Shivaji University, Kolhapur

B.O.S. In Chemistry

B.Sc. Part - I New Syllabus

SEMESTER SYSTEM

In force from June -2013

INTRODUCTION

This syllabus is prepared to give the sound knowledge and understanding of chemistry to undergraduate students at first year of the B.Sc. degree course. The goal of the syllabus is to make the study of chemistry as stimulating, interesting and relevant as possible. The syllabus is prepared by keeping in mind the aim to make students capable of studying chemistry in academic and industrial courses. Also to expose the students and to develop interest in them in various fields of chemistry. The new and updated syllabus is based on disciplinary approach with vigour and depth taking care of the syllabus is not heavy at the same time it is comparable to the syllabi of other universities at the same level.

The syllabus is prepared after discussions of number of faculty members of the subject and by considering the existing syllabi of B.Sc. Part-I, II & III, new syllabi of XI^{th} & XII^{th} standards, syllabi of NET and SET exams. U.G.C. model curriculum, syllabi of different entrance examination and syllabi of other Universities.

The units of the syllabus are well defined and the scope is given in detail. The periods required for units are given. The lists of reference books are given in detail.

OBJECTIVES

To enable the students-

- To promote understanding of basic facts and concepts in Chemistry while retaining the excitement of Chemistry.
- To make students capable of studying Chemistry in academic and Industrial courses.
- To expose the students to various emerging new areas of Chemistry and apprise them with there prevalent in their future studies and their applications in various spheres of chemical sciences.
- To develop problem solving skills in students.
- To expose the students to different processes used in Industries and their applications.
- To developed ability and to acquire the knowledge of terms, facts, concepts, processes, techniques and principles of subjects,
- To develop ability to apply the knowledge of contents of principles of chemistry.
- To inquire of new knowledge of chemistry and developments therein.
- To expose and to develop interest in the fields of chemistry
- To develop proper aptitude towards the subjects.
- To develop the power of appreciations, the achievements in Chemistry and role in nature and society.
- To develop interest in students to study chemistry as a discipline.
- To develop skills required in chemistry such as the proper handling of apparatus and chemicals.

List of Laboratory equipments & Chemicals required:-

Apparatus & equipments and chemicals required.

1. Viscometer
2. Stop watch

3. Eudiometer
4. Digital balance with 1 mg accuracy
5. Burette, pipette and conical flask
6. $1/10^0$C thermometer
7. Polythene bottles
8. Measuring cylinder
9. Stopper bottle
10. Test tube, Beaker
11. Thile's tube
12. Capillary tube
13. Evaporating dish
14. Glass rod
15. Wire gauze
16. Burner
17. Water bath
18. Chromatography paper
19. Gas jar
20. Watch glass
21. Tripod stand
22. Burette stand
23. Iron stand
24. Test tube holder
25. Test tube stand
26. Spot tile
27. Dropper
28. Dryer

Chemicals:-

All the chemicals required for experiments are mentioned in the syllabus.

B.Sc. Part - I (Theory) Course structure

SEMESTER – I

Paper – I (Physical Chemistry)

Time :- 2 hours **Marks:- 50**

Subject	Unit No.	Title	Periods	Marks	Option
(Physical)	Unit - 1	Distribution Law	06	08	05
	Unit - 2	Thermodynamics	07	10	07
	Unit – 3	Chemical Kinetics	12	15	10
	Unit - 4	Gaseous State	06	09	05
	Unit - 5	Nuclear Chemistry	07	08	05
Grand Total			**38**	**50**	**32**

Paper – II (Inorganic Chemistry)

Time :- 2 hours **Marks:- 50**

Subject	Unit No.	Title	Periods	Marks	Option
Inorganic	Unit - 1	Ionic Solids	10	13	08
	Unit - 2	Covalent Bonding	10	13	08
	Unit – 3	Acids and Bases	04	06	04
	Unit - 4	p-block elements(group 15,16)	08	10	07
	Unit - 5	Chemistry of Noble gases	05	08	05
Grand Total			**37**	**50**	**32**

SEMESTER – II

Paper –III (Organic Chemistry)

Time :- 2 hours **Marks:- 50**

Subject	Unit No.	Title	Periods	Marks	Option
Organic	Unit - 1	Fundamentals of Organic Reaction Mechanism	08	12	08
	Unit – 2	Stereochemistry	09	12	08
	Unit – 3	Cycloalkanes, Cycloalkenes, alkadienes	06	07	04
	Unit - 4	Synthetic Reagents	07	12	08
	Unit - 5	Aromaticity	07	07	04
Grand Total			**38**	**50**	**32**

Paper – IV (Industrial Chemistry)

Time :- 2 hours **Marks:- 50**

Subject	Unit No.	Title	Periods	Marks	Option
Industrial	Unit – 1	Basic Concepts in Industrial Chemistry	08	10	07
	Unit – 2	Water	08	10	07
	Unit – 3	Fuels	07	10	06
	Unit – 4	Unit operations	07	10	06
	Unit – 5	Fertilizers	07	10	06
Grand Total			**37**	**50**	**32**

Total contact hours : Theory - 150 hrs.

Practicals - 75 hrs.

Total - 225 hrs.

SHIVAJI UNIVERSITY, KOLHAPUR

Chemistry

New Syllabus (Semester System) for B.Sc. Part – I

In force from June, 2013

General Structure:

There will be two theory papers for each semester of 50 marks each.

SEMESTER - I

1) **Paper – I : (**Physical Chemistry) 50 Marks.

2) **Paper – II :** (Inorganic Chemistry) 50 Marks.

SEMESTER – II

1) **Paper – III :** (Organic Chemistry) – 50 Marks.

2) **Paper – IV :** (Industrial Chemistry) – 50 Marks.

There will be annual practical examination. Practical will be of 50 marks. Physical, Inorganic and Organic sections carry 15 marks each. Five marks are reserved for journal. The duration of practical examination will be of six hours.

SYLLABUS

N. B. (i) Figures shown in bracket indicate the total lectures required for the respective units.

(ii) The question paper should cover the entire syllabus. Marks allotted to questions should be in proportion to the lectures allotted to respective to units.

(iii) All units should be dealt with S.I. units.

(iv) Industrial tour is prescribed.

(v) Use of recent editions of reference books is essential.

(vi) Use of Scientific calculator is allowed.

SEMESTER – I

PAPER - I Physical Chemistry

(Total periods:38)

Unit -I Distribution law (06)

1 Introduction (solution, solute, solvent, immiscible liquids, miscible liquids etc.)

2 Nernst distribution law & its limitations

3 Modification of distribution law with respect to change in molecular state of solute (i.e. association and dissociation of solute in one of the solvent.)

4 Applications of distribution law

i. Process of extraction (derivation expected)

ii. Determination of solubility of solute in particular solvent.

iii. In distribution indicators.

iv. Determination of molecular weight of solute in different solvents.

5 Numerical Problems.

Ref:1 Page no. 645-652;Ref. 3 Page no. 486-508; Ref. 4 Page no. 1.651-1.672.

UNIT - II. Thermodynamics (07)

1 Introduction (Basic terms involved in thermodynamics)

2 Statement of Zeroth law, First law and Third law.

3 Spontaneous & non–spontaneous processes – definitions, distinguishing points and examples. Second law of thermodynamics and its different statements.

4 Carnot's cycle, its efficiency and Carnot's Theorem (Heat engine).

5 Numerical Problems.

Ref. 1 Page no.518, 520,521;Ref. 2 Page no.3-8, 13,57-60, 64-72;Ref. 5 Page no. 366-369,371,404 436-441.

Unit- III. Chemical Kinetics (12)

1. Introduction, Rate of reaction, Definition and units of rate constant.
   Factors affecting rate of reaction. (Nature of reactant, Concentration, pressure, temperature and catalyst.)
2. Order and Molecularity of reaction,
3. First order reaction: (Derivation not expected). Characteristics of first order reaction.
4. Pseudo-unimolecular reactions. Examples: i) Hydrolysis of methyl acetate
   ii) Inversion of cane sugar
5. Second order reaction: Derivation of rate constant for equal and unequal concentration of the reactants. Characteristics of Second order reaction.
   Examples: i) Reaction between $K_2S_2O_8$ and KI
   ii) Saponification of ethyl acetate
6. Numerical Problems.

(Ref. 1 Page No 966-976,985; Ref. 2 Page No 670-671,676-679;
Ref. 4 Page No. 2.165-2.189).

Unit - IV. Gaseous State (06)

1. Introduction, assumptions of Kinetic Theory of Gases
2. a) Ideal and Non ideal gases
   b) Deviation from ideal behaviour. (Boyle's law,Charles law and Avogadro law)
   c) Causes of deviation, Van der Waal's equation, explanation of real gas behaviour by Van der Waal's equation.
3. Critical Phenomena : PV-isotherms of real gases (Andrew's isotherms), Continuity of state, relationship between critical constants and Van der Waal's constants.
4. The law of corresponding states and reduced equation of state.
5. Numerical Problems .

(Ref. 1 Page No.426-431,436-439; Ref.2 Page No.1357-1383;Ref. 3 Page No. 538-560)

Unit- V. Nuclear Chemistry (07)

1. Introduction.
2. Types of nuclear radiation, properties of α, β and γ rays.
3. Rate of radioactive decay, Decay constant,
4. Half life, average life,
5. Nuclear stability, mass defect and binding energy. N/Z ratio
6. Application of radioisotopes:
   a) As tracers: i) In studying reaction mechanism, ii) In medicine, iii) In agriculture, iv) In industry, b) As radiotherapy, c) In mutation of crops.
   d) Carbon dating.
7. Numerical problems

(Ref. 5 Page No.117-118,122-124, 148,167)

Reference

1. Principles of Physical Chemistry Puri, Sharma and Pathania, Vishal Publishing House, 44th Edition
2. Advanced Physical Chemistry Gurdeep Raj GOEL Publishing House, 36th Edition
3. Essentials of Physical Chemistry,Bahl , Tuli and Bahl
4. Text Book of Physical Chemistry, Soni and Dharmarha
5. Essentials of Nuclear Chemistry by H J Arnikar, New Age, 4th edition.
6. Mathematical preparation of Physical Chemistry : F. Daniel ,Mc-Graw Hill Book Company Ltd.
7. Elements of Physical Chemistry : S. Glasstone and D.Lewis (D.Van Nostrand Co.Inc)
8. Physical Chemistry : W. J. Moore (Orient Longman)
9. Principles of Physical Chemistry : Maron Prutton
10. University Chemistry : B. H. Mahan (Addision - Weseley Publ. Co.)

SEMESTER –I PAPER – II

Inorganic Chemistry (Total periods:37)

Unit -1. Ionic Solid (10)

1. Definition of bonds (Ref.6 Page no.150 to189)
2. Formation of ionic bonds (Ref.6 Page no. 150 to 151)
3. Energetics of ionic bond formation (Ref.1 Page no. 59, Ref.2 Page no. 52, Ref.6 Page no. 150 to 189)
4. Born- Haber cycle (Ref. 1 Page no. 64, Ref.4 Page no. 173, Ref.5 Page no. 224, Ref.6 Page no. 152-154)
5. Fajan's rule (Ref.5 Page no. 196 to 197)
6. Radius ratio, radius ratio effect and calculation of r+/r- for octahedral geometry (Ref.1 Page no. 83 to 84, Ref.2 Page no. 50, Ref.3 Page no. 285 to 286, Ref.4 Page no. 177 to 178, Ref.5 Page no. 217, Ref.6 Page no. 288 to 289)
7. NaCl structure (Ref.2 Page no. 45, Ref.3 Page no. 283, Ref.4 Page no. 179, Ref.6- Page no. 292)
8. CsCl structure (Ref.2 Page no. 46, 3 Ref. Page no. 283, Ref. 4 Page no. 180, Ref.6- Page no. 295)
9. Zinc blend (ZnS) structure (Ref.2 Page no. 46, Ref.3 Page no. 292, Ref. 6 Page no. 293)
10. Rutile (TiO_2) structure (Ref.2 Page no. 48, Ref.3 Page no. 287, Ref.6 Page no. 297)

Reference Book:

1. Inorganic Chemistry by J.E.Huheey,3rd edition
2. Inorganic Chemistry by Shriver and Atkins,3rd edition
3. Theoretical Inorganic Chemistry by Day and Selbin,2nd edition

4. Fundamental concepts of Inorganic chemistry by E.S. Gilreath (International student edition)
5. Concept and models of Inorganic chemistry by Dauglas, Daniel and Alexander,2nd edition
6. Principles of inorganic chemistry by Puri, Sharma and Jauhar

Unit-2. Covalent Bonding (10)

1. Lewis theory-Octet rule, exception to octet rule (Ref.4 Page no. 72 to74 , Ref.5 Page no. 51-53)
2. Valence bond theory (VBT)
3. Concept of hybridization – Definition, different types of hybridization, Geometry of molecules (Ref.4 Page no. 80-86, Ref.5 Page no. 57)
4. Valence Shell Electron Pair Repulsion (VSEPR) Theory (Ref.4 Page no. 75to78, Ref.5 Page no. 57to61) H_2O , SF_4 , ClF_3 , ICl_4^-
5. Molecular Orbital Theory (MOT) (Ref.5 Page no. 116 to129)
6. Introduction
7. L. C. A.O. Method
8. Formation of bonding , Anti-bonding and non-bonding molecular orbitals
9. Conditions for successful overlaps
10. Types of overlaps : s-s, s-px, px-px and py-py or pz-pz overlaps
11. Energy level Sequence for Molecular Orbital when n=1 and n=2
12. Bond order and its significance
13. Molecular Orbital diagrams for a)Homonuclear diatomic molecules- N_2^+, N_2, N_2^-, O_2^+, O_2, O_2^- (Ref.4 Page no. 89 to108, Ref.5 Page no. 116 to129);

b) Hetero nuclear diatomic molecules- CO, NO (Ref.4 Page no. 110 to 112, Ref. 5 Page no. 135 to140)

References:

1. Principles of inorganic chemistry by Puri, Sharma and Kalia
2. Principles of Structure and reactivity by J.E. Huheey
3. Theoretical Inorganic Chemistry by Day and Selbin,2nd edition
4. Concise Inorganic Chemistry by J. D. Lee

5. Inorganic Chemistry by Gary Meissler and Donald Tarr
6. Advanced Inorganic Chemistry Vol.-I ,by Satya Prakash ,Tuli Busu , Madan

Unit- 3. Acids and Bases (4)

1. Arrhenius concept (Ref.1 Page no. 349, Ref.4 Page no. 236)
2. Bronsted-Lowry concept (Ref.1 Page no. 350, Ref.2 Page no. 143, Ref. 3 Page no. 318, Ref.4 Page no. 237)
3. Lewis concept (Ref.1 Page no. 355, Ref.2 Page no. 159, Ref.3 Page no. 324, Ref.4 Page no. 240)
4. Lux-Flood concept (Ref.1 Page no. 352, Ref.3 Page no. 319, Ref.4 Page no. 238)

References :

1. Principles of Inorganic Chemistry, Twenty B. R. Puri, L. R. Sharma, K. C. Kalia. Ninth edition, Vallabh Publications, Delhi-
2. Inorganic Chemistry by D. F. Shriver, P. W. Atkins. , Third edition, Oxford University Press.
3. Inorganic Chemistry by J. E. Huheey, E. A. Keiter, R. L. Keiter, Fourth Edition(Pearson Education).
4. Theoretical Principles of Inorganic Chemistry by G. S. Manku, Eleventh reprint, Tata Mc Graw Hill Publishing company Ltd.

Unit-4. p- Block elements (Group 15, 16) (8)

1. Introduction
2. Electronic configuration
3. Periodic trends
4. Allotropic forms of phosphorus and sulphur
5. Oxoacids of phosphorus and sulphur
6. Structures of HNO_2 , HNO_3 , H_3PO_3 ,H_3PO_4 , H_2SO_3 , H_2SO_4

Reference:

Principles of Inorganic Chemistry by Puri Sharma and Kalia, Page No. 475-520 (Gr.15th) 522-550 (Gr. 16th)

Unit -5 Chemistry of Noble Gases (5)

1. Introduction
2. Physical properties
3. Chemical properties
4. Clathrate compounds
5. Structure and Bonding of Xenon Compounds.

Reference

1. Principles of Inorganic Chemistry by Puri Sharma and Kalia, Page No. 602-615.

SEMESTER –II PAPER – III

Organic Chemistry (Total periods:38)

Unit No. I. Fundamentals of Organic Reaction Mechanism [9]

1. Introduction: Curved arrow notation, Nature of bond fission, Types of reagents and organic reactions.
2. Reactive Intermediates:

2.1 Carbocation : Introduction, generation, structure, stability, reactions-elimination of a proton, reaction with neucleophiles, addition to unsaturated compounds, molecular rearrangement.

2.2 Carbanions: Introduction, generation, structure, stability, reactions-elimination, displacement, rearrangement, oxidation of carbanions.

2.3 Free Radicals: Introduction, generation-photolysis, thermolysis and redox reaction, stability, reaction - recombination, disproportionation, reaction with olefins, rearrangements. Application free radicals for conversion of benzene to benzenehexchloride, toluene to benzyl chloride, methane to carbon tetrachloride, propylene to n-propyl bromide and ethylene into polyethylene.

2.4 Carbenes: Introduction, generation–from aliphatic diazocompounds, ketenes, epoxides , diazirines, tetrazoles and alkyl halides, structure, stability, reaction-cycloadditions, insertion, rearrangement, ring expansions, synthesis of allenes.

2.5 Nitrenes: Introduction, generation-from azides and sulfinyl amines, structure, reactions.

2.6 Benzynes: Introduction, generation, structure, reactions

(Rf. No. 1, P. No. 78 – 121)

1. Organic Reaction Mechanism(Third edition) Narosa publishing house Mumbai by V K Ahluwalia
2. Advanced Organic Chemistry, by B S Bahl and A Bahl.

3. Advanced Organic Chemistry, by Sachin Kumar Ghosh.

Unit II. Stereochemistry of Organic Compounds [9]

1. Introduction: Types of stereoisomerism, optical activity, polarimeter.
2. Nomenclature of stereoisomers - D and L, Erythro and Threao, R and S, E and Z systems.
3. Optical isomerism - Elements of symmetry, Chiral centre (Explanation with lactic acid), Optical isomerism in tartaric acid and 2,3-dihydroxybutanoic acid, Enantiomers and diastereoisomers, Racemic modification, Geometrical isomerism, Cause of geometrical isomerism.
4. Geometrical isomerism with respect to C=C, C=N and alicyclic compounds, geometrical isomerism in maleic acid and fumaric acid, geometrical isomerism in aldoximes and ketoximes. Configuration of Ketoximes-Beckmann transformation (Mechanism and proof not expected), Configuration of aldoximes.

Reference Books:

1. Organic Chemistry by Morrison and Boyd, 6th Edition. (P. No. 125,126,135 to 146, 279 to 282, 1162 to 1164)
2. Organic Chemistry Vol.2 - Steriochemistry and the Chemistry of Natural Products by I.L.Finar, 5th Edition. P No. 69,70,84 to 101, 104 to 107, 116 to 118, 156 to 160, 183 to 186, 245 to 256)
3. Stereochemistry of Organic Compounds by D. Nasipuri.(Pages- 26 to 30, 35, 36, 46 to 53,55,56,58 to 60,64)
4. Stereochemistry of Carbon Compounds by Eliel. - Relevant pages.

Unit No. III. Cycloalkanes , cycloalkenes and Alkadienes. [6]

1 Cycloalkanes: -

1. Introduction.

2. Method of formation -a) By addition of carbene to alkene b) Action of metallic sodium on dihaloalkane c) Diels - Alder reaction d) By reduction of aromatic compounds

3. Chemical properties- a) Photohalogenation b) Catalytic halogenations c) Catalytic hydrogenation d) Effect of heat e) Reaction with hydrogen halide

(Ref.1 P.N.272 – 279; Ref.2 P.N. 585-589)

2 Cycloalkenes :

1. Introduction
2. Method of formation from cyclic compounds,
3. Chemical Properties - a) Hydrogenation b) Addition of Halogens and halogen acids, c) Allylic halogenations

3 Alkadienes :

1. Introduction
2. Classification
3. Buta-1,3-diene - a) Structure b) Methods of formation - from cyclohexane, From Butane by dehydrogenation, From acetylene, From Butane-1,3 - diol, From ethanol and acetaldehyde (Industrial method)
4. Chemical Properties - a) Reaction with hydrogen halide b) Reaction with halogens -With one molar equivalent of halogens (Cl_2 or Br_2) c) Diels- Alder reaction d) Reduction – hydrogenation e) Oxidation – Ozonolysis f) Polymerization (Ref.2 P.N. 245 -248)

References :

1. Organic Chemistry 2nd Edition by Robert Thornton Morrison and Robert Neilson Boyd.
2. A Text – boot of Organic Chemistry by Arun Bhal , B.S.Bhal 18th Edition , 2006.

Unit No. IV. Synthetic Reagents [7]

1. Ethyl acetoacetate: Introduction, reactive methylene group, acidity of methylene hydrogen, Synthesis by Claisen condensation, Keto-enol tautomerism, Synthetic applications-Synthesis of Alkyl and dialkyl derivatives, Monobasic acids, Dibasic acids, α- β- unsaturated acid, ketonic acids, ketones and heterocyclic compounds.

2. Diethyl malonate: Introduction, Synthesis, Synthetic applications - Synthesis of alkyl and dialkyl derivatives, fatty acids, dibasic acid, α- β- unsaturated acid, α-amino acid and, heterocyclic compounds.

3. Grignard Reagent: Introduction to organometallic compounds, Preparation of Grignard reagent, Synthetic application , Nucleophilic substitution (Synthesis of alkanes, alkenes, alkynes, ethers, ketones, esters, primay amines and cyanides) and Nucleophilic addition (Synthesis of Primary, secondary and tertiary alcohols, carboxylic acids, aldehydes and ketones). Reactions with oxygen, sulphur and halogens.

Reference:

1. Organic Chemistry (Sixth edition) - R. T. Morrison and R. N. Boyd Prentice Hall of India private limited New Delhi (1996) Carbanion II-Malonic Ester and Acetoacetic ester synthesis (P. No. 923-930)

2. A Textbook of Organic Chemistry (Third Edition)- K.S. Tewari, N. K. Vishnoi Vikas Publishing House, New Delhi (2007) - Reactive Methylene Compounds (Page No. 1098-1128) Organometallic Compounds (Page No. 975-986)

3 Textbook of Organic Chemistry (Twenty Eighth Edition) - P. L. Soni, H. M. Chawla-Sultan Chand & Sons, New Delhi (2001) – Organometallic Compounds (Page No. 2-335-345), Acetoacetic, Malonic and Cyanoacetic esters (Page No. 2-351-370)

4. Organic Chemistry Vol I (Second Edition) - S.M.Mukherji, S.P.Singh, R.P.Kapoor, R.Das –New Age International (P) Ltd. Publishers Mumbai (2010) –Organometallic Compounds (Page No. 691-710)

5. Organic Chemistry Vol II (First Edition) - S.M.Mukherji, S.P.Singh, R.P.Kapoor,–New Age International (P) Ltd. Publishers Mumbai (2008) – Organic Synthesis via Enolates (Page Nos 870-900)

6. Modern Organic Chemistry M.K.Jain, S. C. Sharma-Vishal Publishing Co Delhi (2010) –Topic on Organic Active methylene compounds (Page Nos 637-663) Organometallic Compounds (Page Nos 778-786)

7. Textbook of Organic Chemistry (Fourth Edition) - Raj K. Bansal -New Age International (P) Ltd. Publishers Mumbai (Fourth Edition 2003) Functional derivatives of carboxylic acids(Page No 600-610) Organometallic Compounds (Page No 690-701)

8. Organic Chemistry (Fifth Edition) – Stanley H. Pine-Tata-McGraw-Hill Publishing Company Ltd.- New Delhi (2007)-Organometallic Compounds (Page No 241-245)

Unit No V. Aromaticity [07]

1. Introduction: Characteristic properties of aromatics compounds.
2. Meaning of Important terms- Aromatic, Non aromatic, Anti aromatic, Pseudo aromatic
3. Structure of Benzene - Kekules structure, Resonance, M.O.T.
4. Modern Theory of Aromaticity
5. Huckels Rule and its applications
6. General Mechanism of Electrophilic substitution.

8. Aromatic Nucleophilic substitutions - orientation and reactivity, bimolecular displacement, Elimination–addition, Reactivity and orientation in Aromatic Nucleophilic substitutions.

References:

1. R. T. Morrison and R.N Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (P. No. 493-509, 952-966)

2. I. L. Finar, 'Organic Chemistry '- Vol.- 6th Edition I, Pearson Education

3. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Vishal Publishing Company Co.

4. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House.

SEMESTER – II PAPER – IV

Industrial Chemistry [37]

Unit I Basic Concepts in Industrial Chemistry [08]

1. Introduction.
2. Definition and Explanation of following terms- Solute , Solvent, Solution, Polar solvent, Non-Polar solvent, Saturated solution, Unsaturated solution, Super saturated solution, Normality, Equivalent weight, Molality, Molecular weight, Molarity, Molarity of mixed solution, Acidity of base, Basicity of acid, Percentage solution, ppt, ppm, ppb solutions, Mole Fraction, Weight fraction, Percentage composition by W/W, W/V, V/V.
3. Problems based on Normality, Molarity, mole fraction, mixed solution, etc.

References :

1) Principles of Physical Chemistry by Puri, Sharma and Pathania, Vishal Publishing company Jalindhar, (Page No. 747-750).
2) Essential of Physical Chemistry by Bahl B.S., Tuli G.D. and Bahl Arun, S. Chand and Company Ltd.New Delhi(Page No. 425-450).
3) Modern Analytical Chemistry By David Harvey, McGRAW-Hill International Edition, 2000 (Page No. 11-34).

Unit II Water [08]

1. Introduction.
2. Water for Industry.
3. Sources of water.
4. Main quality, characteristics of water: hardness(Temporary and permanent, unit of hardness), Total solids, transparency and silica contents.
5. Potability of water.
6. Sterilization and disinfection of water; Chemical methods (Aeration, use of $KMnO_4$, ozonization, bleaching powder) and physical methods of sterilization (Boiling, exposure to sunlight and UV light, Irradiation with ultrasound).

7. Softening of water (Mention methods and detail explanation of Ion exchange method).
8. Measurement of water quality by chemical and physical examination: Colour, Taste, Turbidity, Alkalinity, Suspended solids, Hydrogen ion concentration, Acidity, Biological oxygen demand(BOD), Chemical oxygen demand(COD), Dissolved oxygen(DO).

References :

1) Industrial chemistry by B.K.Sharma, Goel Publishing Housing, 16th edition 2011 (Page No. 3-131).
2) Analytical chemistry by B.K.Sharma, Krishna Prakashan Media Ltd, Meerut, edition 3rd 2011 (Page No. 104-145).
3) Industrial Chemistry By R.K.Das, Part-II, Kalyani Publisher, Ludhiana, New Delhi, (Page No. 1-15).

Unit III Fuels **[07]**

1. Introduction.
2. What is Fuel.
3. Calorific value and its determination.
4. Classification of fuels(solid, liquid and gas fuels).
5. Properties of good fuels.
6. Knocking.
7. Octane number.
8. Cetane number.
9. Anti-knocking compounds.
10. Advantages and Disadvantages of solids over liquid and gas fuels.
11. Biofuels.

References :

1) Industrial chemistry by B.K.Sharma, Goel Publishing Housing, 16th edition 2011(Page No. 217-310).

2) Advanced Inorganic Chemistry, Vol.No.1, by Gurudeep Raj, Krishna Prakashan Media Ltd, Goel Publication, Meerut(Page No.1063-1073).
3) Analytical chemistry by B.K.Sharma, Krishna Prakashan Media Ltd, Meerut, edition 3rd 2011(Page No. 3-72).

Unit IV Unit Operations [07]

1. Distillation techniques.
2. Distillation of liquid mixtures.
3. Types of distillation.
4. Types of columns and packings, Condensers, Vacuum distillation, Spinning-band distillation, Steam distillation, Kiigelrohr distillation, Isopiestic or isothermal distillation.
5. Recrystallization techniques.
6. Filtration, Choice of solvents, Petroleum ethers, Mixed solvents.
7. Sublimation.

References:

1) Purification of Laboratory Chemicals, 5th Edition, by Wilfred L.E. Armarego, Christina L.L. Chai, (Page No.1-17).
2) Industrial chemistry by A.K.Dee (Page No.860-875).

Unit V Fertilizers [07]

1. Introduction.
2. Micronutrients.
3. Types of Fertilizer.
4. Needs and Essential requirements of fertilizer.
5. Fertility and pH Value of soil.
6. Classification of fertilizer and Action of urea as a fertilizer.
7. Mixed fertilizer(NPK fertilizer).
8. Complex fertilizer.
9. Phosphatic fertilizer.

10. Manufacture of triple Super-phosphate.
11. Pollution caused by the fertilizer.
12. Effect of fertilizer.

References :

1) Industrial chemistry by B.K.Sharma, Goel Publishing Housing, 16th edition 2011 (Page No. 762-808)
2) Industrial chemistry by Harish Kumar, Srup and Sons , New Delhi, edition 1st (Page No. 207-224)
3) Shreve's Chemical Process Industries, 5th edition by George T., Austin, McGRAW-Hill International Edition (Page Nos. 273-276, 311-313, 477-481).

Laboratory Course (Practicals)

N.B.: i) Use of analytical or Digital balance with 1mg sensitivity is allowed.

ii) Use S.I. units wherever necessary.

iii) All dilutions should be done in 100 mL volumetric flask.

iv) Double burette method should be used for titration.

Physical Chemistry

1. Determination of viscosity of given liquids A and B. (Density data of liquids, viscosity of water to be given) [Any two liquids from: Acetone, CCl_4, Chloroform, Ethyl alcohol. Benzyl alcohol, Ehylene glycol and n-propyl alcohol.]
2. Determination of equivalent weight of Mg by Eudiometer.
3. Study of specific reaction rate of hydrolysis of methyl acetate in presence of HCl.
4. Study of reaction between $K_2S_2O_8$ and KI (Equal concentrations).
5. Determination of heat of ionization of weak acid by using polythene bottle.
6. Preparation and standardization of HCl and H_2SO_4 solutions from bulk.

References:

1) Practical book of Physical Chemistry: Nadkarni, Kothari & Lawande.

2) Experimental Physical Chemistry: A. Findlay.

3) Systematic Experimental Physical Chemistry: S. W. Rajbhoj, Chondhekar. (Anjali Publ.)

4) Experiments in Physical Chemistry: R. C. Das and B. Behra. (Tata Mc Graw Hill)

5) Advanced Practical Physical Chemistry: J. B. Yadav (Goel Publishing House.)

6) Practical Physical Chemistry: B. D. Khosala. (R. Chand & Sons)

7) Experiments in Chemistry: D. V. Jagirdar.

8) A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis: A.I. Vogel (Third Ed.)
(ELBS)

Organic Chemistry

1) Estimations(any two) :

1. Estimation of aniline.
2. Estimation of acetamide.
3. Estimation of Aspirin.

2) Organic Qualitative analysis :

Identification of at least **Six** organic compounds with reactions including **one** from acids, **one** from phenols, **one** from bases and **three** from neutrals from the list of compounds given below :

1. Acids : Oxalic acid, Benzoic acid and Cinnamic acid.

2 Phenols : □-Naphthol, Resorcinol.

3 Bases : Aniline, p-Toluidine.

4 Neutrals : Acetone, Ethyl acetate, Glucose, Chloroform, Chlorobenzene, m-Dinitrobenzene, Thiourea.

Note : A systematic study of an organic compound involves the following operations which should be taught in details with reactions in the detection of elements and functional group.

1) Preliminary tests and Physical examination.
2) Physical constant.

3) Detection of Elements.
4) Detection of Functional group.
5) A Search into the literature.
6) Special Test.
7) Summary.
8) Result.

References:

1) Vogel's Text Book of Quantitative Chemical Analysis. (Longmann) ELBS Edition.
2) Vogel's Text Book of Qualitative Chemical Analysis. (Longmann) ELBS Edition.
3) Hand book of Organic Qualitative Analysis : Clarke.
4) Comprehensive Practical Organic Chemistry – Qualitative Analysis by V. K. Ahluwalia, Sunita Dhingra. University Press. Distributor – Orient Longman Ltd.
5) Comprehensive Practical Organic Chemistry preparation and Quantitative Analysis : V. K. Ahluwalia, Renu Aggarwal. University Press. Distributor – Orient Longman Ltd.
6) A Laboratory Hand - Book of Organic Qualitative Analysis and Separation : V. S. Kulkarni. Dastane Ramchandra & Co. Pune.

Inorganic Chemistry

A) Inorganic Quantitative Analysis :

1) Determination of amount of acetic acid in commercial vinegar using NaOH..

2) Water analysis :

To determine alkalinity of water sample by using phenolphthalein and methyl orange indicator. Standard HCl solution to be supplied.

3) Volumetric Analysis :

1. To prepare a standard solution of Oxalic acid and determine the strength of Potassium permanganate solution in terms of normality and Kg/dm3.

2 To prepare standard solution of Potassium dichromate and determine strength of Ferrous Ammonium Sulphate solution in terms of normality and Kg/dm3. (Use internal indicator)

B) Qualitative Analysis :

1) Spot Tests :

Detection of following cations using spot tests : Cu^{2+}, Co^{2+}, Ni^{2+}, Fe^{3+}, Zn^{2+}, Mg^{2+}, Al^{3+}, Pb^{2+}.

2) Chromatography :

Separation and identification of cations by Paper Chromatographic technique from the following mixtures :

a) Ni^{2++} Cu^{2+}

b) Ni^{2++} Co^{2+}

c) Cu^{2++} Co^{2+}

References:

1) Vogel's Text Book of Quantitative Chemical Analysis
(Longman ELBS Edition).

2) Vogel's Text Book of Qualitative Chemical Analysis
(Longman ELBS Edition)

3) Basic Concepts in Analytical Chemistry (Wiley Eastern Ltd.) : S. M. Khopkar.