pH meter, pH solution
4. Volumetric analysis of Sodium bi Sulphite
5. Volumetric analysis of Sodium Nitrite
6. Volumetric analysis of Sodium Hydro Sulphite
7. Volumetric analysis of Hydrogen Peroxide (permanganametry)
8. Volumetric analysis of Sodium Hypochlorite.
9. Estimation of available Chlorine in Sodium Hypochlorite.

PREPARATION OF DYES

1. Methyl Red
2. Malachite Green
3. Methyl Orange
4. Pare nitro benzene azo beta naphthol
5. Azo Amino Benzene.

ELECTIVE I - A POLYMER CHEMISTRY

UNIT I :

Classification of polymers-natural polymers and synthetic polymers. Synthetic polymers-Addition polymers, condensation polymers-Mechanism of polymerization, step reaction polymerization, chain reaction polymerization, -ionic, radical and coordination polymerization-one example each.

UNIT II :

Molecular weight of polymers-Number average and weight average molecule weight methods.

1. Osmometry (membrane)
2. Cryoscopy & ebullioscopy
3. Osmometry (Vapour pressure)
4. Viscometry

5. End Group Analysis-number average
Weight average Mw (i) Light scattering (ii) Ultra centrifugation Molecular weight distribution.

UNIT III :

Primary and secondary bond forces in polymers-coherence energy-structure property relationship

- (i) Mechanical properties
- (ii) Thermal stability-glass transition temperature
- (iii) Flame resistance
- (iv) Chemical resistance
- (v) Degradability
- (vi) Electrical Conductivity

UNIT IV :

Important industrial polymers, preparation and applications

- (i) Polyethylene, polypropylene
- (ii) Polyamides
- (iii) Polyvinyl chloride, polymethylmethacrylate
- (iv) Polyesters, polycarbonates
- (v) Polyurethanes
- (vi) Phenol-formaldehyde, melamine-formaldehyde
- (vii) Polysilanes, polysiloxanes
- (viii) Polyaniline

UNIT V :

Rubber, Cellulose, starch, wool, silk, collagen, coal, nucleic acids, general structure-importance-applications.

Reference

1. Polymer chemistry an introduction-M.P.Stevens, Oxford-1990
2. Textbook of polymer Science-FW Billmeyer, Wiley-1984.

ELECTIVE I - B AGRO INDUSTRIAL CHEMISTRY

UNIT I :

Water source for agriculture- Water Treatment & Water Analysis

Sources of water supply for agriculture.Hard and soft water. Water softening methods: lime soda process, phosphate conditioning, permutit and ion-exchange processes. Water analysis; determination of hardness of water, acidity, alkalinity,pH value, amount of free CO₂, fluoride content, chloride content and their estimation. Biological oxygen demand (BOD), chemical oxygen demand (COD), chlorine demand and their determinations. Recycling of water.

UNIT II :

Chemistry of soil-soil classification and soil analysis

Definition of soils. Classification of soils. Properties of soils-physical properties and mechanical analysis. Structure and Texture. Soil water, soils air and soil temperature. Chemical properties- soil mineral matter-soil colloids, ion-exchange reactions. Soil fertility and its evaluation. Soil organic matter and their influence on soil properties –N ratio effects. Soil reactions. Soil pH, acidity, alkalinity, buffering of soils and its effects on the availability of N, P, K, Ca, Mg, I, Al,Mn & sulphuric acid. soils salinity, acid & alkaline soils- their formation and reclamation.

UNIT III :

Fertilizers

1. Effect of N,P,K, secondary nutrients and micro nutrients on plant growth and development.
2. Importance of nitrogenous fertilizers. Nitrogen cycle and fixation of atmospheric nitrogen. principle and manufacture of ammonium nitrate, ammonium sulphate, and urea
3. Phosphate fertilizers. preparation and uses of mono and diammonium phosphates, super phosphate and triple super phosphate.
4. potassium fertilizers-potassium nitrate, potassium chloride, potassium sulphate. Mixed fertilizers. Methods of compost in green manuring, concentrated organic manures and their chemical composition. Oil cakes, horn and hoof metal.

Pesticides

Classification-Insecticides, fungicides and herbicides. general methods of preparation, application and toxicity. Insect attractants and repellants-fluorine compounds, boron compounds, arsenic compounds, organomercuric compounds, DDT, BHC, 2,4 -D compounds, pyridine compounds.

UNIT IV :

Chemistry of sugar and fermentation

1. Details of manufacture of sucrose from cane sugar-extraction of juice, purification, concentration, crystallization, separation and refining of crystals, recovery of sucrose from molasses. Manufacture of sucrose from beetroot. Estimation of sucrose and inversion sugar by polarimetry.
2. Manufacture of alcohol from molasses and starch by fermentation process.

UNIT V :

OILS, fats and Waxes

Classification of oils fats and waxes: distinction between oil, fats and waxes Hydrogenation of oils-principle and manufacturing details. Definition and determination of soapification value, acid value, iodine value RM value and Hehner value and their signification. Elaidin test for oils. Some common waxes like spermaceti, Bees wax, baybeery wax and their uses. Soap and its manufacture; toilet and transparent soaps. Cleansing action of soap. Detergent.

References

1. Nature and properties of soils-Harry, O Buckman N Yle C. Brandy
2. Soils Sceince-A.Sankara
3. Insecticides, Pesticides and Agro based Industries – R.C.Palful, K.Goel, R.K.Gupta
4. Applied Chemistry- Theory and Practise- O.P.Vermani & A.K.Narula
5. Industrial Chemistry-B.N Chakrabarty
6. Industrial Chemistry-B.K.Sharma.

ELECTIVE I - C PHARMACEUTICAL CHEMISTRY

UNIT I :

1. Important terminologies used in pharmaceutical chemistry-Definition of the following terms-drug, pharmacology, pharmacognosy, pharmacy, therapeutics, toxicology, chemotherapy, pharmacopoeia (BP, IP, USP), National formulary,

- pharmaeophore, bacteria, virus, vaccines, toxoids, primary immunization, additive effect, synergism, antagonism, plausibility, LD₅₀, ED₅₀ and therapeutic index
2. Routes of drug administration-local, enema, oral or external, parental-advantages and disadvantages oral and parental routes-inhalation, intradermal, subcutaneous, intramuscular, intravenous-intraarticular-intraarticular-transcutaneous-transmuscular.
 3. Clinical chemistry-A Diagnostic test and one method of estimation bilirubin and cholesterol in serum or plasma or urine. Biuret test for urea.
 4. First aid to prevent bleeding and maintain breathing
 5. Causes and symptoms of food poisoning, botulism-mushroom and plant poisoning-first aid.
 6. Causes, symptoms and treatment of anemia, diabetes, tuberculosis, asthma, jaundice, piles, leprosy, typhoid, malaria, cholera and filarial.
 7. Indian medicinal plants and their importance. Spices and their medicinal uses.

UNIT II :

1. Alkaloids- definition-general methods of isolation-colour tests for identification-source, isolation, structure and use of atropine-source, extraction, structure, SAR and uses of morphine and quinine.
2. Analgesics-definition different types of pain (superficial, deep non visceral, visceral, referred and psychogenic), classification – morphine and its derivatives. Synthesis assay and uses of pethidine and methadone-antipyretic analgesics-salicylic acid derivatives-paracetamol, phenacetin-propanoic acid derivative-Ibuprofen.
3. Antibiotics: definition –microbial synthesis structure, assay and uses of chloramphenicol and penicillin-structure and use of streptomycin and tetracyclines.
4. Sulphonamides: Definition-mechanism of action-classification-SAR- synthesis and use of sulpha acetamide, sulphathiazole, phthalyl sulphathiazole-sulphadiazine and sulpha pyridine-assay.

UNIT III :

1. Antiseptics and disinfectants: Definition and distinction- phenol coefficient-examples-phenolic compounds, dyes, cationic surfactants and chloro compounds. Tranquilizers-definition and examples. Psychotropic drugs LSD and marijuana.
2. Anaesthetics – Definition –Classification –volatile anaesthetics(N₂O, ethers, halohydrocarbons, chloroform, haloethane)-ferguson principle –intravenous anaesthetics- structure of thiopental sodium-local anaesthetic cocaine-source and structure – preparation and uses of procaine orthocaine and benzocaine.
3. Vitamins-Definition-classification, sources and deficiency diseases of vitamins A,B,C,D,E and K.Importance of vitamin A in vision (rhodopsin cycle).
4. Definition of cancer and antineoplastic drugs-examples antimetabolite, natural substances hormones, alkylating agents, inorganic complexes and other compounds-definition of hypoglycemic drugs-types and cause for diabetics-examples (Sulphonyl ureas and biguanides)

UNIT IV :

1. Medicinally important compounds of Al₂P₂As, Hg and Fe. Uses of the following MgSO₄ 7H₂O, milk of magnesia, magnesium trisilicate-Aluminium hydroxide gel, dihydroxy aluminium amino acetate, Aluminium acetate and aluminium monostearate-paroxon-phosphorine, cyclophosphamide-tricyclophosphorine-preparation and use of thiotepa-sodium and copper cacodylates-preparation and uses of aromatic arsenicals (carbosone, triparasomide, acetarsonide,

nearsphenamine, oxophenarinsince)- HgCl_2 , HgI_2 and $\text{Hg}(\text{CN})_2$ as disinfections-importance of organic mercury compounds-structure and uses of thiomersal, netromersal merbromine and mersalyl acid-Ferrous gluconate, FeSO_4 , scale preparation (ferric ammonium acetate), ferrous fumarate, ferrous succinate and ferrous chlorinate.

2. Organic pharmaceutical aids-Definition-agents for kidney function (aminophippuric acid)-liver function (sulphobrophthalein sodium, rose Bengal)-corneal ulcer detection (Fluoescein sodium)-Blood volume determination (Evans Blue) pituitary function (metyrapone)-ointment bases-preservatives-antioxidants-sequesants, colouring, sweetening, flavouring, emulsifying and stabilizing agents.
3. AIDS-cause HIV-prepagation-prevention and treatment.

UNIT V :

1. Blood-composition-grouping-Rh factor-buffers in blood-Functions of plasma proteins-clotting mechanism-blood pressure.
2. Coagulants and anticoagulants-definitions and examples.
3. Antianemic drugs (iron, vitamin B_{12} , folic acid).
4. Cardiovascular drugs : definition and names of to drugs for each of the following-carduitibue agents-antiarrythmic drugs-antihypertensive drugs-antianginal agents-vasodilators-lipid lowering agents-scelrosing agents.

Text and References

1. Pharmaceutical Chemistry by S. Lakshmi, Sultan Chand & Sons, 2nd ed (1998).
2. Pharmacolgy and pharmatherapeutics, Vol.1 & 2, R.S. Satoskar and S.D. Bhandarkar 11th Ed, Popular prakashan, Mumbai, 1989.
3. Bentleys, Text book of pharmacutics, 8th Ed. E.A. Raubins, 1992, All India traveler book sellers, Delhi.
4. Medicinal Chemistry, Ashutosh kar, New Age International, 1992.
5. A text book of pharmaceutical chemistry, Jayashree ghosh, S. Chand, 1997.

ELECTIVE I - D FORENSIC SCIENCE AND CRIME INVESTIGATION

UNIT I :

Criminology-Definition-nature and scope-types of crimes-penology-Indian penal code-Indian Evidence Act-Indian Criminal Procedure Code.

UNIT II :

1. Forensic Science-Definition, principles and uses in crime investigation.
2. Fingerprints-Patters-classification-Uses of finger prints in crime investigation direct and latent prints-development by powders-chemistry of powders-other methods of development transfer methods for finger prints.
3. Tracks and Traces-Foot Prints-casting of foot prints-Residue Prints-Walking pattern-tier marks-miscellaneous tracks and traces-glass fracture-Tool marks-paints-Fibers.
4. Biological substances-Blood, Semen, Saliva, Sweat, Urine and Hair.

UNIT III :

1. Arson-Natural fires and arson-Nature of action of fire-drifts and air supply-burning characteristics and chemistry of combustible material-Nature of combustion.

2. Explosives-Definition-Classification-Composition and mechanism of explosion-bombs.
3. Ballistics-Classification-Internal external and terminal ballistics and overall view. Small arms-Classification and characteristics. Laboratory examination of the barrel washing and detection of powder residues by chemical tests.

UNIT IV :

Documents-Chemistry of paper and ink-Writing paper-carbon paper-safety paper. Ink-various writing inks. Chalk-coloured chalk-adhesives-sealing waxes. Different types of forged signatures-simulated and traced forgeries-inherent signs of forgery models-writing deliberately modified-uses of ultraviolet rays-comparison of typewritten letters-Counterfeit currency and coins.

UNIT V :

Poisons-Types and classification-Diagnosis of poisoning in the living and in the dead-clinical symptoms-post-mortem appearances –treatment in cases of poisoning-use of antidotes.

Reference

1. Criminalistics and introduction to forensic science-Richard Saferstein, Prentice Hall of India-1978.
Forensic Science –T.H.James-Stanley Thornes Ltd.1987

ELECTIVE I - E DAIRY CHEMISTRY

UNIT I :

Milk: Definition-General composition of milk-physical properties of milk- colour, odour, acidity-natural and developed, specific gravity-Recknagel effect viscosity and conductivity, factors affecting the gross composition of milk, physico-Chemical change taking place in milk due to processing parameters-boiling pasteurization- sterilization and homogenization. Adulterants, preservatives and neutralizers-example and their detection. Estimation of fat, specific gravity, acidity and total solids in milk.

UNIT II :

1. Milk lipids-terminology and definitions classification – saponifiable (triglycerides) and unsaponifiable matters (sterols and cholesterol) phospholipids-structure and properties (Lecithin and Cephalin) Milk fat constants-refractive index-saponification number, Iodine number, R.M.number, R.M number and polenske number.
2. Milk proteins-Chemistry of proteins in general structure-N-terminal and C-terminal, hydrogen bond, disulphide bond and salt linkages, outlines of primary, secondary and tertiary structure of proteins. Physical properties of milk proteins-Electrical properties and hydration, solubility. Reaction of milk proteins with formaldehyde and ninhydrin. Non-protein nitrogen constituents of milk, effect of heat on milk protein, milk enzyme and functions.
3. Milk carbohydrate-Lactose-Its structure, solubility, hydrolysis, Oxidation and reduction, Estimation of lactose in milk.
4. Milk vitamins-water and soluble vitamins, effect of heat and light on vitamins.
5. Ash and mineral matters in milk.

UNIT III :

1. Creams : Definition-composition-chemistry of creaming process-gravitational and centrifugal methods of separation of cream-Factors influencing cream separation (Mention the factors only)-Cream neutralization. Estimation of fat in cream.
2. Butter : Definition-% composition-manufacture-Estimation of fat, acidity, salt and moisture content-Desi butter.
3. Ghee : Major constituents-common adulterants added to ghee and their detection-rancidity-definition-types (hydrolytic, oxidative and ketonic) prevention-antioxidants and synergists (natural and synthetic)-Measurements.

UNIT IV :

1. Fermented milk products : Fermentation of milk-definition, conditions, cultured milk-definition of culture-examples, conditions, types-cultured cream-cultured butter milk-Bulgaricus milk-acidophillus milk-yogurt. Racteriophage-definition and its function.
2. Indigenous products : Definition percentage composition-preparation-physico-chemical changes take place during khoa-making-khoa sweet-Gulabjamum, chana sweet-Rossogolla-ingredients and preparation.
3. Ice cream : Definition-percentage composition-types-iungredients needed-manufacture of ice-cream stabilizers-emulsifiers and their role.

UNIT V :

1. Milk powder : Definition-need for making powder-drying process-spray drying, drum drying, jet drying and foam drying-principles involved in each. Manufacture of whole milk powder by spray drying process-keeping quality of milk powder.
2. Dairy Detergents : Definition-characteristics-classification-washing procedure (modern method) sterilization-chloramin-T and hypochlorite solution.

Reference Books

1. Outlines of Dairy Technology-Sukumar De
2. Principles of Dairy Chemistry-Robert Jenness & S.Patarn.
3. Indian Dairy products-K.S. Rangappa and K.T. Achaya.
4. Modern Dairy Products-L.M. Lampert.
5. Principles of Dairy processing-Warner.

ELECTIVE II - A

LEATHER CHEMISTRY

UNIT I :

1. Hides, Skins,Leather-An elementary knowledge of the structure and composition of hides and skins. proteins and their characteristics, Anatomy and histology of protein constituents of leather (an elementary concept).
2. Basic principle involved in pre-tanning such as soaking, liming, deliming, bating , pickling involved in pre-tanning such as soaking, liming, deliming, bating, pickling and depickling.

UNIT II :

1. Types of tanning-vegetable and mineral tanning, Different types of vegetable tanning-materials classification and chemistry of vegetable tanning. Factros and Physio-chemical principle involved in vegetable tanning, Fixation of vegetable tanning.
2. Synthetic tannings-their classifications, general methods of manufacture and use.

UNIT III :

1. The preparation and chemistry of chrome tanning liquids, Olation, Oxolation and hydrolysis of chrome liquids. Effect of adding tanning agents-Role of pH in the reaction of chromium complexes with hide proteins. Factors governing chrome tanning-chemistry of neutralization process. A brief survey of chemistry of other tanning like Al, Zr and Te salts and their relative merit in contrast with chrome tanning

2. Chemistry of combination of tannages involving vegetable tanning aldehydes, chrome and other mineral tanning agents.

UNIT IV :

1. Chemical methods of curing and preservation of hides and skins in acid and alkaline solution.

2. Principles of analytical methods employed in curing, liming, deliming, bating, pickling. Analysis of vegetable tanning materials and extract.

3. process of dyeing leather-Use of mordants, dyeing auxillaries such as leveling, wetting and dispersing agents-Dye fixations.

UNIT V :

1. Animal bye-products-their collection, handing and preservation methods (such as hair, blood, bones, glands, Kerationus materials and their utilization).

2. Tannery effluents and treatment: Types of water pollution-physical, chemical, physiological and biological. Different types of tannery effluents and wastes-beam-house waste-liquors-tanning and finishing yard waste liquors, solid waste-origin and disposal.

Books for Reference

1. Chemical technology of Leather (ISI).
2. Fundamentals of Leather Science-Woodroffe.
3. Tanning processes-Crthmann.
4. Chemistry of Leather manufacture-Mchanghlils.
5. Vegetable tanning materials-Howes.
6. Publications of CLRI-Madras.

ELECTIVE II - B CHEMISTRY OF PLANT BASED PRODUCTS (STARCH, CELLULOSE, PROTEINS)

UNIT I :

Chemistry of starch : Structure, physical and chemical properties. Manufacture and uses of unmodified and modified starch, dextrin, sugar syrup, hydrolysis of starch to edible and industrial glucose applications of starch in textile sizing and in fermentation industries.

UNIT II :

Chemistry of cellulose : Structure physical and chemical properties general reactions, major sources and uses of cellulose, chemical and enzymatic hydrolysis of cellulose. Statistics and economics and cellulose. Chemistry of minor products of wood like lignin, pentosans, resins etc, laboratory preparation, manufacture and uses of chemical cellulose.

UNIT III :

Chemistry of proteins : Structure, Properties, Major sources, technological uses, hydrolysis of proteins and protein isolates. Manufacture, Properties and uses of gelatin, casein, collagen, protein isolates.

UNIT IV :

Cellulose derivatives like cellulose nitrate, cellulose acetate, ethyl and methyl cellulose, sodium cellulose sulphate, sodium, carboxy, hydroxyl, methyl, cellulose, regenerated cellulose, major cellulose-plastics-sodium carboxy methyl cellulose.

UNIT V :

Different methods of pulping, manufacture and uses of different quality of paper products like card-board, newsprint, writing paper, tissue paper and filter paper. A short discussion of the pollution problems and by-products utilization of industries based on starch cellulose and proteins.

Reference

1. Textbook of Biochemistry-K. Ranganatha rao, Prentice Hall (1975).
2. Biochemistry-S.K. Dasgupta, Macmillan (1977).

ELECTIVE II - C DYE CHEMISTRY

UNIT I :

Colour and constitution-Relationship of colour observed-to wave length of light absorbed-Terms used in colour chemistry-Chromophores, Auxochromes, Bathochromic shift, Hypsochromic shift. Colour of a substance-Quinonoid theory molecular orbital approach.

UNIT II :

Classification of Dyes-chemical classifications-classification according to their applications-Acid dyes-Basic dyes. Azoic dyes, mordant dyes, vat dyes, Sulphur dyes, Disperse dyes, Nitro dyes-and Nitroso dyes process of dyeing (simple treatment).

Azo dyes-Principles governing azo coupling-mechanism of diazotization-Coupling with amines, coupling with phenols Classification according to the number of azo group & application-Tautomerism in azo dyes.

UNIT III :

Synthesis, reactions and applications of Di and Triphenyl methane dyes-phthalein dyes-Xanthen dyes-acridine dyes-sulphur dyes. Phthalocyanines-Cyanine dyes. Malachite green, Parosaniline, crystal violet.

UNIT IV :

Azine, Oxazine and Triazine Dyes.Synthesis and applications of quinonoid dyes including vat dyes based on anthraquinone.

UNIT V :

Pigments-requirements of a pigment: Typical Organic and Inorganic pigments-application and their uses in paints. Reaction of dyes with fibres and water-Fluorescent Brightening agents. Application of dyes in other areas-medicine, chemical analysis, cosmetics, colouring agents, food and beverages.

Reference

1. Dyes and their intermediates-E.N.Abraha, Bergamon Press, 1969.
2. The chemistry of synthetic dyes and pigments-H.A.Lubs,ACS Publication, Halner, 1970.
3. The chemistry of synthetic dyes Vol, I, II, III & IV-K.Venkataraman, Academic Press N.Y., 1949.
4. Physical and Chemistry applications of dyestuffs-F.P.Schafer, Springer-Veriag N.Y.1976.
5. Organic chemistry Vol.I-I.L.Finar, ELBS.
6. Modern paint pigment and Varnish –S.K.Jain & S.K.Maikl, Industries Small business Publication, New Delhi.

ELECTIVE III - A ANALYTICAL CHEMISTRY II-LAB TECHNIQUES

UNIT I :

Chromatography: Classification of the chromatographic methods, principles of differential migration, Adsorption phenomenon, nature of the adsorbent, solvent systems. Rf. values column Chromatography. Partition chromatography, paper chromatography, TLC, Electrophores-theory and techniques.

UNIT II :

Spectroscopy: theory, Instrumentation and application of

- | | |
|--------------------------------------|---------------------------|
| (i) UV and visible spectrophotometry | (ii) IR spectrophotometry |
| (iii) Flame Photometry | (iv) NMR spectroscopy |

UNIT III :

Polarimetry: Theory Instrumentation, experimental procedure and application.

UNIT IV :

Electro chemical methods of Analysis, polarography, cyclic voltametry, differential pulse polarography, calorimetry: Theory, techniques and applications.

UNIT V :

Preparation and purification of organic and inorganic compounds like;

- | | |
|---|--|
| (i) Aspirin from salicylic acid | (ii) Acetanilide from aniline |
| (iii) Benzanilide from aniline | (iv) iodoform from ethanol/and acetone |
| (v) Meta di nitro benzene | (vii)preparation of Nylon 666 |
| (vi) Methyl orange/methyl red | (ix) Caesin and lactose from milk |
| (viii) Caffine from tea leaves | (xi) Bakelite from phenol and formaldehyde |
| (x) Nicotine and Nicotine sulphate
From tobacco waste | (xii) As ₂ O ₃ Sol, Fe (OH) ₃ Sol |
| (xiii) As ₂ O ₃ Sol, Fe (OH) ₃ Sol | (xiv) Tetra mine Cobalt carbonate |
| (xiv) Tetra mine Cobalt carbonate | (xv) Sodium thiosulphate and dithionate |
| (xv) Cuprous chloride | |

Books for Reference

1. Physical methods of chemistry-R.S.Drago
2. Spectroscopy in Inorganic chemistry-C.N.R Rao and JR Ferraro
3. Analytical Chemistry-R.V.Dills
4. Fundamentals of Analytical Chemistry-D.A.Skoag and D.M.West
5. Instrumental methods of Chemical Analysis-Ewing
6. Quantitative Chemical Analysis-A.I.Vogel.

ELECTIVE III - B
ENVIRONMENTAL CHEMISTRY

UNIT I :

1. Concept and scope of environmental chemistry-Nomenclature: Pollutant, contaminant, receptor, sink, pathways of a pollutant, speciation, dissolved oxygen, chemical oxygen demand (COD), biochemical oxygen demand (BOD)-Environmental segments.
2. Composition of the atmosphere-atmospheric structure-earth's radiation balance – particles, ions and radicals in the atmosphere-formation of inorganic particulate matter- formation of organic particulate matter-ions and radicals-photochemical reactions in the atmosphere-formation of NO₂,SO₂, organic compounds, green house effect.

UNIT II :

- Biological cycles & their significance-Gaseous and sedimentary cycles.
- (a) Oxygen cycle and ozone chemistry
 - (b) Carbon cycle
 - (c) Nitrogen cycle
 - (d) Sulphur cycle
 - (e) Phosphorus cycle

UNIT III :

1. Water pollution: Hydrological cycle –aquatic environment-classification of water pollution – organic pollutants, inorganic pollutants, sediments, radioactive materials, thermal pollution, BOD & COD –signification-experimental determination. Trace elements in water.Chemical speciation of copper, lead and mercury.
2. Eutrophication-sewage treatment-primary and secondary treatments. Industrial waste water treatment by 1) activated charcoal/synthetic resins 2) membrane techniques.

UNIT IV :

1. Air pollution: Air pollutants-primary pollutants-sources of carbon monoxide, nitrogen oxides, sulphur dioxide; sink and control. Hydrocarbons, photochemical smog, acid rain.
2. Particulates: sources-inorganic and organic particulate matters-effects on a human beings, materials, climate control of particulate emission- of atmospheric pollution, corrosion of metals-indoor reactions of air pollutants-sinks of atmospheric gases.
3. Air quality standards: Monitoring –Analysis of carbon monoxide-nitrogen oxides-sulphur dioxides-hydrocarbons.

UNIT V :

1. Thermal pollution-definition, sources-environmental effects-control and prevention. Solar energy as alternative source of energy, strategies for energy conservation.
2. Noise pollution: Sources and effects of noise pollution-control and prevention-solutions to abuse. Supersonic jets and its effects.
3. Radioactive pollution: Sources of radioactive pollution-environmental threat of nuclear reactors-breeder reactors-environmental conflicts between nuclear powers Methods of control and prevention.

Reference

1. Environmental Chemistry-AK De, Wiley eastern Ltd., New Delhi (1993).

2. A text book of Environmental Chemistry-Krishnan & Kannan, Anmol Publications, New Delhi (1992).
3. Environmental chemistry & pollution control – Dhar, S.Chand &Co., New Delhi (1995).

ELECTIVE III - C TEXTILE CHEMISTRY

UNIT I :

1. Fibre theory –polymers and polymerization-Morphology of fibres – Molecular arrangements in fibres.
2. General classification of fibres-chemical structure, production, properties and uses of the following natural fibres (a)natural cellulosic fibres (cotton and jute) (b) natural protein fibre (wool and silk).

UNIT II :

Chemical structure, production, properties and uses of the following synthetic fibres. (i) Man made cellulosic fibres (Rayon, modified cellulosic fibres) (ii) Man made protein fibres (Azions) (iii) Poly amide fibres (different types of nylons) (iv) Poly ester fibres (v) Acrylic fibres and (vi) Olefin fibres.

UNIT III :

Impurities in raw cotton and grey cloth, wool and silk- general principles of the removal – Scouring – bleaching – Desizing – Kierboiling- Chemicking –Chemical and machinery use- Degumming and Bleaching of silk Scouring and Bleaching of wool.

UNIT IV :

Dyeing – Classification of dyes and their properties- applications – direct, basic, sulphur and azoic dyes on cotton. Application of Vat and solubilised vat dyes on cotton and viscose. Mordant mineral colours and black. Application of vegetable and other colour to cotton.

UNIT V :

1. Dyeing of wool and silk –Fastness properties of dyed materials – dyeing of nylon, terylene and other synthetics.
2. Finishes given to fabrics- Mechanical finishes on cotton, wool and silk, method used process of mercerizing –Anti-crease and Anti-shrink finishes –Water proofing.

Reference

1. Chemical Technology of fibrous Materials – F.sadov, M.Horchagin and A.Matetshy, Mir Publishers.
2. The Identification of Textile Fibres – Bruno Nuntak.
3. Introduction to Textile Science -3rd edition, Maryory L.Joseph.
4. Textile Chemistry –Vol.II R.H.Peters, Elsevier, Avesterdam.
5. Dyeing and chemical Technology of Textile fibres-5th Edition, E.R.Trotman, Charles Griffin & Co Ltd
6. Chemistry of dyes & Principles of Dyeing -V.A.Shenai, Sevak Publications.
7. Scouring and Bleaching E.R.Trotman, Charles Griffin & Co Ltd.
8. Text Book of Applied Chemistry- K.Kapur.
9. A Students Text Book of Textile Science- A.J.Hall.