

**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)**

Part	Study Components	Course Title	Ins. hrs / week	Exam			Credits
				CIA	Uni. exam	Total	
<b>Semester I</b>							
I	Language-I		6	25	75	100	4
II	English-I		6	25	75	100	4
III	Core I – Chemistry Paper I		7	25	75	100	4
III	Core Chemistry Practical – I		3	-	-	-	-
III	Allied A - Paper I* (or) Paper I **		6	25	75	100	4
			4	20	55	75	3
III	Allied Practical**		2	-	-	-	-
IV	Environmental Studies #		2	-	50	50	2
<b>Semester II</b>							
I	Language-II		6	25	75	100	4
II	English-II		6	25	75	100	4
III	Core II– Chemistry Paper II		7	25	75	100	4
III	Core III– Chemistry Practical I (Inorganic Quality Analysis)		3	40	60	100	4
III	Allied A - Paper II* (or) Paper II **		6	25	75	100	4
			4	20	55	75	3
III	Allied Practical**		2	20	30	50	2
IV	Value Education - Human Rights #		2	-	50	50	2
<b>Semester III</b>							
I	Language-III		6	25	75	100	4
II	English-III		6	25	75	100	4
III	Core IV – Chemistry Paper III		3	25	75	100	4
III	Core V – Chemistry Paper IV (Nanotechnology Paper I)		3	25	75	100	4
III	Core Practical II		2	-	-	-	-
III	Allied B - Paper I* (or) Paper I**		6	25	75	100	4
			4	20	55	75	3
III	Allied Practical**		2	-	-	-	-
IV	Skill Based Subject Chemistry of natural and synthetic fibers		2	20	55	75	3
IV	Tamil @/Advanced Tamil # (Or) Non-Major Elective - I (yoga/women's rights #)		2	-	50	50	2
<b>Semester IV</b>							
I	Language-IV		6	25	75	100	4
II	English-IV		6	25	75	100	4
III	Core VI – Chemistry Paper V		4	25	75	100	4
III	Core VII– Chemistry Practical II (Volumetric and Organic Analysis)		3	40	60	100	4

Part	Study Components	Course Title	Ins. hrs / week	Exam			Credits
				CIA	Uni. exam	Total	
III	Allied B - Paper II* (or) Paper II**		6	25	75	100	4
			4	20	55	75	3
III	Allied Practical**		2	20	30	50	2
IV	Skill based Subject Technology of Dyeing of Natural Fibres		3	20	55	75	3
IV	Tamil @/Advanced Tamil # (OR) Non-major elective -II (General Awareness #)		2	-	50	50	2
<b>Semester V</b>							
III	Core VIII – Chemistry Paper VI		5	25	75	100	4
III	Core IX – Chemistry Paper VII		5	25	75	100	4
III	Core X – Chemistry Paper VIII		5	25	75	100	4
III	Core XI – Chemistry Paper IX (Nanotechnology Paper II)		4	25	75	100	4
III	Core - Chemistry Practical III		4	-	-	-	-
III	Elective –I From Group I		4	25	75	100	4
IV	Skill based Subject Water & Effluent Treatment And Pollution Control		3	20	55	75	3
<b>Semester VI</b>							
III	Core XII – Chemistry Paper X		5	25	75	100	4
III	Core XIII - Chemistry Paper XI		5	25	75	100	4
III	Core XIV - Chemistry Practical III Gravimetric And Physical		7	40	60	100	4
III	Elective –II From Group II		4	20	55	75	3
III	Elective –III From Group III		4	20	55	75	3
III	Core XV– Practical for Elective subjects		3	40	60	100	4
IV	Skill based Subject Textile Chemistry Practical		2	30	45	75	3
V	Extension Activities @		-	-	-	50	2
Total						3500	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 papers as electives)**

Elective I	Elective II	Elective III
(A) polymer chemistry	(A) Leather chemistry	(A)Analytical chemistry II Lab Techniques
(B) Agro industrial chemistry	(B)Chemistry of plant based products	(B)Environmental chemistry
(C) Pharmaceutical chemistry	(C)Dye 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

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 carbanions 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

1. 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).

2. Dienes: Stability of isolated and conjugated dienes-1, 2 and 1, 4 additions, Diels -Alder reaction. Free Radical addition – Polymerization – synthetic rubber.

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

#### 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;  $\text{NaBH}_4$  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 –  $\text{S}_{\text{N}}1$ ,  $\text{S}_{\text{N}}2$  and  $\text{S}_{\text{N}}i$  reactions – Elimination versus substitution-Benzyne 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 of energy. First law of thermodynamics – properties of energy changes in relation to properties of system- isothermal 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 combustion – determination by Bomb Calorimeter – Bond energies – Resonance energies – Heats of solution – integral and differential heat of 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. Mughergee, 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 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  $\text{GeCl}_4$ ,  $\text{TiO}_2$ ,  $\text{TiCl}_4$ , and  $\text{SnCl}_2$ .

**Unit III:**

Chemistry of Carbonyl Compounds – I:

Reaction mechanisms: Nucleophilic addition of Grignard reagent,  $\text{NH}_3$ , 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  $\text{LiAlH}_4$  and  $\text{NaBH}_4$  – 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 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**

Metallic and oxide based nanomaterials – ceramic oxide nanomaterials – semiconductor oxide nanomaterials – nanocomposites and core-shell nanomaterials – micellar 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  $V_2O_5$ ,  $ZrOCl_2$ , ammonium molybdate, molybdenum blue,  $WO_2$ , and tungsten bronzes.

#### **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 and Gattermann reactions.

### 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 :

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 suplhur, water, carbondioxide 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 VII - CHEMISTRY PRACTICAL II Volumetric and Organic Analysis III & IV TH SEMESTERS

### I. EXPERIMENTS IN VOLUMETRIC ANALYSIS:

- A. Acidimetry & Alkalimetry: Estimation of  $\text{Na}_2\text{CO}_3$       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  $\text{K}_2\text{Cr}_2\text{O}_7$       2. Estimation of Copper.
  3. Estimation of  $\text{As}_2\text{O}_3$ .

### 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 :

Structure of metals and alloys-substitutional and interstitial solid solution-Hume Rothery ratios-metallic bonding-electrical, optical and mechanical properties of metals-semiconductors, intrinsic and extrinsic-their uses. Super conductors-An elementary treatment.

#### 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 istopes – 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 disintergration series.

#### UNIT IV :

Co-ordination compounds – Nomenclature – conductivity and precipitation studies – Werner Co-ordination theory – electronic interpretation of coordinate bond by SidgeWick. 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 V :

The solvents- solubility of compounds – effect of temperature on solubility- Role of water as solvent- chemical structure and solubility. Classifications of solvents-general behaviour- properties of ionizing solvents. Types of reactions in non aqueous solvents-protonic solvents - ammonia, hydrogen fluoride. Non Protonic solvents-SO<sub>2</sub> and BrF<sub>3</sub>. Organic solvents - C<sub>2</sub>H<sub>5</sub>OH and Ether.



### **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, 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 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:**

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 principle. 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-Deposition and discharge potential.

## **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

Particle 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:

1. Nano: The Essentials Understanding Nano Science and Nanotechnology. T.Pradeep. Tata Mc Graw-Hill publishing company Ltd.New Dehli.
2. Introduction to Nano technology Charles P Poole Jr. & Frank J Owens. Wiley Interscience.
3. The chemistry of nanomaterials. Synthesis, properties and applications. CNR Rao, A Muller and AK Cheetham Wiley-VCH Verlag GmbH & co KGaA
4. Nanostructures and nanomaterials-Guozhong Cao-Imperial College Press.(2004)
5. Nanotechnology: Basic Science and Emerging Technologies- Mick Wilson, Kamli Kannangara, Geoff smith, Michelle Simmons, Burkhard Raguse, overseas press(2005)
6. Nanotechnology: A Gentle introduction to the next big idea, Mark A.Rather, Daniel Rather, Mark Rather, prentice Hall PTR; 1<sup>st</sup> edition (2002)
7. Robert W. Kel Sall, Mark Geoghenan, In W.Hamley, Nano Scale Science and technology, John Wiley and sons, 2005 ISBN 0470850868.
8. Recent advances in the liquid phase synthesis of inorganic nanoparticles Brain L.Cushing, Valdimir L. Kolesnichenko, Charles J.O\* Connor, Chem Rev 104 (2004)3893-3946.
9. Nano composite science and technology, Palical M.Ajayan, Linda S.Schadles, Paul V. Braues, Wiley-VCH Verlag Weileim(2003).
10. [www.eng.vcedu/Ngbeaucag/calsses/XRD/Neutron\\_diffraction\\_at\\_LNL.pdf](http://www.eng.vcedu/Ngbeaucag/calsses/XRD/Neutron_diffraction_at_LNL.pdf)
11. Nano particles as Drug Carriers, Edited by Vladimir P.Torchilin, Imperial college press, North Einstein university, USA (2006), ISBN1-86094-630-5.
12. Magnetic materials: Fundamental and device applications Nichola. Ann spaldin, Cambridge University PRESS (2003) ISBN 0521016584
13. Robert W.Kelsall, Mark Geohegan, Ian W.Hamlt, Nano Scale and Technology, John Wiley and sons,2005 ISBN 0470850868
14. Ultra thin magnetic structure III – Fundamentals of nano magnetism Jac B 1 and B. Heinrich, springer (2004) ISBN 3540219536.
15. Magnetic materials: fundamentals and device applications Nicola Ann Spaldin, Cambridge University press (2003) ISBN 051016584
16. Bionanotechnology : Lessons from nature by : Davids Good Sell, Wiley- Liss(2004)
17. Nanobionanotechnology : Protocols, Sadra J. Rosenthal, David W.Write. Series: methods in molecular biology (2005)
18. John N.Helbert “ Hand books of VLSI microlithography” moyer publication, USA 2004.
19. James R. Sheats and Bruce W. Amith, “Microlithography Science and Technology”- Marcell, Dekkar INC new York, 1998.
20. Nano electronics and Nanosystems: from transistors to molecular devices K. Gosser, P. Glosekolter , J. Deinstall. Springer (2004).

## **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 :**

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

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

#### **UNIT V :**

Chemotherapy; Introduction-Classification of drugs-applications of sulpha drugs, anti materials 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 dipole moment 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 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 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 H<sub>2</sub>/Br<sub>2</sub> reaction.

Kinetics of photochemical reactions. Absorption of light and photochemical process. The Stark-Einstein law of photochemical equivalence. Photochemical chain reaction H<sub>2</sub>/Br<sub>2</sub> reaction. Quantum yield of photochemical reactions. Comparison of thermal & photochemical kinetics of H<sub>2</sub>/Br<sub>2</sub> 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. Mughergee, 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-Wesly 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 2<sup>nd</sup> 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.Maroon 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 carbon tetra chloride and Water.
2. Determination of rate constant of acid-catalysed hydrolysis of an ester (Methyl acetate or Ethyl acetate).
3. Determination of Kf / molecular weight by Rasts macro method-Naphthalene, Diphenyl and diphenylamine.
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.

**CORE XVI - PRACTICAL FOR ELECTIVE SUBJECTS  
V AND VITH 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 chromate (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<sup>+++</sup> with Ammonium thiocyanate.  
(b) Estimation of Ni as Nickel Dimethyl glyoxime.  
(c) Estimation of Cu<sup>++</sup> by K<sub>4</sub>Fe (CN)<sub>6</sub>

**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**

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. Kadolph, 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..

**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 :**

Introduction to dyeing : Theory of Colour, chromophore, auxochrome, chromogen. Primary and Secondary colour. Chromatic and Achromatic Colours – Classification of dyes. Definition – Affinity, Substantivity, Exhaustion, % Shade, Adsorption, Diffusion, Aggregation, Migration – Effects of M:L ratio, salt, time and temp. of dyeing. Properties of direct dyes – Application of direct dyes of Cotton : Mechanism of dyeing. Stripping and Redyeing. After treatment with  $\text{CuSO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$  and dye fixing agents.

**UNIT II :**

Reactive dyes – properties, Cold Brand, Hot Brand, Vinyl sulphone dyes, LS dyes, HE dyes, bifunctional dyes, Mechanism of dyeing. Exhaust dyeing, pad-batch, pad-steam, pad-cure, pad-silicate Methods. Stripping and redyeing.

**UNIT III :**

Naphthols and Fast Bases : properties and application – Diazotisation and coupling. Brief study on dissolution (classification of naphthols, cold and hot dissolution methods). Bases – direct and indirect method of diazotization. Application procedure of any one naphthols and base using Jigger and pad-dry-develop method. Stripping and Redyeing.

**UNIT IV :**

Types of Vat dyes. Details of vatting, dyeing, oxidation and soaping. Application procedure : Leuco vat, vat acid – pigment padding – pad steam process. Merits and demerits of above methods. Dyeing of yarn with vat dyes by conventional method.

**UNIT V :**

Brief study – solubilised vat dyes – properties – advantages and disadvantages over vat dyes – application – exhaust dyeing method. Sulphur dyes – Properties of Sulphur dyes – application. Jigger and continuous dyeing defects. Bronziness and acid tendering – Stripping and redyeing. Use of hydros. Properties of basic dyes mordants used for cotton. Dyeing wool & silk with basic dyes. Eco-friendly sulphur dyeing. Acid dyes – Properties, classification of

dyes – leveling acid dyes, milling acid dyes – supermilling acid dyes – application to wool and silk. Mechanism of dyeing – Dyeing of nylon with acid dyes.

### Reference

1. Shenai V.A., Technology of Textile Processing Vol. 2, Chemistry of Dyes and Principle of Dyeing Ed. 3, 1983, Sevak Publication, 306, Sri Hanuman Industrial Estate, GC Ambedkar Road, Wadala, Bombay 400 031.
2. Shenai V.A., Technology of Textile Processing Vol. 1, Technology of Dyeing, 1980 and Sevak Publication, 306, Sri Hanuman Industrial Estate, GC Ambedkar Road, Wadala, Bombay 400 031.
3. Trotman E.R., Dyeing and Chemical Technology of Textile Fibre, Charles Griffin & Co, 42, Dhury lane, London WC2.
4. Chakravarthy RR and Trivedi S.S., Technology of Bleaching and Dyeing of Textile Fibre Vol 1, Part 1, 1979, Mahajan Book Publi shres, Supermarket Basement, Near Nataraj Cinema, Ashram Road, Ahmedabad 380 009.
5. Gokhle S.V. and Shah.R.C., Cotton Piece dyeing, 1981, Ahmedabad Textile Industrial Research Assn. (ATIRA), PO Polytechnic, Ahmedabad 380 015.
6. Storey (Joyce), Manual of Dyes and Fabrics, 1981, Thames and Hindson, London.
7. Srivastava SB, Recent Process of Textile Bleaching, Dyeing and Finishig, 1981, SB Srivastava, S B P Board Consultant, S B P Buildings, 4/45 Roopnagar, Delhi 110 007.
8. Prayag R.S., The bleaching and deying of Cotton material 1983, Weaver's Service Cent., 15A, Mamparamanand Marg, Near Roxy Cinema, Bombay 400 004.
9. Achwal, Dixit Joshi and Teli, Orientation Programme in Chemical processing for Senior Executives 1991, Textile Association (India), Bombay.
10. D.M. Lewis, Wool Dyeing, SDC Publications, UK.
11. J.K.Aspland, Textile Dyeing and Colouration, AATCC Publications, USA.
12. Mc Donald, Colour Physics for Industry, SDC Publications, UK.
13. Precsten, Cellulosic Dyeing, Dyer Company Publications Ltd., London.
14. Parish et. Al., Cellulosic Dyeing, SDC Publications, UK.
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 :**

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 di oxide 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, setting 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 of wastes- Brief study on Screening, Sedimentation, Equalization, Neutralization, 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, ion exchange 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.

**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.         |   |
| 6.Light scattering             | 7.Ultra centrifugation. Molecular weight distribution |

### 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
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 CO<sub>2</sub>, 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, plaubo, LD<sub>50</sub>, ed<sub>50</sub> 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
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. Sulphanamides: 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. Psychedelic drugs LSD and marijuana.
2. Anaesthetics – Definition –Classification –volatile anaesthetics(N<sub>2</sub>O, 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 Al<sub>2</sub>P<sub>2</sub>As, Hg and Fe. Uses of the following MgSO<sub>4</sub> 7H<sub>2</sub>O, milk of magnesia, magnesium trisilicate-Aluminium hydroxide gel, dihydroxy aluminium amino acetate, Aluminium acetate and aluminium monostearate-paroxon-phosphorine, cyclophosphomide-tricyclophos-preparation and use of thiotepa-sodium and copper cacodylates-preparation and uses of aromatic arsenicals (carbosone, triparasomide, acetarsonide, neoarsphenamine, oxophenarisonce)- HgCl<sub>2</sub>, HgI<sub>2</sub> and Hg(CN)<sub>2</sub> as disinfectants-importance of organic mercury compounds-structure and uses of thiomersal, netromersal merbromine and mersalyl acid-Ferrous gluconate, FeSO<sub>4</sub>, 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-sequestrants, colouring, sweetening, flavouring, emulsifying and stabilizing agents.
3. AIDS-cause HIV-propagation-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<sub>12</sub>, folic acid).
4. Cardiovascular drugs : definition and names of two drugs for each of the following-  
cardiotonic agents-antiarrhythmic drugs-antihypertensive drugs-antianginal agents-  
vasodilators-lipid lowering agents-sclerosing agents.

#### Text and References

1. Pharmaceutical Chemistry by S. Lakshmi, Sultan Chand & Sons, 2<sup>nd</sup> ed (1998).
2. Pharmacology and pharmaceuticals, Vol.1 & 2, R.S. Satoskar and S.D. Bhandarkar 11<sup>th</sup> Ed, Popular prakashan, Mumbai, 1989.
3. Bentleys, Text book of pharmaceuticals, 8<sup>th</sup> 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 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. Factors 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, Oxidation, 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 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 :**

Synthesis, reactions and applications of Di and Triphenyl methane dyes-phthalein dyes-Xanthen dyes-acridine dyes-sulphur dyes. Phthalocyanines-Cyanine dyes. Malachite green, Para-rosaniline, 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.Mailk, 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, -theory and techniques.

#### UNIT II :

Spectroscopy: Theory, instrumentation and application of

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|--------------------------------------|---------------------------|
| (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,

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|---|--|
| (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 66               |
| (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<br>From tobacco waste          | (xiii) Tetrammine-copper sulphate          |
| (xii)As <sub>2</sub> O <sub>3</sub> Sol, Fe (OH) <sub>3</sub> Sol | (xv) Sodium thiosulphate and dithionate    |
| (xiv) Tetrammine Cobalt carbonate                                 |  |
| (xvi) 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 NO<sub>2</sub>,SO<sub>2</sub>, 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.Matetsky, Mir Publishers.
2. The Identification of Textile Fibres – Bruno Nuntak.
3. Introduction to Textile Science -3<sup>rd</sup> edition, Maryory L.Joseph.
4. Textile Chemistry –Vol.II R.H.Peters, Elsevier, Avesterdam.
5. Dyeing and chemical Technology of Textile fibres-5<sup>th</sup> 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.