

NORTH MAHARASHTRA UNIVERSITY, JALGAON

F.Y.B.Sc.

Chemistry Syllabus

Subject Title: Physical and Inorganic Chemistry

Semester I

Subject Code CH- 111

Part-I Physical Chemistry

Chapter 1: The Gaseous State

(Marks-28, Lectures-20)

The kinetic theory of ideal gases. Assumptions of kinetic theory of gases. Derivation of kinetic gas equation. Deductions of Avogadro's principle, Graham's law, kinetic energy of translation. Deviations of real gases from ideal behavior. Reasons for deviation, compressibility factor, Van der Waal's equation, its applications. Andrew's experiment, Andrew's isotherms of CO₂, relation between critical constants and Van der Waal's constants, Liquification of Gases, Joule Thomson effect, Lindes Process, related numericals

Ref. 1, 2 (Relevant pages)

Chapter 2: Mathematical Preparation in Chemistry

(Marks- 12, Lectures-10)

Logarithm: Rules of Logarithm (without proof), Characteristic and Mantissa of Logarithm, Negative Logarithm, numerical based on applications of Logarithm in calculating pH with change of base of logarithm, antilogarithm.

Graphical representation of equations: Rules for drawing graph co-ordinates etc., Equation of straight line, slope and intercept, plotting the graph from the data of chemical properties and problems.

Derivative: Rules of differentiation (without proof), Algebraic, Logarithmic and exponential functions and numerical.

Integration: rules of integration (without proof), Integration with limit, Algebraic, Logarithmic and exponential functions and numerical. Numerical related to Chemistry.

Ref.5 (Relevant pages)

Reference Books

1. Principles of Physical Chemistry, S. H. Maron and C. F. Prutton (4th edition).

2. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli, Arun Bahl (S. Chand . and Co Ltd.) (25th edition).
3. Elements of Physical Chemistry, S. Glasstone and D. Lewis (The Macmillan Press. Ltd. (2nd edition).
4. Principles of Physical Chemistry, Puri, Sharama and Phathaniya (44th Eddⁿ)
5. Mathematical Preparation for Physical Chemistry, Farrington Daniels, Mc Graw- Hill Publication.

Part-II Inorganic Chemistry

Chapter 1: General Properties of Elements

(Lectures 10)

Periodic law, periodicity in following properties right through the periodic table (General trends in each block are expected, trends in any particular group or period not expected)

- a) Size of atoms
- b) Ionization energy
- c) Electron affinity
- d) Electronegativity, determination of electronegativity by Mulliken method and Pauling method
- e) Metallic character
- f) Lattice energy, Born-Haber cycle.

Ref. 1, 3- relevant pages

Chapter 2: VSEPR theory and shapes of molecules

(Lectures 5)

Sidgwick-Powell theory, Valence Shell Electron Pair Repulsion (VSEPR) Theory – assumptions, need of theory, effect of lone pairs and electro negativity. Applications of the theory to explain geometry of irregular molecules like, NH_3 , H_2O , ClF_3 , SF_4 , XeF_2 .

Ref. 1, 2, 3 - relevant pages.

Reference books

- 1) Concise inorganic chemistry- J D Lee (5th edition)
- 2) A new guide to modern valency theory -G I Brown
- 3) Advanced inorganic chemistry (volume I)- Satyapakash , Tuli, Basu, Madan (S Chand publications)
- 4) Analytical Chemistry – G D Christian (6th edition)
- 5) Vogel's textbook of quantitative chemical analysis
- 6) Principles of inorganic chemistry – B R Puri, L R Sharma, K S Kalia
- 7) Theoretical principles of inorganic chemistry – G S Manku (Tata McGraw Hill edition)

Subject Title: Physical and Inorganic Chemistry

Semester II

Subject code CH-121

Part-I Physical Chemistry

Chapter1: Second Law of Thermodynamics

(Marks-16 , Lectures-12)

Introduction, Limitations of first law of thermodynamics, spontaneous and non spontaneous process with examples, Statements of second law of thermodynamics, entropy, entropy changes in isolated systems, entropy changes for systems only, entropy of mixing of gases, entropy changes in ideal gases and physical transformation, Numerical.

Ref.1 (Relevant pages)

Chapter 2: Electrolytic conductance.

(Marks-14, Lectures-10)

Electrolytic conductance, determination of conductance, variation of conductance with concentration, equivalent conductance at infinite dilution, Kohlrausch's law and its applications.

Applications of conductance measurement-

- a. Solubility of sparingly soluble salts.
- b. Determination of degree of ionization.
- c. Conductometric titration, Numerical problems relevant to the topic are expected.

Ref. 2,3 (Relevant pages)

Chapter 3: Liquid State.

(Marks-10, Lectures-08)

Introduction, Surface tension of liquid, units of surface tension, factors affecting surface tension, determination of surface tension of liquids by single capillary method and stalagmometer method. Viscosity of liquid, units of viscosity, measurement of viscosity of liquid by Ostwald's method, related numerical.

Ref. 2,3 (Relevant pages)

Reference Books

1. Principles of Physical Chemistry, S. H. Maron and C. F. Prutton (4th edition).
2. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli, Arun Bahl (S. Chand and Co Ltd.) (25th edition).
3. Elements of Physical Chemistry, S. Glasstone and D. Lewis (The Macmillan Press Ltd. (2nd edition).

Part-II Inorganic Chemistry

Chapter 1: Chemical bonding and structure

(Lectures 9)

Attainment of stable configuration, Types of bonds-

- Ionic bond-NaCl, CaCl₂
- Covalent bond (Lewis concept)- H₂, Cl₂, HF, NH₃, H₂O, O₂, N₂ molecules
- Coordinate bond NH₄⁺, H₃O⁺
- Metallic bond.

Types of overlap:- S-S, S-P, P-P overlaps with examples like H₂, F₂, HF, O₂ and N₂ molecules.

Theories of bonding: Valence Bond theory – Heitler- London theory and Pauling- Slater theory.

Ref. 1, 2, 3 - relevant pages.

Chapter 2: Metals and Metallurgy

(Lectures 6)

Occurrence of metals, various steps involved in metallurgical processes, concentration of ore, calcinations, roasting, reduction to free metals, electrometallurgy, hydrometallurgy, refining of metals.

Ref. 6,7 - relevant pages.

Reference books

- Concise inorganic chemistry- J D Lee (5th edition)
- A new guide to modern valency theory -G I Brown
- Advanced inorganic chemistry (volume I)- Satyapakash , Tuli, Basu, Madan (S Chand publications)
- Analytical Chemistry – G D Christian (5th edition)
- Vogels textbook of quantitative chemical analysis
- Principals of inorganic chemistry – B R Puri, L R Sharma, K S Kalia
- Theoretical principles of inorganic chemistry – G S Manku (Tata McGraw Hill edition)

PROPOSED SYLLABUS FOR F.Y.B.Sc. (CHEMISTRY)

Subject Title: Organic and Inorganic Chemistry

Semester I

Subject Code CH-112

Part-I Organic Chemistry

Chapter 1: Basic Principles of organic chemistry (L- 11, M-15)

- Introduction of organic chemistry, general properties of organic compounds, applications of organic compounds.
- Structural effects -1) Inductive effect 2) Resonance- conditions for resonance, resonance structures of benzene, naphthalene, acetate ion, phenoxide ion, aniline, nitrobenzene and allyl carbonium ion. 3) Hyperconjugation - stability of alkenes and carbocations 4) Steric effect 5) Electromeric effect.
- Fundamentals of organic reaction mechanism - Fission of covalent bond (Homolytic and Heterolytic fission), reactive intermediates (carbonium ion, carbanion and carbon free radicals), types of reagents (electrophiles and nucleophiles), types of organic reactions.
- Isomerism, types of structural isomerism.
- Purification techniques- crystallisation, distillation, sublimation.
- Solvents- properties of solvents, classification of solvents- 1) protic and aprotic 2) acidic, basic and amphoteric 3) aqueous and nonaqueous 4) polar and nonpolar.

Ref. 1, 2, 3, 4, 5 (Relevant pages)

Chapter 2 : Nomenclature of organic compounds (L -10, M-12)

- Monofunctional compounds - Common and IUPAC nomenclature of - alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, sulphonic acids, cyanides, thiols and nitroalkanes.
- Bifunctional compounds- nomenclature based on priority order.
Ref. 1, 2, 4, 5 (Relevant pages)

Chapter 3 : Hydrocarbons

(L-09, M-13)

- **Alkanes**
Preparation of alkanes - by Wurtz reaction, by hydrogenation of alkenes and alkyl halides. Reactions of alkanes – halogenation, nitration, sulphonation, combustion, pyrolysis, isomerisation.
 - **Alkenes**
Preparation of alkenes - by dehydration of alcohols, dehydrohalogenation of alkyl halides, dehalogenation of vicinal dihalides, reduction of alkynes. Reactions of alkenes - addition of halogen, hydrogen halide, hydration, ozonolysis.
 - **Alkynes**
Preparation of alkynes- by double dehydrohalogenation of vicinal and geminal dihalides, alkylation of acetylene. Reactions - Addition of halogens, hydrogen halides, hydration.
Ref. 1, 2, 4, 5 (Relevant pages)
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Part- II Inorganic Chemistry

Chapter 1: S Block elements

(Lectures 5)

Alkali metals

- a) Electronic structure
- b) Size of atoms and ions and ionization energy.
- c) Chemical properties, reaction with water and air.
- d) Solutions of metals in liquid ammonia.
- e) Biological importance of alkali metal ions.
- f) Difference between lithium and other group-I elements.

Alkaline Earth Metals

- a) Electronic structure.
- b) Size of atoms and ion
- c) Biological role of Mg and Ca.
- d) Difference between beryllium and other group-II elements

Ref. 1, 3 - relevant pages.

Chapter 2: Acids and Bases

(Lectures 10)

Theory of acids and bases – Arrhenius theory, Bronsted- Lowry theory, conjugate acid base pairs, Lewis theory, strong and weak acid and bases, degree of dissociation, dissociation constants of acid and bases, P^H and P^{OH} , ionic product of water, numerical. Buffer solutions – Definition, properties, types, Henderson equation, numerical.

Ref. 3,4,6 - relevant pages.

Reference books

- 1) Concise inorganic chemistry- J D Lee (5th edition)
- 2) A new guide to modern valency theory -G I Brown
- 3) Advanced inorganic chemistry (volume I)- Satyapakash , Tuli, Basu, Madan (S Chand publications)
- 4) Analytical Chemistry – G D Christian (6th edition)

- 5) Vogels textbook of quantitative chemical analysis
 - 6) Principals of inorganic chemistry – B R Puri, L R Sharma, K S Kalia
 - 7) Theoretical principles of inorganic chemistry – G S Manku (Tata McGraw Hill edition)
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Part-I Organic Chemistry**Chapter 1 : Halogen derivatives of alkanes****(L- 6, M-08)**

- **Monohalogen derivatives**- Introduction, Classification, Methods of preparation- from alcohols (using HX, PX_3 , PX_5 , $SOCl_2$). Physical properties. Reactions - with aqueous alkali, sodium alkoxide, alc.KCN, silver salt of acid, alc.ammonia, NaSH/KSH, dehydrohalogenation, formation of Grignard's reagent.
- **Dihalogen derivatives**- preparation of vicinal and geminal dihalides, reactions- hydrolysis with aqueous NaOH.
Ref. 1, 2, 4, 5 (Relevant pages)

Chapter 2 : Alcohols, Ethers and Epoxides**(L-8, M-11)**

- **Alcohols** - Introduction, classification, methods of preparation from Grignard's reagent (using aldehydes and Ketones), by reduction of aldehydes and Ketones. Physical properties. Reactions of alcohols – reaction with active metals, dehydration, oxidation, reaction with copper.
- **Ethers** - Introduction, classification, Methods of preparation- by Williamson's synthesis, by dehydration of alcohols, from diazomethane. Reactions of ethers- formation of oxonium salts, reaction with HI, hydrolysis with dil. H_2SO_4 .
- **Epoxides** – Preparation of ethylene oxide, reaction with dilute acid, alcohol, ammonia, HX, Grignard's reagent.
Ref.1, 2, 4, 5 (Relevant pages)

Chapter 3 : Aldehydes and Ketones**(L-8, M-11)**

- Introduction, structure of carbonyl group.

- Aldehydes- preparation by reduction of acid chlorides, from Grignard's reagent and HCN, from terminal geminal dihalides, from calcium salt of acids.
- Ketones- preparation from Grignard's reagent and R-CN, from nonterminal geminal dihalides, from calcium salt of acids.
- Reaction of aldehydes & Ketones- reducing properties of aldehydes- reaction with Tollen's reagent and Fehling's solution, Clemmenson reduction, Wolff Kishner reduction, Aldol condensation, Cannizzaro reaction, addition of HCN, NaHSO₃, addition of derivatives of ammonia (hydroxyl amine, phenyl hydrazine, 2,4 DNP, semicarbazide), haloform reaction.

Ref. 1, 2, 4, 5 (Relevant pages)

Chapter 4 : Carboxylic acids and their derivatives

(L-8, M-10)

- **Carboxylic acids** Introduction, preparation of carboxylic acids- by carbonation of Grignard's reagent, by hydrolysis of nitriles. Physical properties of acids, acidity of acids. Reactions of carboxylic acids- formation of salt (with NaOH, KOH, Na₂CO₃, NaHCO₃, NH₄OH and active metals), Hell-Volhard-Zelinsky reaction, formation of acid anhydrides.
- **Esters** - Preparation from alcohol & acid, alcohols & acid chloride. Hydrolysis of esters (alkaline and acidic).
- **Acid chlorides** - preparation -from acids and PCl₃, PCl₅, SOCl₂. Reaction- with benzene, with sodium salt of acids.
- **Amides** - Preparation from acid and ammonia, acid chloride and ammonia. Reactions - hydrolysis, reaction with Br₂ and NaOH.

Ref. 1, 2, 4, 5 (Relevant pages)

Reference Books

- 1) Organic chemistry - Francis A Carey (3rd Edition)
Tata McGraw Hill (1999)
- 2) Organic chemistry - Morrison and Boyd (6th Edition)
- 3) Guide book to mechanism in organic chemistry -Peter Sykes (6th Edition)
- 4) Organic chemistry - Stanley H pine (5th Edition)
- 5) Text book of organic chemistry – Arun Bahl and S.B.Bahl, (S Chand)

Part-II Inorganic Chemistry

Chapter 1: Basic Concepts in volumetric analysis (Lectures 8)

Molecular weight, formula weight, equivalent weight, calculation of equivalent weight of acids, bases, oxidizing and reducing agents, units of concentration – molarity, normality, formality, molality, related numerical, standard solution, primary and secondary standards, titrant, analyte, end point, equivalence point.

Ref 4,5 relevant pages.

Chapter 2: P Block elements (Lectures 7)

Group 13

Electronic structures, size of atoms and ions, ionization energy, metallic and non-metallic character of the elements.

Group 14

Electronic structure, difference between carbon, silicon and the remaining elements, allotropes of carbon-graphite and diamond.

Group 15

Electronic structure, oxidation state, metallic and non-metallic character, reactivity, fertilizers and nitrogen fixation.

Group 16

Electronic structure, difference between oxygen and other group elements.

Group 17

Electronic structure, physical state, colour, oxidizing power and reactivity.

Ref. 1, 3 - relevant pages.

Reference books

- 1) Concise inorganic chemistry- J D Lee (5th edition)
- 2) A new guide to modern valency theory -G I Brown
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F. Y. B. Sc. CHEMISTRY PRACTICALS

Course Subject code: CH-113

Subject Title : Chemistry Practical

Semester I

A) Physical Chemistry Experiments (Any three)

1. Calibration of volumetric apparatus Pipette / Volumetric flask.
2. Determination of surface tension by drop number method of given liquid by using stalagmometer.
3. To determine the gas constant R in different units by Eudiometer method.
4. Determination of heat of solution of $\text{KNO}_3/\text{NH}_4\text{Cl}$ by water equivalent method.
5. To standardize commercial sample of HCl using Borax and to write material safety data of the chemicals involved.

B) Analytical Chemistry Experiments (Any three)

- 1) Preparation of standard 0.1N Na_2CO_3 solution and standardization of HCl solution.
- 2) Preparation of standard 0.1N oxalic acid solution and standardization of KMnO_4 solution.
- 3) Preparation of standard 0.1N NaCl solution and standardization of AgNO_3 solution.
- 4) Determination of loss per gram and percentage purity of zinc carbonate gravimetrically.
- 5) Determination of loss per gram and percent purity of mixture of NaHCO_3 and Na_2CO_3 .

C) Inorganic Chemistry Experiments

Inorganic Qualitative Analysis (Any Five Compound)

Analysis of inorganic compound containing one cation and anion (excluding phosphate and borate)

F. Y. B. Sc. CHEMISTRY PRACTICALS

Course Subject code: CH-123

Subject Title : Chemistry Practical

Semester II

A) Physical Chemistry Experiments (Any three)

1. Determination of relative viscosity of liquid A and B by viscometer.
2. Determination of percentage composition (v/v) of given mixture of ethyl alcohol and water by viscometer.
3. Conductometric titration - NaOH Vs HCl/CH₃COOH.
4. Determination of dissociation constant of weak monobasic acid (CH₃COOH) by conductance measurement.
5. Determine the solubility and solubility product of sparingly soluble salt by conductometry.

B) Analytical Chemistry Experiments (Any three)

- 1) Determination of molecular weight of a dibasic acid.
- 2) Estimation of aniline / phenol.
- 3) Preparation of standard 0.1N ZnSO₄ solution and standardization of EDTA solution.
- 4) Preparation of standard 0.1N K₂Cr₂O₇ solution and standardization of Na₂S₂O₃ solution.
- 5) Determination of number of molecules of water of crystallisation in sample of crystalline barium chloride / magnesium sulphate.

C) Organic Chemistry Experiments

Organic Qualitative Analysis (Any Five Compound)

- | | |
|-----------------------|---------------------------|
| 1) Type determination | 3) Physical constant |
| 2) Preliminary tests | 4) Functional group tests |
- (Structural formula not expected)

Examination Pattern.
Chemistry Practical Semester I
CH-113

Time 4 Hrs 30Min
Marks 60

Q 1. Physical Chemistry experiment	(25+5 oral)	30 Marks
OR Analytical Chemistry experiment		
Q 2. Inorganic Qualitative analysis	(20+5 oral)	25 Marks
Q 3. Journal		05 Marks
	Total	60 Marks

Examination Pattern
Chemistry Practical Semester II
CH-123

Time 4 Hrs 30Min
Marks 60

Q 1. Physical Chemistry experiment	(25+5 oral)	30 Marks
OR Analytical Chemistry experiment		
Q 2. Organic Qualitative analysis	(20+5 oral)	25 Marks
Q 3. Journal		05 Marks
	Total	60 Marks

Note- $\frac{1}{4}$ of the students in batch will be given with physical chemistry experiment, $\frac{1}{4}$ will be given with analytical chemistry experiment and $\frac{1}{2}$ will be given with Inorganic or Organic chemistry experiment at the beginning then after they are to be rotated.

