## BHARATHIAR UNIVERSITY, COIMBATORE - 641 046

### B.Sc. CHEMISTRY WITH NANO TECHNOLOGY

**SCHEME OF EXAMINATIONS (CBCS PATTERN)**

(For the students admitted during the academic year 2010-2011 and onwards)

<table>
<thead>
<tr>
<th>Part</th>
<th>Study Components</th>
<th>Course Title</th>
<th>Ins. hrs /week</th>
<th>Exam</th>
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### Part III

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| Total          | 3500 140 |

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* 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 papers as electives)

<table>
<thead>
<tr>
<th>Elective I</th>
<th>Elective II</th>
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<tr>
<td>(A) polymer chemistry</td>
<td>(A) Leather chemistry</td>
<td>(A) Analytical chemistry II Lab Techniques</td>
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<tr>
<td>(B) Agro industrial chemistry</td>
<td>(B) Chemistry of plant based products</td>
<td>(B) Environmental chemistry</td>
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<tr>
<td>(C) Pharmaceutical chemistry</td>
<td>(C) Dye chemistry</td>
<td>(C) Textile chemistry</td>
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### ALLIED SUBJECTS

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
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 II
1. 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 carbonanions with simple examples.
2. Aliphatic Hydrocarbons: Restricted rotation about single bond preferred rotational conformations.
3. Cycloalkanes: Preparation by Dieckmann ring closure and by reduction of aromatic hydrocarbons – ring opening reactions of cyclopropane with H_2, Br_2 and HI.

UNIT III

UNIT IV
Liquid crystals–the concept of mesomorphic state-typical liquid crystalline 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 V:
1. Failure of classical theory in explaining black body radiation- Planck’s theory of quantization of energy – Einstein theory of photoelectric effect-compton effect. deBroglie theory of wave-particle dualism-Heisenberg’s uncertainty principle
2. Covalent bonds – Molecular orbital theory – application to molecules such as H_2, H_2+, He_2, O_2, N_2, F_2, CO and NO.
CORE II - CHEMISTRY PAPER II

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 acids and bases, aromaticity, and thermodynamics

Objectives: To study the principles of acids and bases and thermodynamics.

Contents

Unit I:  
Acids and bases; Definitions- different approaches to protonic acid – base systems – strengths of Lewis Acids and Bases - Hard and Soft Acids and Bases. Applications of HSAB concept Basis of hardness and softness, limitations of HSAB concept.

Unit II:  
Chemistry of Boron family – Group discussion – Electron acceptor behaviour and electron deficiency of boron hydrides; bonding in diboranes; NaBH₄ and borazole - preparation, properties, structure and uses-Classification of silicate- simple silicates chain silicates and sheet silicates only.

Unit III:  
Structure of benzene-Aromaticity-Huckel’s rule. Electrophilic substitution in benzene with mechanism. Grignard reagents and synthetic applications-Nucleophilic substitution reaction – S_N1, S_N2 and S_Ni reactions – Elimination versus substitution-Benzyne mechanism and intermediate complex mechanism.

Unit IV:  

Unit V:  

TEXTBOOKS FOR REFERENCE:
**CORE III - 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 adopted.

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 IV - CHEMISTRY PAPER III**

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:**

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

**UNIT II**

Occurrence, extraction, properties and uses of Thallium, Germanium, Titanium and Tin - their important compounds such as GeCl₄, TiO₂, TiCl₄, and SnCl₂.

**Unit III:**

Chemistry of Carbonyl Compounds – I:

Reaction mechanisms: Nucleophilic addition of Grignard reagent, NH₃, 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 LiAlH₄ and NaBH₄ – 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 V - CHEMISTRY PAPER IV
Teaching hours: 45 hours per semester (3 hours per week)

NANOTECHNOLOGY PAPER – I

INTRODUCTION TO NANO SCIENCE AND NANO TECHNOLOGY.

UNIT I: INTRODUCTION
Definition-origin of nanotechnology-difference between bulk and nanomaterials-size dependent properties (magnetic, electronic, transport and optical)

UNIT II: CLASSIFICATION OF NANOMATERIALS
Classification based on dimensional property - zero D, 1D, 2D and 3D nanostructures.

UNIT III: TYPES OF NANOMATERIALS
Metal oxides and metal nano particles-ceramic nano particles- semi conducting quantum dots-coveshell quantum dots-nanocomposites - micellar nanoparticles

UNIT IV: CARBON BASED NANOMATERIALS
Fullerenes- Carbon nanotubes-single walled and multiwalled nano tubes- structures-carbon nanofibre

UNIT V: METALLIC AND OXIDE BASED NANOMATERIALS

CORE VI - CHEMISTRY PAPER V
Teaching hours : 60 Hours per semester (4 hours per week)

Subject description
This paper presents the chemistry of few metals, 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:
Occurrence, extraction, properties and uses of Zirconium, Vanadium, Molybdenum and Tungsten -their important compounds such as V₂O₅, ZrOCl₂, ammonium molybdate, molybdenum blue, WO₂, and tungsten bronzes.

UNIT II:
UNIT III:
Amines- Preparation and properties of aliphatic and aromatic primary, secondary and tertiary amines – their separation, comparison of their basicity – ring substitution, diazotiazation and coupling reaction of aromatic amines.
Diazomethane and diazoacetic ester – preparation, structure and their synthetic applications.

UNIT IV:

UNIT V:
Solutions: ideal and non ideal – Raoults’ 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 VII - CHEMISTRY PRACTICAL II
Volumetric and Organic Analysis
III & IVTH SEMESTERS

I. EXPERIMENTS IN VOLUMETRIC ANALYSIS:
   A. Acidimetry & Alkalimetry: Estimation of Na$_2$CO$_3$
   B. Permanganametry:
      1. Estimation of Ferrous sulphate & Oxalic acid
      2. Estimation of Calcium-Direct method.
   C. Dichrometry: Estimation of Ferrous iron using internal indicator.
   D. Iodimetry:
      1. Estimation of K$_2$Cr$_2$O$_7$
      2. Estimation of Copper.
      3. Estimation of As$_2$O$_3$.

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 VIII - CHEMISTRY PAPER VI
Teaching hour : 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:

UNIT II:

UNIT III:

UNIT IV:

UNIT V:
CORE IX - CHEMISTRY PAPER VII
Teaching hour: 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. Optical activity due to restricted rotation (biphenyls, allenes and spiranes) and molecular over crowding.

UNIT II:
Mechanism of molecular rearrangement reactions: Pinacol Pinacolone, Beckmann, Hoff.mann, 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 andCellulose. An elementary account. (Elucidation of structure not necessary)
Inter conversion of sugars-mutarotation – Epemerisation.

UNIT IV:
Aminoacids and proteins
Amino acids-Classification –Preparation and properties of 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 X - CHEMISTRY PAPER VIII
Teaching hour: 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:

UNIT II:

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:

UNIT V:

CORE XI - CHEMISTRY PAPER IX
NANOTECHNOLOGY PAPER – II
PREPARATION, CHARACTERISATION AND APPLICATIONS OF NANOMATERIALS

UNIT I: PREPARATION OF NANOMATERIALS - I
Definition-bottom-up and top-down approaches- Thin film deposition - catalytic assisted growth - chemical vapor deposition - physical vapor deposition- sol gel method.

UNIT II: PREPARATION OF NANOMATERIALS -II
Chemical reduction - photochemical reduction - biochemical reductions - nano-lithography - ball-milling - template assisted synthesis-stabilization of nanomaterials.
UNIT III: CHARACTERISATION TECHNIQUES – I
Basic principles of scanning Electron Microscopy (SEM) , AFM, STM, SPM and TEM.(Instrumentation not needed).

UNIT IV: CHARACTERISATION TECHNIQUES -II
Paricle size analyzer - XPS - XRD - photoluminescence.(Instrumentation not needed)

UNIT V: APPLICATIONS
Applications of nanoscience and nanotechnology in molecular and nanoelectronics (MEMS and NEMS) - catalysis- drug delivery.

REFERENCES:
3. The chemistry of nanomaterials. Synthesis, properties and applications. CNR Rao, A Muller and AK Cheetham Wiley-VCH Verlag GmbH & co KgaA
CORE XII - CHEMISTRY PAPER X
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 hormones.

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 rotational spectra-Molecular rotation-diatomic molecule as rigid rotor-diatomic molecule as non-rigid rotor-intensities of spectral lines. Applications of rotational spectra-bond length-isotopic substitution.

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

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

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

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

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

UNIT IV:

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

UNIT V:
Chemotheraphy; Introduction-Classification of drugs-applications of sulpha drugs, anti malarials Amibecidal, Antiseptics, Analgesics and Antibiotics (Penicillin, Streptomycin, Chloromycetin, tetracycline-structure and uses only).
CORE XIII - CHEMISTRY PAPER XI

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 dipolemoment 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.


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

Theoretical aspects. Effects of temperature on 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 H2/Br2 reaction.

TEXT BOOKS AND REFERENCES
Inorganic Chemistry
2. Inorganic chemistry, P.L.Soni, Sultan Chand & Sons
5. A text book of inorganic chemistry, A.K.De, Wiley
6. Concise inorganic chemistry, J.D.Lee.
7. Inorganic chemistry, Shriver and Atkins

Organic chemistry
4. Stereoisomerism of carbon compounds, Ravi Bhusan, CBS Publishers
5. Stereochemistry, Conformation and mechanisms, Kalsi, Wiley-Eastern Ltd.,
7. Organic chemistry, Vol 1 and 2, I.L. Finar, Addison-Wesley Longman

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
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
9. physical Chemistry – Barrow Tata McGraw H.U. editor

Computer Application
5. Unique features of Basic, Pascal and Raman K.V.Chemistry Education june 1996
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

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 carbon tetra chloride and Water.
2. Determination of rate constant of acid-catalysed hydrolysis of an ester (Methyl acetate or Ethyl acetate).
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).
CORE XVI - PRACTICAL FOR ELECTIVE SUBJECTS
V AND VIITH SEMESTERS (3hours per week)

1. Determination of Melting point/Boiling point of an organic substance.
2. Preparation of inorganic complexes.
   (a) Tetrammine copper (II) sulphate  (b) Potassium Trioxalato chrome (III)
   (c) Prussian Blue  (d) Hexammine Cobalt (II) chloride
   (e) Potassium Trioxalato Ferrate(III)  (f) Sodium Cuprous Thiosulphate.
3. Preparation involving, 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 Cu++ by K4Fe (CN)6

SKILL BASED SUBJECT - TEXTILE CHEMISTRY PAPER – I
(Chemistry of Natural and Synthetic Fibers)
Teaching Hours: 30 Hrs. per Semester (2 Hrs per week)

UNIT: I

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

UNIT :III

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:

SKILL BASED SUBJECT - TEXTILE CHEMISTRY PAPER – II
(TECHNOLOGY OF DYEING OF NATURAL FIBRES)
Teaching hours: 30 Hours per semester (2 hours per week)

UNIT I:

UNIT II:

UNIT III:

UNIT IV:

UNIT V:

Reference
11. J.K.Aspland, Textile Dyeing and Colouration, AATCC Publications, USA.
15. Wilfred Ingamells, Colour for Textiles, SDC Publications, UK.

SKILL BASED SUBJECT - TEXTILE CHEMISTRY PAPER – III (WATER & EFFLUENT TREATMENT AND POLLUTION CONTROL)
Teaching hours: 30 Hours per semester (2 hours per week)

UNIT I:
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:

UNIT IV:

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, ion exchange chromatography and HPLC.

Reference
2. Industrial safety & Pollution control Hand Book by National safety council and Associate Data Publisher Pvt Ltd.
5. I.S.O Hand Book.
6. Tamilnadu state publications and Hand book of pollution control –Central Board of pollution control.
SKILL BASED SUBJECT - PAPER – IV
TEXTILE CHEMISTRY – PRACTICAL

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

LIST OF EXPERIMENTS
1. Estimation of pH- paper, digital pH meter, pH solution
2. Volumetric analysis of Sodium bi Sulphite
3. Volumetric analysis of Sodium Nitrite
4. Volumetric analysis of Sodium Hydro Sulphite
5. Volumetric analysis of 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 :
1. Classification of polymers-natural polymers and synthetic polymers. Synthetic polymers-
   Addition polymers, condensation polymers.
2. Methods of preparation of polymers-bulk, solution ,suspension and emulsion

UNIT II :
Different types of polymerization-step growth polymerization,addition polymerization and co-
polymerization -random, alternate ,block and graft polymerization.

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:
Molecular weight of polymers-number average and weight average molecularweight methods.
1. Osmometry (membrane) 2. Cryoscopy & ebullioscopy
3. Osmometry (Vapour pressure) 4. Viscometry
5. End Group Analysis.
UNIT V:
Important industrial polymers, preparation and applications of
(i) Polyethylene, polypropylene  (ii) Polyamides
(iii) Polyvinyl chloride, polymethylmethacrylate
(iv) Polyesters, polycarbonates  (v) Polyurethanes
(vi) Phenol-formaldehyde, melamine-formaldehyde
(vii) Polysilanes, polysiloxanes  (viii) Polyaniline

Reference
1. Polymer chemistry an introduction-M.P.Stevens, Oxford-1990

ELECTIVE I - B
AGRO INDUSTRIAL CHEMISTRY

UNIT I :
Water source for agriculture- Water Treatment & Water Analysis

UNIT II :
Chemistry of soil-soil classification and soil analysis

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.
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 soapanification 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.

References
1. Nature and properties of soils-Harry, O Buckman N Yle C. Brandy
2. Soils Scince-A.Sankara
3. Insecticides, Pesticides and Agro based Industries – R.C.Palful, K.Goel, R.K.Gupta
5. Industrial Chemistry-B.N Chakrabarty

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 immunination, additive effect, synergism, antagonism, plaubo, LD$_{50}$, ed$_{50}$ 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-intrathecal-intraarticular-transcutaneous-transmuscusal.
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
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.


UNIT III:

1. Antiseptics and disinfectants: Definition and distinction- phenol coefficient- examples-phenolic compounds, dyes, cationic surfactants and chloro compounds. Tranquilizers-definition and examples. Psychodelic drugs LSD and marijuana.


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, cyclophosphosphomide-tricyclophos-preparation and use of thiotepa-sodium and copper cacodylates-preparation and uses of aromatic aresericals (carbosone, triparesomide, acetarsonide, neoarsphenine, oxophenarsine)- HgCl₂, Hgl₂ and Hg(CN)₂ as disinfectations-importance of organic mercury compounds-structure and uses of thiomersal, netromersal merbromine and mersalyl acid-Ferous gluconate, FeSO₄, 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 (Fluorescein sodium)-Blood volume determination (Evans Blue) pituitary function
(metyrapone)-ointment bases-preservatives-antioxidants-sequestrants, colouring, sweetening, flavouring, emulsifying and stabilizing agents.


UNIT V:
2. Coagulants and anticoagulants-definitions and examples.
3. Antianemic drugs (iron, vitamin B_{12}, folic acid).
4. Cardiovascular drugs: definition and names of drugs for each of the following-carduutibue agents-antiarrythmic drugs-antihypertensive drugs-antianginal agents-vasodilators-lipid lowering agents-scelerosing agents.

Text and References

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.
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, Keratogenous materials and their utilization).

Books for Reference
1. Chemical technology of Leather (ISI).
3. Tanning processes—Crthmann.
5. Vegetable tanning materials—Howes.

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:
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

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 and molecular orbital approach.

UNIT II:
Classification of Dyes-chemical classification-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:

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

ELECTIVE III - A
ANALYTICAL CHEMISTRY II-LAB TECHNIQUES

UNIT I:

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 and 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 (vi) Methyl orange/methyl red
(vii) Preparation of Nylon 66 (viii) Caffeine from tea leaves
(x) Nicotine and Nicotine sulphate (xi) Bakelite from phenol and
From tobacco waste formaldehyde
(xii) As₂O₃ Sol, Fe (OH)₃ Sol (xiii) Tetrammine-copper sulphate
(xiv) Tetrammine Cobalt carbonate (xv) Sodium thiosulphate and
(xvi) Cuprous chloride dithionate

Books for Reference
1. Physical methods of chemistry-R.S. Drago
2. Spectroscopy in Inorganic chemistry-C.N.R Rao and J.R 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
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 $\text{NO}_2,\text{SO}_2$, 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) Phosphours cycle

UNIT III:
2. Eutrophication-sewag treatment-primary and secondary treatments. Industrial waste water treatment by 1) activated charcoal/synthetic resins 2) membrane techniques.

UNIT IV:

UNIT V:
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
ELECTIVE III - C
TEXTILE CHEMISTRY

UNIT I:
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 nylon) (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:
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
2. The Identification of Textile Fibres – Bruno Nuntak.
7. Scouring and Bleaching E.R.Trotman, Charles Griffin & Co Ltd.