

*Placed at the meeting of  
Academic Council  
held on 26.03.2018*

## **APPENDIX - BH**

# **MADURAI KAMARAJ UNIVERSITY**

*(University with Potential for Excellence)*

## **B.Sc. CHEMISTRY (SEMESTER)**

### **Revised Syllabus**

(This will come into effect from the Academic Year 2018-19)

### **COURSE SCHEME & SCHEME OF EXAMINATIONS**

#### **1. Introduction of the Programme:**

The study of science should be fascinating and enjoyable; the creation of a scientific temper in society is a must which could be achieved through proper education and guidance. To realize this goal, the curriculum should be updated by giving emphasis on various aspects such as the creativity of students, knowledge of emerging trends in the discipline, awareness of environmental impacts due to the development of science and technology, and the skills essential for handling equipments and instruments in laboratories and industries.

Chemistry, being an experimental science, demands testing theories through practical laboratory experiences for a thorough understanding of the subject. The syllabus has been prepared in a participatory manner, after discussions with all stakeholders.

Care has been taken to ensure that the syllabus is well-matched with the syllabi of other universities at the same level. Sufficient emphasis is given in the syllabus for training in laboratory skills and instrumentation. The units of the syllabus are well defined. A list of reference books as well as text books is provided at the end of each course.

#### **2. Eligibility for admission:**

Pass in Higher Secondary Examination with Chemistry, Physics and Mathematics/Zoology as core subjects or any other examination accepted by the Syndicate of Madurai Kamaraj University as Equivalent

**2.1 Duration of the Course : 3 Years**

**2.2. Medium of Instructions : English / Tamil**

#### **3. Objectives of the Programme:**

1. To impart fundamental knowledge in the field of Chemistry
2. The theory and practical aspects of the subject augment the ability of the learner to understand the implications of scientific and technical approaches involved in the domain of knowledge

3. To mould the learner into a prospective skillful scientific workforce for the future
4. Study of Skill based papers and Industrial visit help mutual collaboration

#### 4. Outcome of the programme

A candidate after successfully completing the B.Sc degree in Chemistry becomes eligible:

- i. to pursue post graduate course in various branches of chemistry
- ii. to appear in UPSC and other competitive examinations
- iii. to get employment opportunities in chemical industries like sugar factory, paper industry, tanneries etc
- iv. can become an entrepreneur by setting up small scale industries.

#### 5. Core Subject Papers

Core Subject	Semester	Subject / Title of the Paper
CS1	I	General Chemistry
CS2	II	Organic Chemistry I
CS3	III	Physical Chemistry I
CS4	IV	Inorganic Chemistry
CS5	V	Organic Chemistry II
CS6	V	Physical Chemistry II
CS7	V	Inorganic, Analytical and Applications of Computers in Chemistry
CS8	VI	Organic Chemistry III
CS9	VI	Physical Chemistry III
CS10	VI	Applied Chemistry

#### 6. Skill based course

Skill based Subject	Semester	Subject / Title of the Paper
SB1	I	Introduction to Chemistry Laboratory Techniques
SB2	I	Sugar and Paper Industries
SB3	II	Perfumes and Cosmetics
SB4	II	Leather and Textile Chemistry
SB5	V	Nanotechnology and Green Chemistry
SB6	VI	Medicinal Chemistry

### 7. Non Major Elective (offered by Chemistry Department for other major Students)

Skill based Subject	Semester	Subject / Title of the Paper
NME1	I	Industrial Chemistry
NME2	II	Drugs and Cosmetics

### 8. Unitization

Each paper is divided into 5 units. For core papers (total 60 hours) each unit has to be taught for 12 hours and for skill based, non major elective, environmental studies and value education papers (total 30 hours) each unit has to be taught for 6 hours.

### 9. Pattern of Semester Examinations

The course consists of SIX semesters. For the Theory papers of I/III/V semesters, examinations are held in NOVEMBER/ DECEMBER and for II/IV/VI semesters in APRIL/MAY months.

For Practical papers examinations are usually held in MARCH/ APRIL

### 10. Scheme for Internal Assessment:

Test	10 Marks (average of the best two tests)
Assignment	5 Marks
Seminar/ Group discussion	5 Marks
Peer-Team –Teaching*	5 Marks
Total	25 Marks

\*A minimum of 10% of the syllabus of all subjects shall be through the peer-team-teaching method by appropriate allocation of teaching hours

### 11. External Exam

External Examination –Maximum 75 marks

### 12. QUESTION PAPER PATTERN

Time 3 Hours

Max. Marks 75

Section	Question type	Number of questions to be answered	Marks for each question	Total Marks
A Q. No. 1 - 10	10 Objective questions(Two from each unit) Choose the correct answer from given choices a, b, c and d	10	1	10
B Q. No. 11 - 15	5 Either or type questions (One from each unit with internal choice)	5	7	35
C Q No.16 - 20	Descriptive (One from each unit)	3	10	30

### 13. Scheme of evaluation:

The University constitutes a panel of examiners on the basis of seniority. The senior most teacher shall act as the Chairman of valuation board. There shall be Chief examiners and Additional examiners under him. Each Chief examiner shall revalue 50% of papers valued by additional examiners. The Scheme of Valuation will be strictly adhered.

Candidates who pass all the examinations prescribed for the course in the first attempt and within a period of three academic years from the year of admission to the course alone are eligible for University Ranking.

### 14. Passing minimum

A candidate has to secure a minimum of 40 marks out of 100 marks for passing a paper. (External: Minimum 27 out of 75 marks for theory papers; Minimum of 21 out of 60 marks in the practical papers)

Note: There is no passing minimum for internal assessment marks.

#### 14.1. Classification

Those candidates who secure 75% and above marks shall be declared as passed in First Class with distinction

Those candidates who secure 60% and above marks shall be declared as passed in First Class

Those candidates who secure 50% and above but less than 60% marks shall be declared as passed in Second Class

Those candidates who secure less than 50% shall be declared as passed in Third Class

### 15. Model question paper

#### GENERAL CHEMISTRY

**Time: 3 Hours.**  
**marks**

**Maximum: 75**

#### **SECTION-A (10 X 1 = 10 Marks)**

Answer all the questions choosing the correct answer from the options given below

- The de Broglie equation is given by  
(a)  $\lambda = h/p$  (b)  $E = hv$  (c)  $E = mc^2$  (d)  $\lambda = h/mc^2$
- Which of the following element has the highest Electronegativity?  
(a) oxygen (b) hydrogen (c) carbon (d) fluorine
- The bond between Na and Cl in NaCl is ----- in nature.  
(a) covalent (b) ionic (c) dative (d) coordinate
- The type of hybridization present in  $\text{BeCl}_2$  molecule is -----  
(a) sp (b)  $sp^2$  (c)  $sp^3$  (d)  $dsp^2$

5. Bond order in nitrogen molecule is  
(a) 1 (b) 0 (c) 3 (d) 2
6. Which of the following molecule has intra molecular hydrogen bonding?  
(a) water (b) ammonia (c) ethyl alcohol (d) salicylaldehyde
7. ----- is an example for nucleophile.  
(a)  $\text{OH}^-$  (b)  $\text{Br}^+$  (c)  $\text{NO}^{2+}$  (d)  $\text{CH}_3\cdot$
8. Carbon atom in ----- molecule is sp hybridized.  
(a) methane (b) ethane (c) acetylene (d) ethylene
9. Mathematical form of Boyles law is given by  
(a)  $PV = \text{constant}$  (b)  $V/P = \text{constant}$  (c)  $V/T = \text{constant}$  (d)  $P/T = \text{constant}$
10. According to kinetic theory of gases, kinetic energy of the molecule is directly proportional to ----- of the gas.  
(a) pressure (b) volume (c) density (d) temperature

**Section B-(5 x 7 = 35marks)**

11. (a) Discuss Bohr atom model (or)  
(b) Describe the de Broglie concept dual nature of matter particles
12. (a) What is octet rule? Write about its limitations (or)  
(b) Explain the Born – Haber cycle with an example
13. (a) What is meant by hydrogen bond? Give examples for inter and intra molecular hydrogen bonding. (or)  
(b) Compare valence bond theory and MO theory.
14. (a) Discuss the inductive effect with suitable examples (or)  
(b) Explain homolytic and heterolytic cleavage with examples.
15. (a) Discuss the reasons for deviation of gases from ideal behavior. (or)  
(b) State the law of corresponding states and derive the reduced equation of state.

**Section C-(3 x 10 = 30marks) Answer any THREE questions**

16. State modern periodic law and discuss the periodicity of any four properties.
17. Explain the VSEPR theory and discuss the structure of water and ammonia molecules.
18. Draw the molecular orbital diagram of oxygen molecule and calculate the bond order in oxygen molecule.
19. Write about the stability of carbocation, carbanion and free radicals.
20. Describe Maxwell distribution law of molecular velocities and explain the effect of temperature with a neat graphical representation.

**16. Teaching Methodology**

The following teaching methods are to be implemented for effective teaching- learning:

Chalk and Talk method, power point presentations, use of ICT based technologies, Group Discussion, Seminar, Quiz, Assignment etc

**17 & 18. List of Text Books and Reference Books**

**Mentioned below the each paper**

## 19. Re-totaling and Revaluation Provision

Students may apply for re-totaling and revaluation after declaration of result within 15 days

## 20. Transitory provision 3 + 3

The candidates who are admitted to B. Sc Chemistry course before the academic year 2018-19 shall be permitted to appear for the examinations under the old regulations for a period of three years and thereafter they have to appear in the examinations as per the existing regulations.

## 21. Websites where study materials, video lessons and text books can be downloaded:

<https://ocw.mit.edu/courses/chemistry>

[study.com/academy/course/general-chemistry-course.html/](https://study.com/academy/course/general-chemistry-course.html/)

[www.youtube.com/watch?v=k3rRr19J2F4](https://www.youtube.com/watch?v=k3rRr19J2F4)

[www.openculture.com/chemistry-free-courses](https://www.openculture.com/chemistry-free-courses)

[study.com/online\\_chemistry\\_class.html](https://study.com/online_chemistry_class.html)

[www.collegeopentextbooks.org/textbook-listings/textbooks-by-subject/chemistry](https://www.collegeopentextbooks.org/textbook-listings/textbooks-by-subject/chemistry)

<https://www.examrace.com/CSIR/CSIR-Free-Study-Material/CSIR-Chemical-Sciences>

<https://www.university.youth4work.com> › Study-Material

[www.sparknotes.com](https://www.sparknotes.com) › SparkNotes

Semester	Part	Course	Title	Hours/Week	Credits	
I	I	Language-I Tamil/Other Lang.		6	3	
	II	English-I		6	3	
	III	Core Course-I	General Chemistry-I		4	4
		Core practical-I	Volumetric Analysis		2	
		Allied course –I*			6	4
	IV	Skill Based -I	Introduction to Chemistry Laboratory Techniques		2	2
		Skill Based-II	Sugar and Paper Industries		2	2
Non-Major Elective-I				2	2	
TOTAL				30	20	
II	I	Language-II		6	3	

		Tamil/Other Lang.				
	II	English-II		6	3	
	III	Core Course-II	Organic Chemistry-I	4	4	
		Core practical-I	Volumetric Analysis	2	2	
		Allied course –I*		6	5	
	IV	Skill Based -III	Perfumes and Cosmetics	2	2	
		Skill Based-IV	Leather and Textile Chemistry	2	2	
		Non-Major Elective-II		2	2	
TOTAL				30	23	
III	I	Language-III Tamil/Other Lang.		6	3	
	II	English-III		6	3	
	III	Core Course-III	Physical Chemistry-I		4	4
		Core practical-II	Inorganic Semi micro Analysis		2	
		Allied course –I*			6	4
		Allied course II*			6	4
TOTAL				30	18	
Semester	Part	Course	Title	Hours/Week	Credits	
IV	I	Language-IV Tamil/Other Lang.		6	3	
	II	English-IV		6	3	
	III	Core Course-IV	Inorganic Chemistry		4	4
		Core practical-II	Semi micro Analysis		2	2
		Allied course –I*			6	5
		Allied course – II*			6	5
	IV	Extension activities			1	
TOTAL				30	23	
V	III	Core Course-V	Organic Chemistry-II	4	4	
		Core Course-VI	Physical Chemistry-II	4	4	
		Core Course-VII	Inorganic, Analytical & application of computers in Chemistry	4	4	

		Core practical-III	Organic preparation & gravimetric Estimation	3	
		Core practical-IV	Organic analysis & Estimation	3	
		Core practical-V	Physical Chemistry	2	
		Allied course – II*		6	4
	IV	Skill Based-V	Nanotechnology and Green Chemistry	2	2
		Environmental studies	Environmental studies	2	2
Total				30	20
VI	III	Core Course-VIII	Organic Chemistry-III	4	4
		Core Course- IX	Physical Chemistry-III	4	4
		Core Course- X	Applied Chemistry	4	4
		Core practical-III	Organic preparation & gravimetric Estimation	3	5
		Core practical-IV	Org. analysis & Estimation.	3	5
		Core practical-V	Physical Chemistry	2	5
		Allied course – II*		6	5
	IV	Skill Based-V	Medicinal Chemistry	2	2
		Value Education	Value Education	2	2
Total				30	36

**\*For Allied Course Structure refer the curriculum of concerned subject.**

**I Semester  
Core Paper –I  
GENERAL CHEMISTRY**

Credits – 4  
Max. Marks 100  
OBJECTIVES

Hours/Week: 4  
Ext: 75 + Int: 25

1. To understand the atomic structure and various concepts regarding atomic structure.
2. To learn the periodic properties of elements and their classification.
3. To know the types of bonding in molecules
4. To understand the basic concepts in Organic chemistry
5. To learn about kinetic theory, gas laws and molecular velocities



## **UNIT 1: ATOMIC STRUCTURE AND PERIODIC TABLE**

- Bohr atom model - Bohr-Sommerfeld Model, de Broglie dual nature of electrons - Heisenberg uncertainty principle - Schrodinger equation - significance of wave functions-quantum numbers - Pauli's exclusion principle - Hund's rule - sequence of energy levels (aufbau principle).
- Modern periodic law: Long form periodic table. Periodicity in properties: Atomic and ionic radii - Ionization enthalpy - Electron affinity (electron gain enthalpy) - Electronegativity. Electronegativity scales: Pauling and Mullikan scales. Effective nuclear charge - Slater rule and its applications - Polarizing power. Diagonal relationship and anomalous behavior of first element in a group (basic idea only).
- Balancing of redox equations.(oxidation number method and electron method)

## **UNIT II: CHEMICAL BONDING I**

- Introduction - Type of bonds - Octet rule and its limitations. Ionic Bond: Factors favoring the formation of ionic bonds - Lattice energy of ionic compounds - Born-Landé equation (derivation not expected) - Solvation enthalpy and solubility of ionic compounds - Born-Haber cycle and its applications - Properties of ionic compounds - Polarization of ions - Fajan's rule and its applications.
- Covalent Bond: Lewis theory. VSEPR theory: Postulates - Applications - Shapes of  $\text{BeF}_2$ ,  $\text{BCl}_3$ ,  $\text{SnCl}_2$ ,  $\text{CCl}_4$ ,  $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{PF}_5$  -Valence Bond Theory- Coordinate bond. Hybridization: Definition and characteristics -  $sp$ ,  $sp^2$ ,  $sp^3$ ,  $dsp^3$ ,  $sp^3d^2$  hybridization and geometry with examples-. Limitations of VBT.

## **UNIT III: CHEMICAL BONDING II**

- Molecular Orbital Theory - LCAO - Bonding and anti bonding molecular orbitals - Bond order and its significance. MO diagrams of homo nuclear and hetero nuclear diatomic molecules:  $\text{H}_2$ ,  $\text{He}_2$ ,  $\text{N}_2$ ,  $\text{O}_2$ ,  $\text{F}_2$  and  $\text{CO}$  Comparison of VB and MO theories.
- Intermolecular Forces: Introduction. Hydrogen bond: Intra and inter molecular hydrogen bonds - Effect on physical properties. Induction forces and dispersion forces: Van der Waals forces, ion-dipole, dipole- dipole, ion-induced dipole, dipole-induced dipole and induced dipole-induced dipole interactions.

## **UNIT IV: FUNDAMENTALS OF ORGANIC CHEMISTRY AND ALKANES.**

- Classification, trivial and IUPAC nomenclature of organic compounds
- Cleavage of bonds: homolysis and heterolysis
- Nucleophiles and electrophiles
- Inductive, electrometric, mesomeric, hyper conjugation and steric effect.
- Stability of reactive intermediates: carbocation, carbanion and free radical
- Hybridization in methane, ethylene and acetylene.
- Alkanes: Preparation : catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis
- Reactions: Halogenation (mechanism of free radical substitution), Aromatization.

## **Unit V: KINETIC THEORY OF GASES**

- Postulates of Kinetic Theory of Gases - derivation of Boyle law, Charles law and Avogadro's law from the kinetic gas equation - reason for deviation of real gases

from ideal behavior, compressibility factor Van der Waals equation of state for real gases. Boyle temperature Law of corresponding states and reduced equation of state

- b. Maxwell Boltzmann distribution laws of molecular velocities -equation- graphical representation – (derivation not required) - Temperature dependence of these distributions. Most probable, average and root mean square velocities –numerical problems-(no derivation). Collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only). Principle of equipartition energy

### **TEXT BOOKS**

1. Satya Prakash, Advanced Inorganic Chemistry, R.D.Madan, Volume 1, 5<sup>th</sup> Edition, S. Chand and Sons, New Delhi, 2012.
2. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, 1<sup>st</sup> Multicolour Edition, S. Chand &Company, New Delhi, 2010.
3. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46<sup>th</sup> Edition, Vishal Publishing Company, New Delhi, 2013.

### **REFERENCE BOOKS**

1. S. Glasstone and D.H. Lewis, Elements of Physical Chemistry, 2<sup>nd</sup> Edition, Macmillan &Company, UK, 1962.
2. I.L. Finar, Organic Chemistry Vol. I, 6<sup>th</sup> Edition, Pearson Education, New Delhi, 2014.

## **Part IV: Skill based course - I**

### **INTRODUCTION TO CHEMISTRY LABORATORY TECHNIQUES**

Credits – 2  
Max. Marks 100

Hours/Week: 2  
Ext: 75 + Int: 25

#### **UNIT I: LABORATORY SAFETY**

Handling of concentrated acids, bases and hazardous chemicals, Safety precautions, fire hazards, safety and first aid procedures for laboratory accidents - poisoning – universal antidote.

#### **UNIT II: CONCENTRATION OF SOLUTIONS**

Avogadro number – mole concept – atomic weight, molecular weight, equivalent weight – primary and secondary standards - normality, molarity, molality, weight percentage, volume percentage, dilution from stock solutions- problems.

### **UNIT III: BASIC PRINCIPLES OF QUANTITATIVE ANALYSIS**

Condition for precipitation based on solubility and ionic product-titrimetry-principles of different acid-base titrations - indicators used in acid-base titrations- redox titrations ( $\text{MnO}_4^-$  only) – accuracy – error calculation in volumetric analysis –percentage error.

### **UNIT IV: INORGANIC QUALITATIVE ANALYSIS**

Group separation of common cations –interfering and non-interfering anions – elimination of interfering anions – test for basic anions and cations - phosphate, nitrate, sulphate, carbonate, fluoride, oxalate, chloride, borate, lead, cadmium, copper, aluminium, iron, nickel, calcium, barium, strontium, ammonium(any one test for each).

### **UNIT V: BASICS OF ORGANIC ANALYSIS**

Principle of distillation –Detection of elements – Lassaigne's test - nitrogen, sulphur, halogens – estimation of nitrogen by Kjeldahl method – estimation of halogens by Carius method - qualitative tests to identify organic functional groups – aliphatic and aromatic, test for unsaturation, phenols, aldehydes, ketones, esters, carbohydrates, amines, amides, carboxylic acids (any one test for each).

### **REFERENCE BOOKS**

1. Textbook of Organic Chemistry – P. L. Soni
2. Vogel's textbook of Practical Organic Chemistry
3. Inorganic Semi-micro Qualitative Analysis – V. V. Ramanujam
4. Elements of Analytical Chemistry – R. Gopalan, P.S. Subramanian, K. Rengarajan

### **Part IV: Skill based course - II**

### **SUGAR & PAPER INDUSTRIES**

Credits – 2  
Max. Marks 100

Hours/Week: 2  
Ext: 75 + Int: 25

#### **UNIT I**

Sugarcane and sugar Beet - manufacture of cane sugar - extraction of juice - concentration - separation of crystals - recovery of glucose from molasses defecation.

#### **UNIT II**

Sulphitation and carbonation - testing and estimation of sugar - double sulphitation process-preparation of bagasse- use of bagasse in paper and electricity production - list of important sugar industries in India.

### **UNIT III**

Preparation of alcohol from molasses - preparation of absolute alcohol - manufacture of wine, beer, methylated spirit - power alcohol - estimation of number of hydroxyl groups.

### **UNIT IV**

Introduction to pulp - raw materials for pulp production- mechanical pulping process - debarking - sulphate pulping - black liquor recovery - sulphite pulping - red liquor recovery (outline only).

### **UNIT V**

Beating, refining, filling processes - sizing and bleaching agents, calendaring - list of important paper industries in India.

### **REFERENCE BOOK**

1. Industrial Chemistry - B. K. Sharma (Goel Publishing House)

Note: Visit to the Industry and submission of a report. For the industrial visit / Assignment 5 marks (Internal) – Contact District industrial Centre for visits.

## **Part IV: Non-Major Elective-I**

### **INDUSTRIAL CHEMISTRY**

Credits –2  
Max. Marks 100

Hours/Week: 2  
Ext: 75 + Int: 25

### **UNIT I**

Water - Hardness of water - Types - Temporary and permanent hardness - removal of temporary hardness by boiling - removal of permanent hardness by Lime-Soda method and Reverse Osmosis method - Industrial implications of hard water - Drinking quality water standards - Chlorination.

### **UNIT II**

Agricultural industry - nutrients for plants - Major and Minor nutrients and their significance for plant growth- role of NPK -Urea - Super phosphate - fertilizer manufacturing units in India - Insecticides - Pesticides (chemical formula not necessary).

### **UNIT III**

Natural and synthetic rubbers - drawbacks of natural rubbers - uses of natural rubber - thermoplastics and thermosetting resins - Properties and uses of Bakelite, PVC, Teflon, nylon (Structure not necessary).

#### UNIT IV

Petroleum - refining of petroleum - chemicals from petroleum refining - natural gas - LPG - petrol - diesel - air pollution problems due to automobiles - remedial measures to control pollution.

#### UNIT V

Concept of nuclear fission - nuclear fuels - chain reaction - power generation from nuclear power plants - nuclear power plants in India - nuclear waste disposal and hazards - nuclear fusion.

#### REFERENCE BOOKS

1. Industrial Chemistry - B. K Sharma
2. Applied Chemistry - K. Bagavathi Sundari,
3. Engineering Chemistry - Jain and Jain

### II Semester

#### Core Paper –II ORGANIC CHEMISTRY I

Credits –4  
Max. Marks 100

Hours/Week: 4  
Ext: 75 + Int: 25

#### OBJECTIVES

##### Objectives

1. To learn preparation and reactions of alkenes and alkynes
2. To study aromaticity and mechanism of certain reactions
3. To understand the chemistry of polynuclear hydrocarbons
4. To learn the preparation and reactions of halide based functional groups.
5. To learn the concept of stereochemistry

#### UNIT I: ALKENES AND ALKYNES

- a. Preparation of alkenes: dehydration of alcohols, dehydrohalogenation of alkyl halides, Saytzeff rules, partial dehydrogenation of alkynes. Reactions: addition of HX (Markownikoff's rule and anti Markownikoff's rule), ozonolysis, addition of halogen (mechanism of electrophilic addition), oxidation with Bayer's reagent, hydroboration.
- b. Dienes: conjugated, isolated and cumulative dienes with example, preparation from alkenes, reactions: Diels-Alder reaction and polymerization.
- c. Alkynes: preparation: Acetylene from  $\text{CaC}_2$ , dehalogenation of tetra halides and Dehydro halogenation of vicinal-dihalides. Reactions: formation of acetylides, ozonolysis, oxidation reactions and addition of bromine.

#### UNIT II: AROMATIC HYDROCARBONS

- a. Aromaticity, Huckel's rule, Structure of benzene (M.O model)

- b. Preparation of benzene from phenol, acetylene and by decarboxylation. Reactions: Electrophilic substitution reaction- mechanism of nitration, sulphonation, halogenations, Friedel-Crafts alkylation and acylation
- c. Directive influence of substituents based on electronic effects.
- d. Preparation of toluene, xylene, and mesitylene

### **UNIT III: POLY NUCLEAR HYDROCARBONS, CYCLOALKANES AND CONFORMATION**

- a. Preparations and reactions of biphenyl, naphthalene, anthracene and phenanthrene
- b. Cyclo alkanes: Preparation using Dickmann's method, Freund's method and reduction of hydrocarbons
- c. Bayer's strain theory and theory of strain less rings
- d. Conformational Analysis: Fischer, Saw-horse and Newman projection formula- Difference between configuration and conformation
- e. Conformational analysis of ethane, n-butane, 1,2-dichloroethane, cyclohexane and mono substituted cyclohexane

### **UNIT IV: ALKYL AND ARYL HALIDES**

- a. Alkyl halides: Preparation from alkenes and alcohols, Reactions: Types of nucleophilic Substitution reactions ( $S_N^1$ ,  $S_N^2$  mechanism), hydrolysis, alkyl nitrate and nitroalkane- preparation, reaction with ammonia, elimination reactions ( $E_1$  and  $E_2$  mechanism).
- b. Aryl halides; Preparation from phenol, Sandmeyer's reaction, substitution by OH-Group (nucleophilic bimolecular mechanism) and by  $NH_2$  group (Benzyne mechanism)
- c. Poly halogen derivatives: Preparation and applications of Westron and Freon

### **UNIT V: STEREO CHEMISTRY**

- a. Geometrical Isomerism: Maleic acid and fumaric acids, aldoximes and ketoximes, Determination of configuration of geometrical isomers, E-Z notation.
- b. Optical activity, specific rotation, asymmetric centre, chirality, achiral molecules, Elements of symmetry, resolution of racemic mixtures, Walden inversion,
- c. Asymmetry synthesis, specification of R-S notations. Optical activity of compounds without asymmetric carbon atoms: Allenes, spiranes and biphenyl compounds

### **TEXT BOOKS**

1. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, 1<sup>st</sup> Multicolour Edition, S. Chand & Company, New Delhi, 2010.
2. S.C. Sharma and M.K. Jain, Modern Organic Chemistry, Vishal Publishing Company, New Delhi, 2014.
3. K.S. Tewari, N.K. Vishnoi and S.N. Mehrotra, A Textbook of Organic Chemistry, 2<sup>nd</sup> Edition, Vikas Publishing House (Pvt.) Ltd., New Delhi, 2004.

## REFERENCE BOOKS

1. Jerry March, Advanced Organic Chemistry, 5<sup>th</sup> Edition, John Wiley and Sons, New York, 2004
2. I.L. Finar, Organic Chemistry Vol. I, 6<sup>th</sup> Edition, Pearson Education, New Delhi, 2014.
3. E.L. Eliel, Stereochemistry of Carbon Compounds, Tata McGraw Hill Publishing Company Ltd, New Delhi, 1992.

## Part IV: Skill based course - III **PERFUMES AND COSMETICS**

Credits –2

Max. Marks 100

Hours/Week: 2

Ext: 75 + Int: 25

### **UNIT I: NATURAL PERFUMES**

Perfumes –plant and animal sources– examples –components of perfume – vehicle – characteristics of good vehicle -fixatives and its types, odoriferous compounds, extraction of essential oils by distillation, enfleurage and solvent extraction methods.

### **UNIT II : ARTIFICIAL PERFUMES AND FLAVORS**

Preparation and uses of methyl anthranilate, methyl salicylate, methyl cinnamate, phenyl ethanol, citronellol, vanillin, coumarin and heliotrope.

### **UNIT III: COMPOSITION AND MANUFACTURE OF PERFUMERY COMPOUNDS**

Rose and Jasmine – Composition and preparation of rose and jasmine perfumes –manufacture of fruit flavors – fruit syrup preparation and composition of apple and pineapple flavors.

### **UNIT IV: SOAPS AND DETERGENTS**

Cleansing action of soap – differences between soap and detergents – ingredients of washing and bathing soap – TFM of bathing soap – composition of solid and liquid detergents – functions of ingredients in detergents.

### **UNIT V: COSMETICS AND PERSONAL HYGIENE PRODUCTS**

Characteristics of good cosmetics – demerits of artificial cosmetics –basic composition of talcum powder – face cream – nail polish – hair dye – toothpaste – mouthwash (Composition only)

## REFERENCE BOOKS

1. Industrial Chemistry – B. K Sharma
2. Textbook of cosmetics – Rajesh Kumar Nema, Kamal Singh Rathore, Balkrishna Dubey
3. Manufacture of perfumes, cosmetics, detergents –Gir Raj Prasad (from Small Industry research Institute)

**Part IV: Skill based course -IV**  
**LEATHER AND TEXTILE CHEMISTRY**

Credits –2  
Max. Marks 100

Hours/Week: 2  
Ext: 75 + Int: 25

**UNIT I: INTRODUCTION**

Structure and composition of animal skin-Terminology involved in leather tanneries-chemistry of beam house processes-soaking, liming, unhairing, deliming, bating and pickling-preservation of animal skin-salt curing and brine curing.

**UNIT II: MATERIALS AND METHODS OF TANNING**

Vegetable tans- catechol tans- pyrogallol tans-vegetable tanning process and applications of vegetable tanned leather-Chrome tanning-chemicals used-method-type of leather obtained and its uses-aldehyde tanning- Artificial leather- Corfam-synthetic tans

**UNIT III: POLLUTION AND TREATMENT OF TANNERY EFFLUNT**

Various finishing process in tanneries – drying - bleaching - fat liquoring - dyeing-calendaring. Pollution caused by leather tanneries-Treatment of tannery effluents-primary, secondary and tertiary treatment.

**UNIT IV: TEXTILE FIBRES**

Classification of textile fibres - differences between cellulosic and synthetic fibres - identification of fibres by burning and solubility tests - chemical structure, physical and chemical properties of cotton, wool, silk - chemical structure - physical and chemical properties of cotton, wool, silk

**UNIT V: BLEACHING, DYEING & FINISHING**

Bleaching of cotton fabrics - peroxide bleaching - hypochlorite bleaching - dyeing of cotton with vat dyes -dyeing of wool with acid dyes - dyeing of polyester with disperse dyes - textile finishing - mercerization - water repellent and waterproof finish.

**REFERENCE BOOKS**

1. Textile fibres - R. S.Prayag
2. Industrial Chemistry - B. K Sharma GOEL publishing
3. Technology and Textile Finishing - V. A. Shenai
4. Fundamental concepts of Applied Chemistry by Jayashree Ghosh, S. Chand &Company



**Part IV: Non-Major Elective - II**  
**DRUGS AND COSMETICS**

Credits-2  
Max. Marks 100

Hours/Week:2  
Ext: 75 + Int: 25

**UNIT I**

Significance of drugs - lethal dosage - bacteria - types of bacteria - gram positive - gram negative - examples - viruses - differences between bacteria and virus - fungi - drawbacks of drugs.

**UNIT II**

Analgesics - types - narcotic and non-narcotic analgesics - salicylate - ibuprofen (structure not necessary) antipyretics - paracetamol (structure not necessary). Vitamins - types - functions of A, B6, B12, C, D, E vitamins only (structure not necessary).

**UNIT III**

Antibiotics - types - broad and narrow spectrum antibiotics - tetracycline - rifomycin only (structure not necessary) - mechanism of drug action (PABA) - antimalarial drugs - quinine only (structure not necessary).

**UNIT IV**

Preparation of washing powder - cleaning powder - white, black, yellow colored phenoyls.

**UNIT V**

Characteristics of good cosmetics – demerits of artificial cosmetics - preparation shampoo, bathing soap, basic composition of face powder.

**REFERENCE BOOKS**

1. Pharmaceutical Chemistry - Lakshmi
2. Medicinal Chemistry - Gurdeep R. Chatwal
3. Medicinal Chemistry - Albert Burger
4. Textbook of cosmetics – Rajesh Kumar Nema, Kamal Singh Rathore, Balkrishna Dubey

**PRACTICAL - I**  
**VOLUMETRIC ANALYSIS**  
(Examination at the end of II semester)

Credits -2  
Max. Marks 100

Hours/Week: 2  
Ext: 75 + Int: 25

**Objectives**

1. To enable the students to acquire the quantitative skills in volumetric analysis.

2. At the end of the course, the students should be able to plan experimental projects and execute them.

### I ACIDIMETRY AND ALKALIMETRY

1. Estimation of HCl.
2. Estimation of oxalic acid.
3. Estimation of sodium carbonate
4. Estimation of sodium hydroxide

### II REDOX TITRATIONS

#### A. PERMANGANOMETRY

1. Estimation of Ferrous ion
2. Estimation of oxalic acid

#### B. DICHROMETRY

1. Estimation of ferrous ion
2. Estimation of ferric ion using external indicator

### III IODOMETRY AND IODIMETRY

1. Estimation of potassium dichromate
2. Estimation of potassium permanganate
3. Estimation of copper sulphate
4. Estimation arseneous oxide

### IV ARGENTIMETRY

1. Estimation of potassium chloride

### V COMPLEXOMETRIC TITRATION

- a. Estimation of hardness of water using EDTA (demonstration only)

#### **Scheme of evaluation (Max. marks 100)**

#### **Internal Assessment 40 Marks**

<b>Regularity</b>	<b>20 Marks</b>
<b>Class Test</b>	<b>15 Marks</b>
<b>Observation Note</b>	<b>5 Marks</b>
<b>Total</b>	<b>40 Marks</b>

#### **External Examination: 60 Marks (3 hours)**

<b>Record Note Book</b>	<b>10 Marks</b>
<b>Procedure</b>	<b>15 Marks</b>
<b>Estimation</b>	<b>35 Marks</b>
<b>Total</b>	<b>60 Marks</b>
<b>&lt; 3 %</b>	<b>35 Marks</b>
<b>3 - 4%</b>	<b>25 Marks</b>
<b>4- 5%</b>	<b>20 Marks</b>
<b>&gt; 5%</b>	<b>10 Marks</b>

**III SEMESTER  
CORE PAPER –III  
PHYSICAL CHEMISTRY I**

Credits –4  
Max. Marks 100  
OBJECTIVES

Hours/Week: 4  
Ext: 75 + Int: 25

1. To understand the properties of matter
2. To know the structure and types of solids
3. To learn the characteristics and applications of colloids
4. To understand the principles of adsorption and catalysis
5. To learn about electrical conductance and ionic equilibria.

**UNIT I: PROPERTIES OF MATTER**

- a. Intermolecular forces in liquids-Trouton's rule and significance- Surface tension and Viscosity of a liquid and Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)
- b. Electrical properties: dipole moment -electrical polarization of dielectrics and polarisability –Applications of dipole moment studies - estimation of ionic character, calculation of bond moments, distinguishing geometrical isomers and o-, m-, p-isomers
- c. Magnetic properties: Magnetic permeability, specific susceptibility, atomic and molar susceptibilities – dia-, para- and ferromagnetism – measurement of susceptibility by Gouy's method

**UNIT II: SOLID STATE**

- a. Types of solids. Symmetry in crystals, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices.
- b. X-Ray diffraction by crystals, Bragg's law- determination of crystal structure – rotating crystal method- powder method- Structures of NaCl, KCl and CsCl (qualitative treatment only). Types of crystals-structure of diamond, graphite and ice. Frankel and Schotky defects in crystals.
- c. Liquid crystals – theory and applications.

**UNIT III: COLLOIDAL STATE**

- a. Colloids -Distinguishing characteristics of colloids, suspensions and solutions- Types of colloidal dispersions
- b. Optical properties-Tyndall effect– Kinetic properties – Brownian motion-Electrical properties–Helmholtz and diffuse double layers – electro kinetic or zeta potential – electrophoresis and its applications
- c. Coagulation – methods of coagulation – Hardy Schultz law – Hofmeister series - Protective colloids – protective action – gold number – applications- Emulsions – classification, preparation, identification Gels – preparation – properties (thixotropy, syneresis and imbibition)

#### UNIT IV: CATALYSIS AND ADSORPTION

- a. Catalysis- characteristics- - different types-homogeneous-heterogeneous-acid-base catalysis-auto catalysis-theories of catalysis-intermediate compound formation theory and adsorption theory- kinetics of enzyme catalysis - Michaelis Menton equation. – applications of catalysis
- b. Adsorption-definition-adsorbent-adsorbate-examples-difference between adsorption and absorption- factors influencing adsorption of gases on solids- physisorption and chemisorptions- - Langmuir adsorption isotherm –Applications of adsorption.

#### UNIT V: IONIC EQUILIBRIA

- a. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.
- b. Transference number and its experimental determination using Hittorf method. Ionic mobility.
- c. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt.
- d. Debye Huckle Onsegar theory.
- e. Conductometric titrations (only acid- base).

#### TEXT BOOKS

1. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46<sup>th</sup> Edition, Vishal Publishing Company, New Delhi, 2013.
2. P.L. Soni, O.P. Dharmarha and U.N. Dash, Textbook of Physical Chemistry, 23<sup>rd</sup> Edition, Sultan Chand & Sons, New Delhi, 2011.

#### REFERENCE BOOKS

1. S. Glasstone and D.H. Lewis, Elements of Physical Chemistry, 2<sup>nd</sup> Edition, Macmillan & Company, UK, 1962.
2. W.J. Moore, Physical Chemistry, 5<sup>th</sup> Edition, Orient Longman, London, 1999.

### SEMESTER IV CORE PAPER –IV INORGANIC CHEMISTRY

Credits –4  
Max. Marks 100

Hours/Week: 4  
Ext: 75 + Int: 25

#### OBJECTIVES

1. To understand the concept of nuclear chemistry and its applications
2. To learn the characteristics d and f-block elements
3. To understand the principles metallurgy
4. To know the properties and theories about coordination compounds
5. To learn about carbonyls, silicates and their applications

### **UNIT I: NUCLEAR CHEMISTRY**

- a. Nuclear transmutations-Theory of Nuclear reactions- Comparison of nuclear and chemical reactions - subatomic particles, structure of the nucleus-shell model, liquid drop model; Forces in the nucleus-mesons
- b. Stability of nucleus-n/p ratio, mass defect and binding energy.
- c. Types of nuclear reactions-spallation- nuclear fission- theory of nuclear fission- chain reaction, critical mass-atom bomb- nuclear reactors-fast breeder reactors, fuels used in nuclear reactors, moderators, coolants; nuclear fusion- hydrogen bomb- nuclear reactors in India- Stellar energy
- d. Applications of radioactive isotopes in the field of medicine, agriculture, industry and elucidation of reaction mechanism

### **UNIT II: TRANSITION AND INNER TRANSITION ELEMENTS**

- a. Transition Metals: General characteristics: Metallic character, oxidation states, size, density, melting points, boiling points, ionization energy, color, magnetic properties, reducing properties, catalytic properties, non-stoichiometric compounds, complex formation and alloy formation. Difference between first row and other two rows. Preparation, properties, structure and uses of  $\text{KMnO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$ .
- b. Lanthanides: Electronic configuration and general characteristics – Occurrence of lanthanides — Isolation of lanthanides from monazite sand - Separation by ion-exchange method. Lanthanide contraction: Causes and consequences. Industrial importance of lanthanides.
- c. Actinides: Electronic configuration and general characteristics – Comparison with lanthanides

### **UNIT III: METALLURGY**

- a. Occurrence of metals based on standard electrode potential – Concentration of ores – Calcination and roasting - Reduction to free metal – Electrometallurgy – Hydrometallurgy.
- b. Refining of metals: Electrolytic refining, ion exchange method, zone refining, vapour phase refining and oxidative refining
- c. Ellingham diagrams for metal oxides - Extractive metallurgy of Al, Fe, Ni, Cu and Ti.
- d. Alloys: Definition- Composition and uses of German silver, brass, bronze, gunmetal and alnico.

### **UNIT IV: COORDINATION CHEMISTRY**

- a. Introduction - Types of ligands – Anionic, cationic and neutral complexes – IUPAC nomenclature -Structural and stereo isomerism in coordination compounds.
- b. Bonding theories- Werner's theory and Sidgwick's concept of coordination – EAN rule -Valence bond theory - Geometries of coordination numbers 4 and 6 – Limitations of VBT. Crystal field theory - Splitting of *d*-orbitals in octahedral, tetrahedral, tetragonal and square planar complexes –Factors affecting crystal field splitting - CFSE of low spin and high spin octahedral complexes -Spectrochemical series - Explanation of geometry, magnetism and colour - Merits and demerits of Crystal field theory.

## UNIT V: METAL CARBONYLS, CARBIDES, INTERCALATION COMPOUNDS AND SILICATES

- Bonding and structure of Fe, Co, Ni and Cr carbonyls
- Metal Carbides –types-preparation and applications.
- Intercalation compounds of graphite-preparation-properties and uses
- Silicates-types-structure-mica, beryl, clay, zeolite and quartz

### TEXT BOOKS

- B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, 31<sup>st</sup> Edition, Milestone Publishers and Distributors, New Delhi, 2013.
- Satya Prakash, Advanced Inorganic Chemistry, R.D. Madan, Volume 1, 5<sup>th</sup> Edition, S. Chand and Sons, New Delhi, 2012.
- R. Gopalan, Text book of Inorganic Chemistry, Universities Press India Ltd., Hyderabad, 2012.
- C.N.R. Rao, Understanding Chemistry, Universities Press India Ltd., Hyderabad, 2011.

### REFERENCE BOOKS

- J.E. Huheey, E.A. Keitler and R.L. Keitler, Inorganic Chemistry – Principles of Structure and Reactivity, 4<sup>th</sup> Edition, Pearson Education, New Delhi, 2013
- F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 6<sup>th</sup> Edition, Wiley India Pvt.Ltd., New Delhi, 2009 (Reprint).

## PRACTICAL - II INORGANIC SEMI MICRO QUALITATIVE ANALYSIS (Examination at the end of IV semester)

Credits –2  
Max. Marks 100

Hours/Week: 2  
Ext: 75 + Int: 25

### Objectives

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

### Semi micro qualitative analysis:

- Training sessions for three classes: Mixture of anions containing an interfering anion and its elimination technique. Mixture of cations of simple radicals to familiarize with the inter group separation techniques.
- Semi micro qualitative analysis of inorganic salt mixtures containing two anions (one interfering) and two cations.
- Simple anions: carbonate, nitrate, sulphate, sulphide, sulphite, chloride and bromide.
- Interfering anions: borate, fluoride, oxalate, phosphate, arsenite and chromate.
- Cations:
  - Group I cations: lead
  - Group II cations: lead, copper, cadmium, bismuth, antimony and tin.
  - Group III cations: aluminium, ferrous, ferric and chromium.

- d. Group IV cations: cobalt, nickel, manganese and zinc.
- e. Group V cations: barium, strontium and calcium
- f. Group VI cations: magnesium and ammonium.

**Scheme of evaluation: (Max. Marks 100)**

**Internal Assessment 40 Marks**

<b>Regularity</b>	<b>20 Marks</b>
<b>Class Test</b>	<b>15 Marks</b>
<b>Observation Note</b>	<b>5 Marks</b>
<b>Total</b>	<b>40 Marks</b>

**External Examination: 60 Marks (3 Hours)**

<b>Record Note Book</b>	<b>10 Marks</b>
<b>Reporting 4 ions with procedure 4 x 12.5</b>	<b>50 Marks</b>

**V SEMESTER  
CORE PAPER –V  
ORGANIC CHEMISTRY II**

Credits –4  
Max. Marks 100  
OBJECTIVES

Hours/Week: 4  
Ext: 75 + Int: 25

1. To study the preparation and reactions of hydroxyl compounds
2. To learn the chemistry of ethers, aldehydes and ketones
3. To understand the chemistry of carboxylic acids
4. To know the properties and structure of carbohydrates
5. To learn about nitrogen containing compounds.

**UNIT I: HYDROXY COMPOUNDS**

- a. Alcohols: Preparation of alcohols from Grignard reagent, by reduction of carbonyl compounds, by ester hydrolysis, and by hydroboration - Reactions: with metals, HX, dehydration, oxidation reactions.
- b. Phenols: Classification and nomenclature, Preparation: From sulphonic acids and Diazonium salts. Reactions: Acidity, effect of substituents on the acidity of phenol - Reimer-Tiemann reaction, Electrophilic Substitution reactions: Nitration, halogenation, sulphonation - Hoesch reaction, Kolbe reaction, Schotten-Baumann reaction.
- c. Preparation and properties of Naphthols and alizarin

## UNIT II: ETHERS, ALDHYDES AND KETONES

- Aliphatic and aromatic ethers: Preparation by Williamson's synthesis (mechanism), Reactions: cleavage by acids.
- Aliphatic and aromatic aldehydes and ketones: Preparation from acid chloride and nitrile, Reactions: with HCN, ROH, and Iodoform test
- Mechanism of Cannizzaro, Perkins, Claisen, Benzoin condensation, Knoevenagel MPV reduction.
- Preparation and uses of Cinnamaldehyde and Vanillin.
- Keto-enol tautomerism (Acid and base catalyzed mechanism)

## UNIT III: CARBOXYLIC ACIDS

- Carboxylic acids (aliphatic and aromatic): Preparation: from carbonyl compounds, hydroxyl compound and cyanide. Reactions: decarboxylation, substitution in alkyl group of aliphatic and aromatic acids.
- Effect of substitution on acidity of aromatic acids
- Preparation of oxalic, malonic, succinic, glutaric, adipic and phthalic acids.
- Preparation of cinnamic acid, coumarin, salicylic acid, anthranilic acid and mandelic acid.

## UNIT IV: DERIVATIVES OF ACIDS AND CARBOHYDRATES

- Preparation of acid chloride, anhydride, ester and amides from acids. Reactions: Acidic and alkaline hydrolysis of ester (mechanism) and trans esterification
- Carbohydrates: Classification, Glucose and Fructose (open chain and cyclic Structure), ascending and descending in monosaccharide, Muto Rotation, Structure of disaccharides- sucrose and maltose - Polysaccharides - starch and cellulose (structure only).

## UNIT V: NITROGEN CONTAINING ORGANIC COMPOUNDS

- Aliphatic and aromatic Nitro compounds: Preparation by nitration, Reactions: reduction by chemical and electrolytic methods.
- Synthesis o-,m-,and p- dinitro benzenes and trinitro benzenes
- Amines(aliphatic and aromatic): Preparation from alkyl halides ,Preparation of primary, secondary and tertiary amines, Preparation of aniline and benzylamine , Reactions: effects of substituents on the basic character of amines, reactions in aniline and benzylamine
- Preparation and synthetic applications of benzene diazonium chloride
- Preparation and properties of naphthylamines.

## TEXT BOOKS

- A. Bahl and B.S. Bahl, Advanced Organic Chemistry, 1<sup>st</sup> Multicolour Edition, S. Chand & Company, New Delhi, 2010.



2. S.C. Sharma and M.K. Jain, Modern Organic Chemistry, Vishal Publishing Company, New Delhi, 2014.
3. K.S. Tewari, N.K. Vishnoi and S.N. Mehrotra, A Textbook of Organic Chemistry, 2<sup>nd</sup> Edition, Vikas Publishing House (Pvt.) Ltd., New Delhi, 2004.

#### REFERENCE BOOKS

1. Jerry March, Advanced Organic Chemistry, 5<sup>th</sup> Edition, John Wiley and Sons, New York, 2004
2. I.L. Finar, Organic Chemistry Vol. I, 6<sup>th</sup> Edition, Pearson Education, New Delhi, 2014.
3. R.T. Morrison, R.N. Boyd, Organic Chemistry, 7<sup>th</sup> Edition, Pearson Education, New Delhi, 2013

### CORE PAPER –VI PHYSICAL CHEMISTRY II

Credits –4  
Max. Marks 100

Hours/Week: 4  
Ext: 75 + Int: 25

#### OBJECTIVES

1. To learn the first law of thermodynamics and its applications
2. To understand second law of thermodynamics, entropy and free energy
3. To know the concept of thermodynamic equilibria
4. To understand phase rule and its applications to various systems
5. To learn the fundamentals of group theory and its applications

#### UNIT I: FIRST LAW OF THERMODYNAMICS AND ITS APPLICATIONS

- a. System-surrounding-Intensive and extensive variables; state and path functions; isolated, closed and open systems-zeroth law of thermodynamics
- b. First law of thermodynamics-mathematical form- Heat capacity, relation between  $C_p$  and  $C_v$ . Isothermal process: Change in internal energy, work done,  $W(\text{rev})$  and  $W(\text{irrev})$ . Adiabatic process: work done, and entropy changes. - Application of the laws of thermodynamics to real (van der Waals) gases: Isothermal process- Work done, change in internal energy, heat absorbed. Adiabatic process: Work done
- c. Joule- Thomson effect-derivation of Joule- Thomson coefficient for ideal gases and real gases, inversion temperatures.
- d. Variation of enthalpy change of reaction with temperature (Kirchoff's equation). – Hess's law of constant heat of summation- Bond energy and heat of reaction

#### UNIT II: SECOND LAW OF THERMODYNAMICS AND ITS APPLICATIONS

- a. Second law of thermodynamics: Limitations of first law and the need for the second law. Formulation of the second law of thermodynamics on the basis of Carnot cycle- various statements of the second law of thermodynamics- Carnot theorem- Thermodynamic principle of the working of refrigerator
- b. Concept of entropy- entropy changes for physical transformations- entropy and probability.

- c. Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G and A with T, V and P - Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state. Criteria of spontaneity. Changes in S, G and A as criteria for spontaneous process
- d. Partial molar properties- Chemical potential-variation of chemical potential with temperature and pressure-Gibbs –Duhem equation

### UNIT III: THERMODYNAMICS OF EQUILIBRIUM PROCESSES

- a. Law of mass action. Various forms of equilibrium constants. Relationships between  $K_p$  and  $K_c$ ; Vant Hoff isotherm. Vant Hoff isochore. Le-Chatelier-Braun principle: Formation of ammonia.
- b. *Third Law*: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.- Nernst heat theorem
- c. Colligative properties- relative lowering of vapour pressure-Raoult's law-thermodynamic derivation of relationship between relative lowering of vapour pressure and (i)osmotic pressure, (ii)elevation of boiling point,(iii) depression in freezing point – Abnormal behavior of solutions of electrolytes

### UNIT IV: PHASE EQUILIBRIA

- a. Phase Rule: Concepts of phase, component and degrees of freedom, with examples. Gibb's phase rule – derivation.
- b. One-component system: Phase diagrams: Water and sulphur systems.
- c. Two component system: (i) Simple eutectic: Lead-silver system- Formation of compound with congruent melting point: Ferric chloride – water system.
- d. Clapeyron and Clausius-Clapeyron equations and their applications to equilibria in phase transitions. (solid – liquid, liquid – vapour, solid – vapour)

### UNIT V: GROUP THEORY

- a. Symmetry and importance of symmetry aspects -Symmetry elements and various associated symmetry operations-Definitions and examples
- b. Mathematical group – properties of a group – construction of group multiplication table (GMT) for  $H_2O$  and  $NH_3$  – Abelian and non -Abelian groups-point groups-
- c.  $C_{nv}$ ,  $C_{nh}$  and  $D_{nh}$ - symmetry present with examples – matrix representation of symmetry operations E,  $C_n$ ,  $\sigma$ ,  $S_n$  and i.

### TEXT BOOKS

- 3. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46<sup>th</sup> Edition, Vishal Publishing Company, New Delhi, 2013.
- 4. P.L. Soni, O.P. Dharmarha and U.N. Dash, Textbook of Physical Chemistry, 23<sup>rd</sup> Edition, Sultan Chand & Sons, New Delhi, 2011.

5. J. Rajaram and J.C. Kuriacose, Chemical Thermodynamics, Pearson Education, New Delhi, 2013.
6. Gurdeep Raj, Advanced Physical Chemistry, 35<sup>th</sup> Edition, Goel Publishing House, Meerut, 2009.
7. S. Swarnalakshmi, T. Saroja, R. M. Ezhilarasi, A simple Approach to Group theory in Chemistry, University Press, 2008
8. A. K. Mukherjee. B. C. Ghosh, Group Theory in Chemistry, University Press, 2018

#### REFERENCE BOOKS

1. S. Glasstone and D.H. Lewis, Elements of Physical Chemistry, 2<sup>nd</sup> Edition, Macmillan & Company, UK, 1962.
2. W.J. Moore, Physical Chemistry, 5<sup>th</sup> Edition, Orient Longman, London, 1999.
3. R.P. Rastogi and R.R. Misra, An Introduction to Chemical Thermodynamics, 6<sup>th</sup> Edition, Vikas Publishing House Pvt. Ltd., Noida, 2002.

### CORE PAPER –VII

#### INORGANIC, ANALYTICAL & APPLICATIONS OF COMPUTERS IN CHEMISTRY

Credits –4  
Max. Marks 100

Hours/Week: 4  
Ext: 75 + Int: 25

#### OBJECTIVES

1. To know the various theories of acids and bases
2. To learn the fundamentals of bioinorganic chemistry
3. To understand the importance of inorganic polymers
4. To study the analytical techniques
5. To learn the C language and its applications

#### UNIT I: ACIDS- BASE CONCEPTS AND NON- AQUEOUS SOLVENTS

- a. Arrhenius concept- Bronsted Lowry concept – Conjugate acid base pairs-relative strength of acid – base pair- Lux Flood concept- auto ionization concept – Lewis concept – leveling and differentiating effects – Usanovich concept – Hard and Soft acids – Applications of HSAB principle
- b. Non-aqueous solvents – classification – reactions in liquid ammonia – precipitation reaction – acid – base reaction – protolysis - ammonolysis

#### UNIT II: BIOINORGANIC CHEMISTRY

- a. Metallo porphyrins - Porphyrins – Chlorophyll – vitamin B<sub>12</sub> - Metal ions in biological system – Trace and bulk metal ions – Hemoglobin and myoglobin (elementary idea of structure and oxygen binding mechanism) – Chlorophyll and photosynthesis (mechanism not expected) - Sodium–potassium pump
- b. Biochemistry of Ca, Zn and Co - Toxicity of metal ions (Pb, Hg and As).

- c. Anticancer drugs: *Cis*-platin, oxaliplatin and carboplatin – Structure and significance.

### **UNIT III: INORGANIC POLYMERS**

- a. General properties of inorganic polymers – glass transition temperature
- b. Various types of silicones, preparation, properties and uses of silicones
- c. Sulphur based polymers – polymeric sulphur – polymeric sulphur nitride – preparation, properties and uses

### **UNIT IV: ANALYTICAL CHEMISTRY**

- a. Introduction – Definition – Classification - Principles and applications of column chromatography, thin layer chromatography, paper chromatography, ion exchange chromatography, - R<sub>f</sub> values
- b. Analytical chemistry in consumer protection – detection of adulterants in milk, oils, ghee, coffee powder, chilly powder and pulses – sweeteners – preservatives – flavors – colorants – pesticide residue in food.
- c. Precision – Accuracy – absolute and relative error – classification of errors – confidence limit – students Q-test – rejection of experimental data – sources and elimination of errors – significant errors and computation

### **UNIT V: APPLICATIONS OF ‘C’ LANGUAGE IN CHEMISTRY**

- a. Important features of C – structure of C program – character set of C language – key words - constants in C program – identifiers – variables and data types – operators in a C program
- b. C programs for chemistry – calculation of energy of a photon – calculation of rate constant of a zero order reaction – calculation of half-life period of a first order reaction – calculation of rms speed of a molecule – calculation of entropy change for a phase transition - calculation of molarity, molality and normality of a solution

### **TEXT BOOKS**

1. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, 31<sup>st</sup> Edition, Milestone Publishers and Distributors, New Delhi, 2013.
2. Satya Prakash, Advanced Inorganic Chemistry, R.D.Madan, Volume 1, 5<sup>th</sup> Edition, S. Chand and Sons, New Delhi, 2012.
3. R. Gopalan, Text book of Inorganic Chemistry, Universities Press India Ltd., Hyderabad, 2012.
4. Computers for Chemist by Pundir – Bansal, Pragathi Prakashan, 12<sup>th</sup> edition, 2016

### **REFERENCE BOOKS**

1. Jeffrey A. Lee, The Scientific Endeavor: A Primer on Scientific Principles and Practice, Pearson Education, 1999.
2. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, East West Press, New Delhi, 2002

3. D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, Fundamentals of Analytical Chemistry, 8<sup>th</sup> Edition, Brooks/Cole, Thomson Learning, Inc., USA, 2004.
4. J.E. Huheey, E.A. Keitler and R.L. Keitler, Inorganic Chemistry – Principles of Structure and Reactivity, 4<sup>th</sup> Edition, Pearson Education, New Delhi, 2013

#### **Part IV: Skill based course - V**

### **NANOTECHNOLOGY AND GREEN CHEMISTRY**

Credits –2  
Max. Marks 100

Hours/Week: 2  
Ext: 75 + Int: 25

#### **Unit I: INTRODUCTION TO NANO MATERIALS**

Definition of nano sized material – origin of nano technology - difference in properties between bulk and nano materials - Dimension based classification of nano materials - 0D, 1D, 2D, 3D

#### **Unit II: PROPERTIES AND SYNTHESIS OF NANO MATERIALS**

Magnetic and electrical properties of nano materials - synthesis of nano materials - basics of bottom-up and top down approach - PVD, CVD, Sol-gel, wet chemical synthesis only.

#### **Unit III: APPLICATIONS OF NANO TECHNOLOGY**

Quantum dots - fabrication - applications - CNT - synthesis and applications - application of nano materials in nano medicines and pollution control - Principle of Scanning electron microscope.

#### **Unit IV: INTRODUCTION TO GREEN CHEMISTRY**

Green chemistry and its significance- Difference between conventional chemistry and green chemistry techniques - twelve principles of green chemistry - atom economy - prevention and recycling of byproducts - limitations of green chemical techniques.

#### **Unit V: GREEN SYNTHESIS TECHNIQUES**

Green solvents, - synthesis involving basic principles of green chemistry - synthesis of adipic acid, methyl methacrylate, paracetamol – microwave assisted reactions in water- Hofmann Elimination, Hydrolysis of benzamide, Ultrasound assisted esterification - Cannizzaro reaction.

#### **REFERENCE BOOKS**

1. Textbook of Nanoscience and Nanotechnology - BS Murthy P Shankar, BaldevRaj, BB Rath, and James Murday - Orient Blackswan Private Limited - New Delhi
2. An Introduction to Nanomaterials and Nanoscience A. Das - CBS Publications
3. Nanoscience and Nanotechnology: Fundamentals of Frontiers - Shubra Singh M.S. RamachandraRao
4. A Textbook of Nanoscience and Nanotechnology - T. Pradeep
5. New Trends in Green Chemistry - V.K. Ahluwalia & M.R. Kidwai, Anamalaya Publishers.
6. An Introduction to Green Chemistry - V.Kumar Vishal Publishing Co.,

7. Green Chemistry: Greener Alternatives to Synthetic Organic Transformations - V.K. Ahluwalia
8. Environmental Chemistry - B.K.Sharma, GOEL Publishing House.

**VI SEMESTER  
CORE PAPER –VIII  
ORGANIC CHEMISTRY-III**

Credits –4  
Max. Marks 100

Hours/Week: 4  
Ext: 75 + Int: 25

**OBJECTIVES**

1. To learn the chemistry of heterocyclic compounds and alkaloids
2. To understand the concept of proteins nucleic acids and terpenes
3. To study the chemistry of dyes and know the applications of synthetic reagents
4. To learn the properties of sulphur containing compounds and the mechanism of molecular rearrangements
5. To study the application of spectral techniques to organic molecules

**UNIT I: HETEROCYCLIC COMPOUNDS AND ALKALOIDS**

- a. Heterocyclic compounds: Classification - preparation and reactions of thiophene, furan, pyrrole, pyridine, quinoine and isoquinoline.
- b. Alkaloids: Definition- occurrence and extraction of alkaloids, classification of alkaloids, structure elucidation and synthesis of the following alkaloids - conine, piperine and nicotine.

**UNIT II: PROTEINS, NUCLEIC ACID AND TERPENES**

- a. Preparation of amino acids using Gabriel's phthalimide synthesis, Zwitter ion
- b. Classification and colour reactions of proteins- primary, secondary, tertiary and Quarternary structure of proteins (an elementary idea only).
- c. Nucleic acids, nucleosides, nucleotides, RNA and DNA (an elementary idea about their Structure.)
- d. Terpenes: Classification, occurrence and isolation- general properties- isoprene rule – synthesis and structural elucidation of citral, geranial, menthol and terpeniol.

**UNIT III: DYES AND SOME SYNTHETIC REAGENTS**

- a. Dyes: Theory of colour and constitution, classification of dyes on the basis of their structure and applications. Preparation of malachite green, rosaniline, phenolphthalein, fluorescein, indico, alizarin, methyl orange and congo red.

- b. Synthetic applications of Grignard reagents,  $\text{LiAlH}_4$  and  $\text{SeO}_2$ .
- c. Synthetic applications of acetoacetic ester and malonic ester.

#### **UNIT IV: SULPHUR CONTAINING ORGANIC COMPOUNDS AND MOLECULAR REARRANGEMENTS.**

- a. Thioalcohols and thioethers: Preparation of thiols from alcohol, and its oxidation reactions - Preparation of sulphanol and mustard gas.
- b. Aromatic sulphonic acids: Preparation, reactions of benzene sulphonic acids. Preparation and uses of saccharin, chloramine-T and dichloramine-T
- c. Molecular rearrangements: Detailed mechanisms of the following: pinacol-pinacolone, Hofmann, Curtius, benzil-benzilic acid, Claisen, Beckmann, benzidine, and Fries rearrangement

#### **UNIT V: PRINIPLES AND APPLICATIONS OF SPECTROSCOPY**

- a. UV-VIS. spectroscopy: Types of electronic transitions, absorption laws, bathochromic shift and hypsochromic shift, hyperchromic and hypochromic effect, applications of UV to organic compounds, Woodward-Fieser rules- calculation of ( $\lambda_{\text{max}}$ ) for conjugated dienes
- b. IR spectroscopy: Instrumentation- Modes of vibration, overtone and combination of bonds, applications of IR to organic compounds-finger print region, study of hydrogen bond.
- c. NMR spectroscopy: Introduction- chemical shift – shielding and deshielding effects - factors affecting the chemical shift- solvent used, splitting of signals- NMR spectra of ethanol, benzaldehyde, isopropyl alcohol and mesitylene

#### **TEXT BOOKS**

1. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, 1<sup>st</sup> Multicolour Edition, S. Chand & Company, New Delhi, 2010.
2. S.C. Sharma and M.K. Jain, Modern Organic Chemistry, Vishal Publishing Company, New Delhi, 2014.
3. K.S. Tewari, N.K. Vishnoi and S.N. Mehrotra, A Textbook of Organic Chemistry, 2<sup>nd</sup> Edition, Vikas Publishing House (Pvt.) Ltd., New Delhi, 2004.

#### **REFERENCE BOOKS**

1. I.L. Finar, Organic Chemistry Vol. II, 5<sup>th</sup> Edition, Pearson Education, New Delhi, 2013.
2. R.M. Silverstein and F.X. Webster, Spectrometric Identification of Organic Compounds, 6<sup>th</sup> Edition, John Wiley and Sons, New York, 2004.
3. Y.R. Sharma, Elementary Organic Spectroscopy, 4<sup>th</sup> Edition, S. Chand & Company Ltd., New Delhi, 1012 (Reprint)
4. P.S. Kalsi, Organic Reactions, Stereochemistry and Mechanism, 4<sup>th</sup> Edition, New Age International Publishers, New Delhi, 2006.

**Core Paper –IX**  
**PHYSICAL CHEMISTRY III**

Credits –4  
Max. Marks 100  
OBJECTIVES

Hours/Week: 4  
Ext: 75 + Int: 25

1. To learn about rate, order and theories of reaction rate
2. To understand principles of various types of spectroscopy
3. To know the concept of thermodynamics of ideal solutions
4. To understand about emf and electrochemical cells
5. To learn the fundamentals of photochemistry

**UNIT I: CHEMICAL KINETICS**

- a. Rate- order- rate law- rate constants- Simple reactions involving zero, first, second and third – order reactions. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction.
- b. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction.
- c. General methods for determination of order of a reaction.
- d. Concept of activation energy and its calculation from Arrhenius equation.
- e. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). Lindeman hypothesis.

**UNIT II: SPECTROSCOPY**

- a. Introduction - Distinguishing (i) emission and absorption spectra (ii) atomic and molecular spectra – regions of e.m. spectrum in terms of wave length – conversion to wave number, frequency and energy
- b. Pure rotational spectroscopy -Definitions of rigid rotors,– derivation of equation for moment of inertia, I- equation for rotational energy levels –rotation constant (B) – rotational selection rules - calculation of inter atomic distance
- c. Pure vibrational spectroscopy - normal modes in CO<sub>2</sub> and H<sub>2</sub>O– potential energy versus displacement diagram for HCl –zero point energy – vibrational selection rules – vibration spectrum of an ideal harmonic oscillator – calculation of force constant – meaning of fundamental vibrational transitions, hot bands and overtone spectroscopy
- d. Raman spectroscopy- Stokes and anti stokes lines-Comparison with IR
- e. Electronic spectroscopy–Franck Condon principle
- f. Principle of NMR-Chemical Shift- Principle of EPR –hyperfine splitting of H<sup>+</sup> ion

**UNIT III: SOLUTIONS**

- a. Thermodynamics of ideal solutions: Ideal solutions and Raoult’s law, deviations from Raoult’s law – non-ideal solutions. Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions.



- b. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation.
- c. Nernst distribution law and its applications.

#### **UNIT IV: ELECTRO CHEMICAL CELLS**

- a. Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance.
- b. Types of electrodes. Standard electrode potential. Electrochemical series.
- c. Thermodynamics of a reversible cell, calculation of thermodynamic properties:  $\Delta G$ ,  $\Delta H$  and  $\Delta S$  from EMF data. Calculation of equilibrium constant from EMF data.
- d. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.
- e. pH determination using hydrogen electrode and quinhydrone electrode.
- f. Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).
- g. Commercial cells: Dry cell, lead storage, alkali (Na-S) and  $H_2-O_2$  fuel cells- lithium ion battery.

#### **UNIT V: PHOTOCHEMISTRY**

- a. Introduction - Difference between thermal and photochemical processes - Beer Lambert's law. Laws of photochemistry: Grothus-Draper law and Stark-Einstein's law of photochemical equivalence. Quantum yield and its explanation and determination
- b. Photosynthesis –Kinetics of Photochemical reaction of hydrogen-chlorine and hydrogen-bromine reactions.
- c. Photophysical processes: Jablonski diagram – Fluorescence – Phosphorescence. Non-radiative processes: Internal conversion and inter system crossing.
- d. Photosensitization – Chemiluminescence and bioluminescence -Chemistry of vision.

#### **TEXT BOOKS**

1. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46<sup>th</sup> Edition, Vishal Publishing Company, New Delhi, 2013.
2. P.L. Soni, O.P. Dharmarha and U.N. Dash, Textbook of Physical Chemistry, 23<sup>rd</sup> Edition, Sultan Chand & Sons, New Delhi, 2011.
3. R.L. Madan, G. D. Tuli, Physical Chemistry, S. Chand, Revised edition, 2014

#### **REFERENCE BOOKS**

1. S. Glasstone and D.H. Lewis, Elements of Physical Chemistry, 2<sup>nd</sup> Edition, Macmillan & Company, UK, 1962.
2. P.W. Atkins, Physical Chemistry, 8<sup>th</sup> Edition, Oxford University Press, New Delhi, 2006.
3. P.W. Atkins, J. D. Paula Elements of Physical Chemistry, Oxford University Press, 2017

**CORE PAPER –X  
APPLIED CHEMISTRY**

Credits –4  
Max. Marks 100  
OBJECTIVES

Hours/Week: 4  
Ext: 75 + Int: 25

1. To learn about the analysis and treatment of waste water
2. To understand the various fuels and their applications
3. To learn about match industry
4. To understand about silicate industry
5. To learn the fundamentals of polymer chemistry

**UNIT I: WATER AND SEWAGE TREATMENT**

- a. Water Quality analysis - chemical and physical analysis of water, Quality parameter Seawater as a source of Drinking water - Electro Dialysis method, Reverse osmosis method for purification of water.
- b. Sewage Treatment -Municipal Waste water - Sewage treatment - Aerobic and Anaerobic processes.

**UNIT II: FUELS AND COMBUSTION**

- a. Fuels - Definition , Characteristics of a good fuel , Calorific value , Coal , Varieties of coal , liquid Fuels Gaseous fuels - Preparation and specific uses of producer gas, Water gas, LPG and gobar gas. Advantages and disadvantages of solid, liquid and gaseous Fuels.
- b. Rocket fuels - classification of solid propellants , Liquid propellants mono - bipropellants).- Combustion - Spontaneous ignition temperature (SIT) - combustion calculation.

**UNIT III: MATCH INDUSTRY**

- a. Raw materials - Types of matches - Composition of match head striking surface manufacture of safety matches - Pyrotechnics - Colored matches.
- b. Pyrotechnics and explosives , Classification of explosives, Requirements and classification of a good explosives TNT, RDX , Picric acid, Gun powder , Ammonium nitrate.

**UNIT IV: SILICATE INDUSTRY AND INDUSTRIAL COATINGS**

- a. Silicate industry- Cement, Glass and Gypsum, Raw materials and Manufacture of cement, Glass.
- b. Industrial Coatings- protective coatings, Metallic coatings, non-metallic coatings, Inorganic coatings, organic coatings, - Paints - composition of paints , pigments - lacquers - Varnishes.

**UNIT V: POLYMER CHEMISTRY AND RUBBER**

- a. Polymer chemistry - Types of polymerization - Addition and condensation polymerization - properties of polymers – structure and uses of polyurethane-polyester-polymethyl methacrylate- plastics, classification of plastics.

Difference between thermo plastics of thermo setting plastics - Applications of plastics in industry.

- b. Rubber: Natural Rubber — preparation from latex- defects of natural rubber, vulcanization of rubber, synthetic rubber preparation and application of Neoprene, Buna – S, Thiokol.(specific uses only)

### **TEXT BOOKS**

1. R. Gopalan. P. S. Subramanian and K. Rengarajan. Elements of Analytical Chemistry, Sultan Company (2008).
2. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, 31<sup>st</sup> Edition, Milestone Publishers and Distributors, New Delhi, 2013.

### **REFERENCE BOOKS**

1. A text book of quantitative inorganic analysis, Arthur Vogel. Latest Edition 2006.
2. R. D. Madan. Advanced inorganic chemistry Latest Edition 2006.
3. B.K. Sharma (Goel Publishing House) Latest Edition 2006
4. I.L. Finar, Organic Chemistry Vol. I, 6<sup>th</sup> Edition, Pearson Education, New Delhi, 2014.

## **PART IV: SKILL BASED COURSE- VI** **MEDICINAL CHEMISTRY**

Credits –2

Max. Marks 100

Hours/Week: 2

Ext: 75 + Int: 25

### **OBJECTIVES**

1. To learn about method of analysis of blood and urine
2. To understand vitamins, hormones and enzymes
3. To know the various types of drugs
4. To learn about diabetes and AIDS
5. To know the medicinal values of some plants

### **UNIT I**

Health and Biochemical Analysis: Definition of health - WHO standard - Biochemical analysis of urine and serum. Blood: Composition, grouping and Rh factor - Blood transfusion

### **UNIT II**

Vitamins (name, classification, source, function and deficiency diseases) - Enzymes (classification, characteristics, function and examples) – Hormones (classification, organ of secretion and functions)

### **UNIT III**

Drugs & Pharmaceuticals: Drug discovery, design and development; Basic Retrosynthetic approach. Definition, example and structure the following classes of drugs: analgesics

agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, Ibuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone),

#### **UNIT IV**

Diabetes and Hypoglycemic drugs: Introduction, Types and control of diabetics; Insulin; oral hypoglycemic drugs; sulphonyl urea; biguanide drugs. AIDS – General symptoms of AIDS-prevention treatment

#### **UNIT V**

Indian Medicinal Plants: Kizhanelli, Hibiscus, Adathodai, Thuduvalai, Thulasi, Brahmi, Aloe Vera and Neem plant (major chemical constituents and medicinal uses). Essential Oils: Extraction by steam distillation – Source and medicinal uses of eucalyptus oil, Sandalwood oil and lemon grass oil.

#### **REFERENCE BOOKS**

1. Guyton and Hall, Textbook of Medical Physiology, 12th Edition, Saunders, US, 2010.
2. B.L. Oser, Hawk's Physiological Chemistry, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1979.
3. Gurdeep R. Chatwal, Synthetic Drugs, Himalaya Publishing House, Bombay, 1995.
4. Jayashree Ghosh, A Textbook of Pharmaceutical Chemistry, 3<sup>rd</sup> Edition, S. Chand and Company Ltd., New Delhi, 1999.
5. S.C Rastogi, Biochemistry, 2nd Edition, Tata McGraw Hill Publishing Co., New Delhi, 2007

### **SEMESTER VI PRACTICAL - III GRAVIMETRY AND ORGANIC PREPARATIONS**

**Credits – 5**  
**Max. Marks 100**

**Hours/Week: 3**  
**Ext: 75 + Int: 25**

#### **Objectives**

1. To enable the students to develop skills in quantitative estimation by gravimetric method
2. To learn the art of synthesizing organic compounds.

#### **1. GRAVIMETRY**

1. Estimation of lead as lead chromate
2. Estimation of barium as barium chromate
3. Estimation of calcium as calcium oxalate monohydrate
4. Estimation of nickel as NiDMG

## 2. ORGANIC PREPARATION

1. Nitration: picric acid from phenol
2. Bromination: p-bromoacetanilide from acetanilide
3. Hydrolysis: Aromatic acid from an ester/amide
4. Oxidation: Benzoic acid from benzaldehyde
5. Benzoylation of amine/phenols
6. Acetylation of amine/phenols

**Scheme of evaluation (Max. marks 100)**

**Internal Assessment: 40 Marks**

<b>Regularity</b>	<b>20 Marks</b>
<b>Class Test</b>	<b>15 Marks</b>
<b>Observation Note</b>	<b>5 Marks</b>
<b>Total</b>	<b>40 Marks</b>

**External Examination: 60 Marks (6 hours)**

<b>Record Note Book</b>	<b>10 marks</b>		
<b>Gravimetric estimation</b>	<b>30 Marks</b>	<b>Organic Preparation</b>	<b>20 Marks</b>
<b>Procedure</b>	<b>10 Marks</b>	<b>Procedure</b>	<b>6 Marks</b>
<b>Estimation</b>	<b>20 Marks</b>	<b>Crude sample</b>	<b>10 Marks</b>
<b>&lt; 2 %</b>	<b>20 Marks</b>	<b>Recrystallised sample</b>	<b>4 Marks</b>
<b>2 -3%</b>	<b>15 Marks</b>		
<b>3- 4%</b>	<b>10 Marks</b>		
<b>&gt; 4%</b>	<b>5 Marks</b>		

SEMESTER VI  
PRACTICAL - IV  
ORGANIC ANALYSIS AND ESTIMATION

Credits – 5  
Max. Marks 100

Hours/Week: 3  
Ext: 75 + Int: 25

Objectives

1. To enable the students to develop analytical skills in organic qualitative analysis
2. At the end of the course, the students should be able to plan the experimental projects and execute them.

### 1. Organic Analysis

- a. Identification of acidic, basic, phenolic, and neutral organic substances.
- b. Detection of N, S and halogens.
- c. Test for aliphatic and aromatic nature of substances.
- d. Test for saturation and unsaturation.

- e. Identification of functional groups: i) Carboxylic acids ii) Phenols iii) Aldehydes iv) Ketones v) Esters vi) Carbohydrates vii) Amines viii) Amides ix) Halogen compounds  
 f. Preparation of derivatives for the functional groups.

## 2. Organic Estimation

- a) Estimation of aniline  
 b) Estimation of phenol  
 c) Estimation of glucose

**Scheme of evaluation (Max. marks 100)**

**Internal Assessment: 40 Marks**

<b>Regularity</b>	<b>20 Marks</b>
<b>Class Test</b>	<b>15 Marks</b>
<b>Observation Note</b>	<b>5 Marks</b>
<b>Total</b>	<b>40 Marks</b>

**External Examination: 60 Marks (6 hours)**

<b>Record Note Book</b>	<b>10 marks</b>		
<b>Organic Estimation</b>	<b>25 Marks</b>	<b>Organic Analysis</b>	<b>25 Marks</b>
<b>Procedure</b>	<b>10 Marks</b>	<b>Elements present</b>	<b>8 Marks</b>
<b>Estimation</b>	<b>15 Marks</b>	<b>Aliphatic/aromatic</b>	<b>4 Marks</b>
<b>&lt; 2 %</b>	<b>15 Marks</b>	<b>Saturated/unsatd.</b>	<b>4 Marks</b>
<b>2 -3%</b>	<b>12 Marks</b>	<b>Functional group</b>	<b>6 Marks</b>
<b>3- 4%</b>	<b>10 Marks</b>	<b>Derivative /color reaction</b>	<b>3 Marks</b>
<b>&gt; 4%</b>	<b>5 Marks</b>		

SEMESTER VI  
 PRACTICAL - V  
 PHYSICAL CHEMISTRY EXPERIMENTS

Credits –5  
 Max. Marks 100

Hours/Week: 2  
 Ext: 75 + Int: 25

### Objectives

- To apply the principles of physical chemistry and do some experiments
- At the end of the course, the students should be able to plan the experimental projects and execute them.

- Rast Method-** Determination of cryoscopic constant (K<sub>f</sub>) of solid solvent using a solute of known molecular mass. Determination of molecular mass of the solute using a solvent of known cryoscopic constant (K<sub>f</sub>).

Solid solvents: Naphthalene, biphenyl, camphor. Solutes: Naphthalene, biphenyl, 1,4 dichlorobenzene, diphenylamine, acetanilide, benzophenone

2. **Transition Temperature** - Determination of molal transition point depression constant (Kt) of salt hydrate using solute of known molecular mass. Determination of molecular mass of the solute using a solvent of known molal transition point depression constant (Kt).  
Salt hydrates:  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ ,  $\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$ . Solutes: Urea, Glucose
3. **Phase Equilibria** - Construction of phase diagram & determination of eutectic composition and eutectic temperature.  
Naphthalene-biphenyl system, Naphthalene-diphenylamine system, Biphenyl-diphenylamine system. Naphthalene – m- dinitrobenzene system
4. **Critical solution temperature** –Determination of CST of phenol-water system- Influence of NaCl impurity on miscibility temperature of phenol–water system and determination of concentration of given NaCl solution
5. **Thermochemistry** – Heat of solution – potassium dichromate – ammonium oxalate – oxalic acid
6. **Kinetics** – Determination of relative strength of acids by acid catalysed hydrolysis of ester – inversion of cane sugar
7. **Potentiometric titration** – (i)  $\text{KMnO}_4$  Vs  $\text{Fe SO}_4$  (ii)  $\text{K}_2\text{Cr}_2\text{O}_7$  Vs  $\text{Fe SO}_4$
8. **Conductometric titration**
9. **Partition Coefficient Experiment**
10. **Viscosity** – Determination of composition of unknown mixture

### **Scheme of evaluation (Max. marks 100)**

Internal Assessment 40 Marks

External Examination: 60 Marks (6 hours)

Regularity	20 Marks
Class Test	15 Marks
Observation Note	5 Marks
Total	40 Marks

Record note	10 Marks
Ability to complete the experiment	30 Marks
Graph/calculation	10 Marks
Tabulation	5 Marks
Result	5 Marks

### Allied Chemistry

Common to all disciplines offering chemistry as an Allied Course  
Effective from the academic year 2018 onwards

Distribution of hours

Theory

Year	Semester	Name of the Paper	Hrs/week	Hrs/Semester	Internal	External	credits
I / II	I / III	Organic, inorganic and physical chemistry	4	60	25	75	4
	II / IV	Organic and physical chemistry	4	60	25	75	4
II / III	III / V	Organic, inorganic and physical chemistry	4	60	25	75	4
	IV / VI	Organic and physical chemistry	4	60	25	75	4

Practical

Year	Name of the Paper	Hrs/week	Hrs/ Semester	Internal	External	credits
I / II	Volumetric Analysis	2	60	40	60	1
II / III	Organic Analysis	2	60	40	60	1

### B.Sc., ALLIED CHEMISTRY SYLLABUS

#### ALLIED PAPER I

ORGANIC, INORGANIC AND PHYSICAL CHEMISTRY

Credits –4

Max. Marks 100

Hours/Week: 4

Ext: 75 + Int: 25

#### UNIT I

- Hydrogen:** Isotopes of hydrogen, preparation, properties and uses of heavy hydrogen – ortho and para hydrogen – hydrides – definition – classification – examples.
- Oxides:** Definition, classification – examples.



- c. **Water:** Hardness of water – types of hardness – removal of hardness – industrial implications of hardness in water – estimation of EDTA method (outline only) units of hardness of water.
- d. **Hydrogen peroxide:** Manufacture, properties, structure and uses – estimation by permanganometry method – strength of hydrogen peroxide.

## UNIT II

- a. Nature of valency of carbon in organic compounds – tetrahedral arrangement of valency of carbon – bond-breaking and bond forming in organic reactions – homolytic cleavage – heterolytic cleavage – reaction intermediates – formation, stability and reaction of carbocation and free radical.
- b. **Nucleophiles - Electrophiles :** Definition, types and examples – specific reactions involving these
- c. **Types of reaction:** Mechanism of Substitution  $S_N1$ ,  $S_N2$  – addition – elimination – rearrangement and polymerization – illustration with examples.
- d. Empirical formula, Molecular formula, calculation of EF and MF from percentage composition

## UNIT III

- a. Normality, Molarity, Molality, Mole fraction, mole concept.
- b. Primary and secondary standards - Preparation of standard solutions
- c. Principle of volumetric analysis (with simple problems)
- d. Detection of elements Nitrogen, Sulphur and halogens, Preparation of Lassaigne's extract- Test - aromatic or aliphatic compounds-Saturated or Unsaturated-Test-Functional groups-carbohydrates, Phenols, aromatic acids, carbonyl compounds, amides, amines etc.,

## UNIT IV

- a. V.B theory – postulates of V.B. theory - application to the formation of simple molecules like  $H_2$  and  $O_2$  - overlap of atomic orbitals – s –s, s-p and p-p overlap – principle of hybridization –  $sp$ ,  $sp^2$  and  $sp^3$  hybridization –examples and geometry – VSEPR theory .
- b. **M.O. theory:** Formation of MO's – bonding and antibonding and non bonding.M.O's-M.O diagram for  $H_2$ , He and  $F_2$ .

## UNIT V COLLOIDS

- a. Colloidal state of matter – various types – classification
- b. Sols –dialysis –electro osmosis – electrophoresis – stability of colloids – protective action – Hardy Schulze law – gold number.
- c. Emulsion: Types of emulsions – emulsifier with examples
- d. Gels- classification, preparation-swelling – syneresis- thixotropy
- e. Applications of colloids.

## REFERENCE BOOKS

1. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, 31<sup>st</sup> Edition, Milestone Publishers and Distributors, New Delhi, 2013.
2. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, 1<sup>st</sup> Multicolour Edition, S. Chand & Company, New Delhi, 2010.
3. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46<sup>th</sup> Edition, Vishal Publishing Company, New Delhi, 2013.

## ALLIED PAPER II ORGANIC AND PHYSICAL CHEMISTRY

Credits – 4  
Max. Marks 100

Hours/Week: 4  
Ext: 75 + Int: 25

### UNIT I: NUCLEAR CHEMISTRY

- a. Composition of the nucleus – nuclear forces – mass defect – binding energy – nuclear stability.
- b. Soddy's group displacement law – illustration - law of radioactive disintegration.
- c. Nuclear fission: Definition – theories of fusion – application of fission – the principle of atom bomb.
- d. Nuclear fusion: Definition – emission of energy – Stellar energy – hydrogen bomb.
- e. Application of radioactivity – In medicine, agriculture, industry and analytical fields – carbon dating.

### UNIT II: CARBOHYDRATES

- a. : Definition – classification – monosaccharide – properties and uses of glucose and fructose and configuration of glucose – Haworth structure – conversion of glucose to fructose and vice versa.
- b. **Disaccharides:** Sucrose – manufacture – properties and uses – structure- distinction between sucrose , glucose and fructose
- c. **Polysaccharides:** starch and cellulose (structure only)  $\alpha$ -amylase -  $\beta$  – amylase- difference between these two.

### UNIT III: ISOMERISM

- a. **Classification of organic compounds** – position isomerism-Functional isomerism-Chain isomerism
- b. **Stereo isomerism** - Chiral centre, Optical activity of compounds containing one or two chiral centers- Examples
- c. Geometrical Isomerism of maleic and fumaric acids.

#### UNIT IV: CATALYSIS

- a. Definition– characteristics – different types of catalysis – acid-base catalysis- surface catalytic reactions- definition and example – auto catalysis
- b. Catalytic poisoning- promoter – enzyme catalysis
- c. Applications of catalysis

#### UNIT V: AMINO ACIDS, PROTEINS AND DYES

- a. **Amino acids and proteins:** classification – synthesis – properties of amino acids – polypeptides – proteins – classification and biological functions.
- b. **Dyes:** Definition – theory of color and constitution – classification based on structure and application – preparation of methyl orange – bismark brown, malachite green – vat dye – indigo.

#### REFERENCE BOOKS

1. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, 31<sup>st</sup> Edition, Milestone Publishers and Distributors, New Delhi, 2013.
2. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, 1<sup>st</sup> Multicolour Edition, S. Chand & Company, New Delhi, 2010.
3. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46<sup>th</sup> Edition, Vishal Publishing Company, New Delhi, 2013.

### ALLIED PAPER III

#### ORGANIC, INORGANIC AND PHYSICAL CHEMISTRY

Credits – 4  
Max. Marks 100

Hours/Week: 4  
Ext: 75 + Int: 25

#### UNIT I: ELECTROCHEMISTRY

- a. Faraday's laws of electrolysis – specific and equivalent conductance – electrochemical cell – Nernst equation – convention regarding the sign of the EMF of the cell
- b. electrodes – reference electrodes – hydrogen and calomel electrodes – types of electrodes – metal – metal ion electrodes, metal – metal insoluble salt electrode – glass and ion selective electrodes
- c. pH measurement using glass electrode- membrane potential – Hydrogen – oxygen fuel cell.

#### UNIT II: POLYMERS

- a. Definition – classification of polymers – properties of polymers – addition and condensation polymerization reactions with examples

- b. Natural rubber – isoprene unit – vulcanization of rubber – preparation and application of polystyrene, urea–formaldehyde resin, Teflon and buna-S-rubber.

### UNIT III: PHOTOCHEMISTRY

- a. Comparison of thermal and photochemical reactions - definition of photochemical reactions- laws of photochemistry- Grotthus-draper law- Einstein law - quantum efficiency-reasons for low and high quantum yield with examples – consequences of light absorption by atoms and molecules
- b. Jabalonski diagram – fluorescence – phosphorescence – photosensitiation – chemiluminescence – bioluminescence –
- c. Applications of photo chemistry.

### UNIT IV: CO-ORDINATION COMPOUNDS

- a. Definition - nomenclature – definition of various terms involved in co-ordination chemistry
- b. Werner 's theory – EAN rule – VB theory – Nickel carbonyl – Chelates

### UNIT V: POLLUTION

- a. **Air pollution** : Definition , composition of air – chemical reactions occurring in air due to sunlight – sources of air pollution – classification and effects of air pollutants – effect of fluorocarbons – ozone layer – composition – formation – depletion – green house effect.
- b. **Acid rain**: Formation , theory and control of acid rain – methods to control air pollution
- c. **Water pollution**: Types – sources – water sewages – industrial effluents- inorganic pollutants – organic pollutants – water pollution control – water treatment
- d. **Radioactive pollution**: Sources – nuclear traces – wastes – effect of radiation – preventive methods

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2. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, 1<sup>st</sup> Multicolour Edition, S. Chand &Company, New Delhi, 2010.
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**ALLIED PAPER IV**  
**ORGANIC AND PHYSICAL CHEMISTRY**

Credits –4  
Max. Marks 100

Hours/Week: 4  
Ext: 75 + Int: 25

**UNIT I: VITAMINS AND ANTIBIOTICS:**

- a. Classification and biological function of vitamins A, B<sub>6</sub>, B<sub>12</sub>, C, D, E, K (structural elucidation not necessary)
- b. Classification and biological function of antibiotics - penicillin, chloroamphenicol, streptomycin, tetracycline.

**UNIT II: THERMODYNAMICS**

- a. Importance of thermodynamics – terms used – open and closed system – state function – path function - extensive and intensive properties – reversible and irreversible process – statement and mathematical form of first law of thermodynamics – heat capacity at constant volume and pressure – relation between C<sub>p</sub> and C<sub>v</sub>.
- b. Statement of second law of thermodynamics – entropy – physical significance of entropy- Gibb's free energy and its significance

**UNIT III: ADSORPTION**

- a. Definition – difference between adsorption and absorption – adsorbate - Adsorbent- physical adsorption – chemical adsorption – difference between these two types – factors influencing adsorption
- b. Adsorption isotherm - Langmuir isotherm ( no derivation, statement only)
- c. Adsorption of gases on solid surface – Applications of adsorption

**UNIT IV: CHROMATOGRAPHY**

- a. Principle and application – partition and gas chromatography - thin layer chromatography – column chromatography
- b. Paper chromatography – gas -solid and gas- liquid chromatography.

**UNIT V: CHEMICAL KINETICS**

- a. Reaction rate – order & molecularity of a reaction – zero order – first order.
- b. First order rate equation & half life period – derivation. Examples of first order reactions
- c. Second order reaction – examples.
- d. Enzyme catalysis – Michaelis and Menten mechanism – Lineweaver Burk plot – significance of k<sub>m</sub>

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1. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, 31<sup>st</sup> Edition, Milestone Publishers and Distributors, New Delhi, 2013.
2. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, 1<sup>st</sup> Multicolour Edition, S. Chand & Company, New Delhi, 2010.
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## SEMESTER II/IV PRACTICAL - I

### VOLUMETRIC ANALYSIS

Credits –1  
Max. Marks 100

Hours/Week: 2  
Ext: 75 + Int: 25

### Objectives

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

### I ACIDIMETRY AND ALKALIMETRY

1. Estimation of HCl.
2. Estimation of oxalic acid.
3. Estimation of sodium carbonate
4. Estimation of sodium hydroxide

### II REDOX TITRATIONS

#### PERMANGANOMETRY

1. Estimation of Ferrous ion
2. Estimation of oxalic acid

### III IODOMETRY AND IODIMETRY

1. Estimation of potassium dichromate
2. Estimation of potassium permanganate

### Scheme of evaluation (Max.marks 100)

### Internal Assessment 40 Marks

<b>Regularity</b>	<b>20 Marks</b>
<b>Class Test</b>	<b>15 Marks</b>
<b>Observation Note</b>	<b>5 Marks</b>
<b>Total</b>	<b>40 Marks</b>

**External Examination: 60 Marks (3 hours)**

<b>Record Note Book</b>	<b>10 Marks</b>
<b>Procedure</b>	<b>15 Marks</b>
<b>Estimation</b>	<b>35 Marks</b>
<b>&lt; 3 %</b>	<b>35 Marks</b>
<b>3 - 4%</b>	<b>25 Marks</b>
<b>4- 5%</b>	<b>20 Marks</b>
<b>&gt; 5%</b>	<b>10 Marks</b>

**SEMESTER IV/VI PRACTICAL - II ORGANIC ANALYSIS**

Credits – 1

Hours/Week: 2

Max. Marks 100

Ext: 75 + Int: 25

Objectives

1. To enable the students to develop analytical skills in organic qualitative analysis
2. At the end of the course, the students should be able to plan the experimental projects and execute them.

**1. Organic Analysis**

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

**Scheme of evaluation (Max.marks 100)****Internal Assessment 40 Marks**

<b>Regularity</b>	<b>20 Marks</b>
<b>Class Test</b>	<b>15 Marks</b>
<b>Observation Note</b>	<b>5 Marks</b>
<b>Total</b>	<b>40 Marks</b>

**External Examination: 60 Marks (3 hours)**

<b>Record Note</b>	<b>10 Marks</b>
<b>Elements present</b>	<b>18 Marks</b>
<b>Aliphatic/aromatic</b>	<b>6 Marks</b>
<b>Saturated/unsaturated</b>	<b>6 Marks</b>
<b>Functional group</b>	<b>15 Marks</b>
<b>Derivative /color reaction</b>	<b>5 Marks</b>