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 CO_2, 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) Electronegetivity, determination of electronegetivity 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, effct of lone pairs and electro negativity. Applications of the theory to explain geometry of irregular molecules like, NH_3, H2O, ClF_3, SF_4, XeF_2.

Ref. 1, 2, 3 - relevant pages.

Reference books

1) Concise inorganic chemistry- J D Lee (5^{th} 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 (6^{th} 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)

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-

a) Ionic bond-NaCl, $CaCl_2$
b) Covalent bond (Lewis concept)- H_2, Cl_2, HF, NH_3, H_2O, O_2, N_2 molecules
c) Co ordinate bond NH_4^+, H_3O^+
d) Metallic bond.
   Types of overlap:- S-S, S-P, P-P overlaps with examples like H_2, F_2, HF, O_2 and N_2 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)

Occurance 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

1) Concise inorganic chemistry- J D Lee (5^{th} 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 (5^{th} 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)

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)

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 (5^{th} 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 (6^{th} 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)

Semester II **Subject code CH-122**

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, $NaHSO_3$, 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, Na_2CO_3, $NaHCO_3$, NH_4OH 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 PCl_3, PCl_5, $SOCl_2$. Reaction- with benzene, with sodium salt of acids.
- **Amides -** Preparation from acid and ammonia, acid chloride and ammonia. Reactions - hydrolysis, reaction with Br_2 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 (5^{th} 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 (6^{th} 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)

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 stalagnometer.
3. To determine the gas constant R in different units by Eudiometer method.
4. Determination of heat of solution of KNO_3/NH_4Cl 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/CH_3COOH.
4. Determination of dissociation constant of weak monobasic acid (CH_3COOH) by conductance measurement.
5. Determine the solubility and solubility product of sparingly soluble salt by conductometery.

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 $ZnSO_4$ solution and standardization of EDTA solution.
4) Preparation of standard 0.1N $K_2Cr_2O_7$ solution and standardization of $Na_2S_2O_3$ 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
2) Preliminiary tests (Structural formula not expected)
3) Physical constant
4) Functional group tests

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- ¼ of the students in batch will be given with physical chemistry experiment, ¼ will be given with analytical chemistry experiment and ½ will be given with Inorganic or Organic chemistry experiment at the beginning then after they are to be rotated.

North Maharashtra University, Jalgaon.

S. Y. B. Sc. Syllabus

(Semester III and IV, 60+40 Pattern)

Subject -Chemistry

From June 2016

North Maharashtra University, Jalgaon.

Class- S. Y. B. Sc. (Semester Pattern) (With effect from June 2016)

The nomenclature accepted is as follows. CH-YSC [**Y** for year, **S** for semester and **C** for course number]. The course structure and title of the courses for S. Y. B. Sc. (Chemistry) are as given below

Course Title	Semester	Lectures	Marks	
			Ext.	Int.
CH 231: Physical and Inorganic Chemistry	**III**	**60**	**60**	**40**
CH-232:-Organic and Analytical Chemistry	**III**	**60**	**60**	**40**
CH-233:-Chemistry Practical's	**III**	**60**	**60**	**40**
CH-241:-Physical and Inorganic Chemistry	**IV**	**60**	**60**	**40**
CH-242:-Organic and Analytical Chemistry	**IV**	**60**	**60**	**40**
CH-243:-Chemistry Practical's	**IV**	**60**	**60**	**40**

Note

1. Each course is having weight-age four lectures per week.
2. Each practical course is having weight age four lectures per week.
3. Examination of practical course shall be held at the end of the each semester.

IMPORTANT NOTE

***In volumetric analysis, volume of pipette solution should be 10 ml instead of 25 ml. Similarly preparation of 100 ml solution by using 100 ml volumetric flask instead of 250 ml. (To avoid wastage of chemicals)**

* External Examination Pattern.
Chemistry Practical CH-233

Marks 60
Time 3 hrs

Instructions

1. Duration of examination 3hrs (Batch-I-10.00 am to 1.00 pm. and Batch-II 2 to 5pm)
2. All the students in a batch should be divided in three equal groups, which have been provided with Physical OR Analytical OR Volumetric OR Chromatography and Organic/ Inorganic preparation
3. Students should have complete Certified Journal at the time of practical examination.

1. Physical OR Volumetric OR Chromatography and Organic/ Inorganic preparation 50 Marks
2. Oral 10 Marks

Total 60 Marks

Internal Examination Pattern.
Chemistry Practical CH-233

1. Physical OR Volumetric OR Chromatography and Organic/ Inorganic preparation 30 Marks
2. Journal (Complete and Certified) 10 Marks

Total 40 Marks

External Examination Pattern.
Chemistry Practical CH-243

Marks 60
Time 3 hrs

Instructions

1. Duration of examination 3 hrs (Batch-I-10.00 am to 1.00 pm. and Batch-II 2 to 5 pm)
2. All the students in a batch should be divided in three equal groups, which have been provided with Physical OR Organic qualitative OR Gravimetric analysis experiment.
3. Students should bring complete certified journal at the time of practical examination.

1. Physical OR Organic qualitative OR Gravimetric analysis	50 Marks
2. Oral	10 Marks
Total	60 Marks

Internal Examination Pattern.
Chemistry Practical CH-243

1. Physical OR Organic qualitative OR Gravimetric analysis	30 Marks
2. Journal (Complete and Certified)	10 Marks
Total	40 Marks

S. Y. B. Sc. New Syllabus 2016-17

The Course Structure and title of the courses for S. Y. B. Sc. (Chemistry) are as given below:

Course	Title	Semester	Periods	Marks	
				External	Internal
CH-231	Physical and Inorganic Chemistry	**III**	**60**	**60**	**40**
CH-232	Organic and Analytical Chemistry	**III**	**60**	**60**	**40**
CH-233	Chemistry Practical	**III**	**60**	**60**	**40**
CH-241	Physical and Inorganic Chemistry	**IV**	**60**	**60**	**40**
CH-242	Organic and Analytical Chemistry	**IV**	**60**	**60**	**40**
CH-243	Chemistry Practical	**IV**	**60**	**60**	**40**

Note:-

1. Each period is of 50 minutes duration.
2. Each course is having weightage four periods per week.
3. Each practical course is having weightage four periods per week per batch.
3. Each Practical batch should be consist of maximum of 12 students
4. Examination of practical course shall be held at the end of the each semester.

Subject Title: Physical and Inorganic Chemistry

S.Y.B. Sc. CH-231 Semester-III

Part I - Physical Chemistry

1.Chemical Thermodynamics: (M- 17/25, P-16)

Introduction, The Helmholtz free energy, ΔA for reactions, Gibb's free energy and, ΔG for reactions, Properties and significance of Gibb's free energy changes, Calculation of free energy changes, Fugacity and activity concepts, The reaction isotherm, Standard free energy change of formation, Criteria of equilibrium .

Physical equilibria involving pure substances, Clapeyron equation and its use, Vapour pressure of liquid and variation of vapour pressure with temperature**,** Clausius-Clapeyron equation, Different form of Clausis Clapeyorn equation and is applications, Related numerical.

Ref.-1:- Pages 189-203, 206-213, 215-218
Ref.-2:- Relevant Pages.
Ref.-3:- Relevant Pages.
Ref.-4:- Relevant Pages.

2.Solutions: (M-13/20, P-14)

Introduction, Solubility, Factors affecting solubility, , Types of solutions, Different way of expressing the concentration of solution , Ideal and non-ideal solutions, Raoults law and its limitation, The vapour pressure of actual liquid pairs the vapour pressure of ideal solution. Classification of binary solution of completely miscible liquids (Type-I, Type-II and Type-III) on the basis of Raoults law), Boiling point diagrams of miscible binary mixtures, Distillation of binary miscible solutions, Azeotropes, the fractionating column, Solubility of partially miscible liquid pairs, Phase diagram Phenol-water system, Tri ethyl amine-water and Nicotine-water system

Ref.-1:- Pages 261-264,270-286,288-291

Ref.-2:- Relevant Pages.

Ref.-3:- Relevant Pages.

Ref.-4:- Relevant Pages.

S.Y.B. Sc. CH-241 Semester-IV

Part I - Physical Chemistry

1.Colligative Properties: (M- 17/25, P-16)

Introduction, Lowering of vapor pressure of solvent, Calculation of molecular weight of solute from Lowering of vapor pressure of solvent. Boiling point elevation of solution, Calculation of molecular weight of solute from boiling point elevation of solution, Freezing point depression of solution, Calculation of molecular weight of solute from depression in Freezing point, Osmosis and osmotic pressure, Relation of osmotic pressure to vapour pressure, Van't –Hoff equation for osmotic pressure, Landberger's method for the determination of elevation of boiling point, Beckman's method for determination of depression in freezing point ,Berkley and Hearty's method, Solution of electrolyte, Colligative properties of electrolyte (Qualitative concept only), related numerical.

Ref.-1:- Pages 312-324, 325-330

Ref.-2:- Relevant Pages.

Ref.-3:- Relevant Pages.

Ref.-4:- Relevant Pages.

2.Electrochemistry (M- 13/20, P-14)

Introduction, Electromotive force and its measurements , Standard cell ,Cell reaction and EMF, convention regarding sign of EMF, Single electrode potential, Standard hydrogen and calomel reference electrodes, Calculation of single electrode potential, Calculation of cell EMF from single electrode potential, Thermodynamics and EMF, ΔG, ΔH, ΔS from EMF data, Thermodynamics of electrode potential (Nernst equation), Standard potential and equilibrium constant, Classification of electrodes, Related numericals.

Ref.-1:- Pages 481-497
Ref.-2:- Relevant Pages.
Ref.-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)

4. Physical Chemistry

Robert A. Alberty (John Willey and Sons) (7th edition)

S.Y.B.Sc. CH-231 Semester-III

Part-II Inorganic Chemistry

1. Chemistry of Transition Elements. (M-16, P-16)

(A) Elements of first, second & third transition series.
(B) General characteristics of d-block elements.

a. Metallic character.	b. Molar volume & densities.
c. Atomic radii	d. Ionic Radii
e. Melting & boiling points	f. Ionization Energies
g. Reactivity	h. Oxidation states
i. Standard electrode potential	j. Reducing properties
k. Color	l. Magnetic properties
m. Catalytic Properties	n. Tendency to form complexes.

Ref. 1-653-671
Ref. 4 -615 -624
Ref. 5-1128-1143

2. The Metallic Bond (M-06, P-6)

a. General Properties of Metals.
b. Conducivity, Luster, Malleability & cohesive force.
c. Conductors, Insulators & Semiconductors, Intrinsic & Exitrinsic semiconductors.

Ref. 1 -121 - 144
Ref. 2-220-231
Ref. 4-175-179
Ref.5-259-264

3. The Metallurgy of Alluminium (Electrometallurgy) (M-08, P- 8)

Occurance, Indian resources, Physichochemical principles, Extraction of Alluminium, Purification of Bauxite, Serpeck's Process, Bayer process, Electrolysis & Allumina, Refining of Alluminium, Hoop's process, Properties & uses of Alluminium, Alluminium Indurstry in India.
Ref. 6 relevant pages
Ref. 7 relevant pages

S.Y.B.Sc CH-241 Semester-IV

Part-II Inorganic Chemistry

1) Chemistry of Lanthanoids Elements. (M 12, P-11)

a. Electronic Structure.
b. Oxidation States .
c. Extraction from monazite sand with flow sheet .
d. Uses .
e. Lanthanoid contraction – Definition, Causes, effects of lanthanoid contraction on chemistry of lanthanoids & post lanthanoid elements.
f. Separation of lanthanoids from one another by solvent extraction & ion exchange chromatography.

2) Chemistry of Actinoids Elements. (M 6, P-6)

a. Electronic structure b. Position in periodic table
c. Oxidation states d. Occurrence of actinoids
e. Preparation of actinoids using
   i) Neutron bombardment
   ii) Accelerated projectile bombardment
   iii) Heavy ion bombardment.

Ref. 1 - pages 859-885
Ref. 4 - 704 - 717

3) Molecular Orbital Theory (MOT) (M 12, P-13)

a. Molecular orbital method.
b. LCAO method.
c. s-s, s-p, p-p, p-d & d-d combination of orbitals.
d. Non Bonding combination of orbitals.
e. Rules for linear combination of orbitals.
f. Molecular orbital treatment for Homo nuclear Diatomic species-H_2,He_2, He_2^+, Li_2,Be_2, B_2 , N_2 & F_2
g. Molecular orbital treatment for Hetero nuclear diatomic molecules CO, NO, & HCl.

Reference Books :

1. Concise Inorganic Chemistry by J.D.Lee.5th Edition.
2. Theoretical Principles of Inorganic chemistry by G.S.Manku Tata McGraw Hill edition.
3. Advanced Inorganic Chemistry Volume-I by Satya Prakash, G.D. Tuli S.K. Basu. R. D. Madan S. Chand & Company Ltd.(2004)
4. Principles of Inorganic Chemistry By Sharma, Puri Kalia 30th edition Milestone Delhi.
5. Advanced Inorganic Chemistry Volume - I , by Gurdeep Raj 23rd edition , Goel Publishing House, Meerut.
6. A Textbook of Inorganic Chemistry by P.L.Soni (20th edition) (S. Chand & Sons , new Delhi.)
7. Advanced Inorganic Chemistry by Tuli, Basu, Madan & Satya Prakash -16 Revised Edition 1992 New Delhi.

Semester III Subject Code CH-232

Subject Title: Organic and Analytical Chemistry

Semester III Subject Code CH-232

Part-I Organic Chemistry

Chapter 1: Stereoisomerism (M-12/18, P-12)

a) **Types of stereoisomerism**.
b) **Projection formulas** – Fischer projection formula, Newman projection formula, Saw horse formula.
c) **Optical isomerism** – optical activity, enantiomerism, chiral centre and chirality, Elements of symmetry, dextrorotatory, laevorotatory, Configuration - R and S nomenclature system.
d) **Geometrical isomerism**- Geometrical isomers, condition for geometrical isomerism, nomenclature system - Cis and Trans, E and Z, Syn and Anti (for oximes)
e) **Conformational isomerism**- conformational isomers, conformational isomerism in ethane and n- butane with energy profile diagrams.

Ref 3, 4, 8 (Relevant pages)

Chapter 2: Amines (M-10/15, P-10)

a)Aliphatic Amines - Introduction , Classification, preparation of amines from alkyl halides by reduction of nitroalkanes and cyanides, Gabriel- Pthalamide synthesis, by alkylation of primary and secondary amines, reduction of isocyanides.Physical properties of amines, basicity of amines, **Reactions** –formation of salts, Reaction with HNO_2, acylation, carbylamines reaction, reaction with aldehydes and ketones.

b)Aromatic amines-Preparation of aniline-from chlorobenzene and nitrobenzene.Basicity of Aromatic amines.
Reactions-Benzoylation, N-Alkylation, Preparation of Benzene Diazonium chloride, Reactions of Benzene Diazonium chloride- Formation of Iodobenzene, Sandmaeyer reaction, Azo coupling reaction (formation of methyl orange).

Ref. 1 (Pages 908-942)
Ref. 6 (Pages 548-560, 730-739)

Chapter 3: Organometallic compounds (M-08/12, P-08)

a) Nomenclature, carbon-metal bond in organometallic compounds.
b) Preparation of organolithium compounds, Preparation of alcohols from organolithium compounds,
c) Preparation of organocopper compounds (Lithium dialkyl cuprate) and synthesis of alkanes, Reformatsky reaction.
d) Preparation of organozinc compounds, Synthesis of Cyclopropanes using RZnX (The Simmons-Smith reaction)

Ref. 1 (Pages 578-595)

Semester IV Subject Code CH-242

Part-I Organic Chemistry

Chapter 1: Chemistry of Heterocyclic Compounds. (M-10/15, P-10)

Definition , Classification of heterocyclic compounds, Nomenclature and aromatic character,
a)Five membered rings with one hetero atom:
Furan, pyrrole and thiophene- Synthesis and Reactions - Nitration, Sulphonation, F C Acylation, Reimer Tiemann reaction, Catalytic hydrogenation.
b)Six membered ring with one hetero atom:
Pyridine- Synthesis- from Acrolein, from Acetylene.
Reactions- Nitration, Sulphonation, Bromination, Catalytic hydrogenation.
c) Condensed heterocycles-
Quinoline- Properties, Skraup's Synthesis.
Isoquinoline - Properties, Bischler-Bapieralski Synthesis.

Ref. 2 (Pages 1093-1104)
Ref. 6 (Pages 849-871)

Chapter 2: Synthetic Reagents (M-08/12, P-08)

a) **Acetoacetic ester**-Preparation of acetoacetic ester
Synthesis of alkyl acetic acid, dialkyl acetic acid, succinic acid, adipic acid, α - β unsaturated acid, methyl ketone (butanone) from Acetoacetic ester.

b) **Malonic ester** - Preparation of malonic ester
Synthesis of alkyl acetic acid, dialkyl acetic acid, succinic acid, glutaric acid, β keto acid (acetoacetic acid), α - β unsaturated acid from Malonic ester.

Ref. 1,2 (Relevant pages)

Chapter 3 : Elimination reactions (M-12/18, P-12)

Types of Elimination
a) 1,2-(β)–Elimination, Mechanism of 1,2-(β)–Elimination,
b) E1 and E2 mechanism, Features of E1 and E2 mechanism,
c) Stereochemistry of E2 reactions (Newman Projection formula is expected)
d) Orientation in E2, Saytzev and Hofmann Orientation.
e) Elimination in cyclic system, Bredt's Rule.

Ref.2- (Pages 326-343).
Ref.7 – (Pages 240-255).
Ref. 5,8 (Relevant pages)

Reference Books:

1) Organic chemistry - Francis A Carey (3rd Edition)
2) Organic chemistry - Morrison and Boyd (6th Edition)
3) Stereochemistry of organic compounds- E L Eliel
4) Stereochemistry of organic compounds- P S Kalsi
5) Organic chemistry - Stanley H pine (5th Edition)
6) A Text book of Organic chemistry- Arun Bahl and B S Bahl, S Chand publication.
7) A guide book to reaction mechanism in organic chemistry by Peter Sykes.5th Ed.
8) Organic reaction mechanism by P. N. Mukherjee, Domonant Publishers and Distributors,New Delhi

Semester III Subject Code CH-232

Part-II Analytical Chemistry

Chapter 1: Introduction to Analytical Chemistry

(M-08/12, P-08)

a) Analytical Chemistry, importance of Analytical Chemistry, types of analysis- qualitativeand quantitative analysis.
b) Sampling – Definition, procedure of sampling, types of sampling.
c) Accuracy, precision, significant figures, significance of zero, rounding off.
d) Errors – Definition, types of errors, minimisation of errors.

Ref.1- 1,2,4,14,15,16,20,21,22
Ref.2,3,4,5 Relevent pages

Chapter 2 : Volumetric (Titrimetric) Analysis

(M-22/33, P-22)

a) Classification of volumetric methods of analysis

b) Acid base titrations

Principle, Acid–base indicators, Henderson-Hasselbalch equation, transition range of indicators. study of acid base titrations with respect to- neutralisation curve, selection of indicators and calculations of pH

i) Strong acid versus strong base
ii) Weak acid versus strong base

Applications of acid base titrations (in short)

c) Precipitation titrations

Principle**,** detection of end point in precipitation titrations, preparation of $AgNO_3$ solution, standardisation of $AgNO_3$ solution- by Mohr's method, Estimation of halides- by Fajan's method, precipitation titration curve.

Applications of precipitation titrations (in short).

d) Redox titrations

Oxidation, reduction, redox reaction, oxidising agents, reducing agents, redox titrations, titration of Ce (IV) and Fe (II) - nature of titration curve, calculation of emf, detection of end point- redox indicators, self indicator and starch indicator, iodimetry and Iodometry.

Applications of redox titrations (in short)

e) Complexometric titrations

Complexes, ligands, types of ligands, chelates, chelating agents, formation of complex, formation constant, chelon effrect, chelating agent EDTA, EDTA equilibria, EDTA titration curve, detection of end point- indicators, principleinvolved in colour change of indicator

Applications of complexometric reactions and titrations (in short)

Ref.1- 83, 220-225, 227-230, 690-696, 277-281, 702-704, 284-287, 354-365, 708-718, 250-263,696-701

Ref.2, 3, 4, 5 Relevant pages

Semester IV Subject Code CH-242

Part-II Analytical Chemistry

Chapter 1: Gravimetric analysis (M-15/22, P-15)

Introduction, advantages of gravimetric analysis, solubility product (with problems), conditions for precipitations, steps of gravimetric analysis: preparation of solution, precipitation, digestion. Impurities in the precipitate- a) co-precipitation b) post precipitation. filtration, washing, drying or ignition, weighing, precipitation from homogeneous solution

Applications- estimation of Ba as $BaSO_4$, Ni as Ni-DMG, Pb as $PbCrO_4$.

Ref.1- 145-153, 161-165
Ref.2,3,4,5 Relevent pages

Chapter 2: Chromatography (M-15/23, P-15)

a) Introduction, advantages and disadvantages of chromatography.
b) Principle of chromatography, classification of chromatographic methods- partition, adsorption ion exchange chromatography and size exclusion chromatography.
c) Paper chromatography- principle, technique, Rf value, ascending and descending techniques, applications.
d) Thin layer chromatography- principle, technique and applications.
e) Column chromatography- principle, technique and applications.

Ref.1- 505-510, 550-554
Ref.2,3,4,5,6 Relevent pages

Reference Books

1. Analytical chemistry – G D Christian (5^{th} Edition).
2. Quantitative chemical analysis- J Mendham, R C Denny, Barnes, Thomas
3. Analytical chemistry- D A Skoog, D M West, F J Holler
4. Vogel's text book of quantitative chemical analysis- Bassett, Denney, Jeffrery
5. Quantitative analytical chemistry- James S Fritz, George H Schenk- fifth
6. Chemical Analysis by A.K. Shriwastava, P.C. Jain, S. Chand and company.

NORTH MAHARASHTRA UNIVERSITY, JALGAON

SYLLABUS FOR S. Y. B. Sc.
Subject Title: Chemistry Practical (CH-233)
Sem -III

A) PHYSICAL CHEMISTRY EXPERIMENTS (any 2)

1. Determination of critical solution temperature of phenol-water system.
2. Determination of normality and strength of HCl titrating with standard NaOH potentiometrically.
3. Construct Daniel cell and determine thermodynamic parameters ΔG, ΔH, ΔS of the cell
4. Determine molecular weight of liquid by steam distillation technique

B) VOLUMETRIC ANALYSIS (any 4)

1. Estimation of acetic acid in commercial vinegar using NaOH.
2. Estimation of aspirin in drug sample.
3. Estimation of chloride by Mohr's method.
4. Estimation of Fe(II) by redox titration with $KMnO_4$.
5. Estimation of copper iodometrically.
6. Estimation of Mg^{+2} by complexometric titration with EDTA.

C) CHROMATOGRAPHY (any 1)

1. Separation of mixture of o-nitroaniline and p-nitroaniline by Thin Layer Chromatography and to determine their Rf values.
2. Separation of mixture of any two amino acids by paper chromatography.

D) ORGANIC PREPARATIONS: (any 2)

1. Acetanilide to P-bromoacetanilide using Cerric Ammonium Nitrate.
2. Benzaldehyde to dibenzalpropanone using NaOH.
3. Semicarbazone derivative of Aldehyde / Ketones.
4. Benzoyl derivative of – OH / $-NH_2$.

E) INORGANIC PREPARATIONS (any 1)

1. Tetramine Cu (II) sulphate.
2. Hexamine Ni (II) chloride.
3. Ferrous ammonium sulphate (Mohr's salt).

NORTH MAHARASHTRA UNIVERSITY, JALGAON

SYLLABUS FOR S. Y. B. Sc.

Subject Title: Chemistry Practical (CH-243)
Sem- IV

A) PHYSICAL CHEMISTRY EXPERIMENTS (any 2)

1. Determination of molecular weight of solute (acetanilide/ m -dinitrobenzene /sulphur) by depression of freezing point method.
2. Determination of molecular weight of non-volatile solute (KCl/ $BaCl_2$/ Urea) by using Landsbergers apparatus.
3. Determination of standard electrode potential of Cu/Cu^{+2} or Ag/Ag^{+}, Zn/Zn^{+2} electrodes potentiometrically.

B) **ORGANIC QUALITATIVE ANALYSIS (any 6 compounds)**

Determination of

1. Type
2. Preliminary tests
3. Physical constant (melting/ boiling point)
4. Elements (Sodium fusion test)
5. Functional groups
6. Structure

C) GRAVIMETRIC ANALYSIS (any 2)

1. Estimation of Ni as Ni-DMG (by Counterpoise method)
2. Estimation of Ba as $BaSO_4$ (by Ignition using filter paper)
3. Estimation of Pb as $PbCrO_4$ (by Gooch crucible or by counterpoise method)

Suggested books for Chemistry Syllabus :

1. Principles of Physical Chemistry, Fourth edition, P.W.Marron and C.F. Prutton

2. Essentials of Physical Chemistry, Colour edition, B.S.Bahl, Arun Bahl and G.D.Tuli, S.Chand & Company (Reprint 2008)

3. Physical Chemistry, R.A.Alberty, Wiley Estern Ltd.

4. Elements of Physical Chemistry, P.W.Atkins, Oxford

5. Physical Chemistry, Ira N. Levin, McGraw Hill, Inc.

6. Physical Chemistry , W. J. Moore

7. Chemical Kinetics , K. J. Laidler, McGraw Hill

8. Concise Inorganic Chemistry by J.D.Lee ,5th Edition

9. Principles of Inorganic Chemistry by B.R.Puri,L.R.Sharma,Vishal Publication Jallandher,Delhi.

10. Text book of Inorganic Chemistry by P.L.Soni.

11. Principles of Inorganic Chemistry,B.R.Puri,L.M.Sharma & K.C.Kalia-Vallabh Prakashan ,DElHI]

12. Basic Inorganic Chemistry, F.A.Cotton, G.Willkinson and P.L.Gaus, Wiley.

13. Advanced Inorganic Chemistry Satya Prakash, Tuli, Basu.

14. Concepts of Models of Inorganic Chemistry, B.Douglus, D.Mcdaniel and J.Alexander, John Wiley.

15. A Text Book of Organic Chemistry, Arun Bahl and B.S.Bahl, S.Chand & Company (7th Edition)

16. Reaction mechanism, Peter Sykes, Orient Longman.

17. Organic Chemistry, S.H. Pine

18. Industrial Chemistry , Shreve.

19. Organic Chemistry, Vol. I & II, Finar ELBS

20. Stereochemistry of Carbon compounds, Eliel McGraw Hill

21. Organic Chemistry, Franicis A.Carey, Tata McGraw Hills

22. College Organic Chemistry, 15th Edition Rao & Others, Himalaya Pub. House, MUMBAI.

23. Organic Chemistry, Morrision and Boyd, Pearson Education (6th Edn.)

24. Outline of Biochemistry, E.E.Conn and P.K.Stumpf, John Wiley
25. Green Chemistry – Theory and Practice, D.T. Anastas, J. C. Warner Oxford.
26. An Introduction to Green Chemistry, V.K.Ahluwalia , Vishal Publishing Company, Jalhandhar.
27. An Introduction to Green Chemistry, V. Kumar, Vishal Publishing Company, Jalhandhar.
28. Green Chemistry – Environment, Friendly Alternatives, Rashmi Sanghi and M.M. Shrivastav , Narosa Publishing House, Mumbai .
29. Analytical Chemistry by G.D.Christain(5th Edition)
30. Fandamentals of Analytical Chemistry, 6th Edn D.A.Skoog and D.M. West.
31. Instrumental methods of chemical analysis by Chatwal and Anand (5th edtion)

S Y B Sc CHEMISTRY EQUIVALANCE

Syllabus to be Implemented from 2016-2017

Name of Subject (old)	Subject Code OLD[80:20]	Name of Equivalent Subject (New)	Subject Code NEW [60:40]
Semester III			
Physical and Inorganic Chemistry	**CH 231**	**Physical and Inorganic Chemistry**	**CH 231**
Organic and Analytical Chemistry	**CH-232**	**Organic and Analytical Chemistry**	**CH-232**
Semester IV			
Physical and Inorganic Chemistry	**CH-241**	**Physical and Inorganic Chemistry**	**CH-241**
Organic and Analytical Chemistry	**CH-242**	**Organic and Analytical Chemistry**	**CH-242**
Chemistry Practical (Annual)	**CH-203**	**Chemistry Practical**	**CH-233*** **OR** **CH-243****

*** If Practical Examination held in October Equivalent subject is CH-233**
**** If Practical Examination held in March Equivalent subject is CH-243**

North Maharashtra University, Jalgaon

SYLLABUS

T. Y. B. Sc.

Subject- Chemistry

(Semester 60-40 Pattern)

With Effect From- June 2017

Prepared By

Conveners of Syllabus designing workshop And

Experienced Teachers in Chemistry,

North Maharashtra University, Jalgaon.

North Maharashtra University, Jalgaon.

Class:- T.Y.B.Sc. (Semester 60-40 Pattern)

(with effect from June-2017)

CH-YSC [Y for year, S for semester and C for course number].

The course structure and title of the courses for T.Y.B.Sc. (Chemistry) are as given below:

Course Number	Course Title	Periods	Marks	
			Internal	External
	Semester-V			
CH -351	**Physical Chemistry**	**60**	**40**	**60**
CH -352	**Inorganic Chemistry**	**60**	**40**	**60**
CH -353	**Organic Chemistry**	**60**	**40**	**60**
CH- 354	**Analytical Chemistry**	**60**	**40**	**60**
CH -355	**Industrial Chemistry**	**60**	**40**	**60**
CH -356 (A) OR	**Bio Chemistry**	**60**	**40**	**60**
CH -356 (B)	**Environment Chemistry**	**60**	**40**	**60**
CH -357	**Physical Chemistry Practical**	**60**	**40**	**60**
CH -358	**Inorganic Chemistry Practical**	**60**	**40**	**60**
CH -359	**Organic Chemistry Practical**	**60**	**40**	**60**
	Semester- VI			
CH -361	**Physical Chemistry**	**60**	**40**	**60**
CH -362	**Inorganic Chemistry**	**60**	**40**	**60**
CH -363	**Organic Chemistry**	**60**	**40**	**60**
CH- 364	**Analytical Chemistry**	**60**	**40**	**60**
CH -365	**Industrial Chemistry**	**60**	**40**	**60**
CH -366 (C) OR	**Polymer Chemistry**	**60**	**40**	**60**
CH -366 (D)	**Chemistry In Every Day Life**	**60**	**40**	**60**
CH -367	**Physical Chemistry Practical**	**60**	**40**	**60**
CH -368	**Inorganic Chemistry Practical**	**60**	**40**	**60**
CH -369	**Organic Chemistry Practical**	**60**	**40**	**60**

Note:-

1. Each period is of 50 minutes duration.
2. Each course is having weightage of four periods per week.
3. Each practical course is having weightage of four periods per week.
4. Examination of practical course shall be held at the end of the each semester.
5. An industrial study tour is compulsory for the T.Y.B.Sc. students. The students should submit their tour reports at the time of practical examination of VI Semester.
6. All units should be in SI unit.

NOTE:

1. There are in all Six theory courses and Three practical courses for each semester.
2. Each theory paper carry 100 Marks out of which 40 Marks are allotted for internal assessment and 60 Marks for external assessment. As per the directions given by University, at the end of each semester internal examination will be conducted for 40 marks and University Examination will be conducted for 60 Marks.
3. The practical examination for courses CH-357, CH-358,CH-359 will be conducted at the end of V^{th} Semester and that of CH-367, CH-368, CH-369 will be conducted at the end of VI^{th} Semester Each practical course will carry 100 Marks out of which 40 Marks will be allotted for internal assessment and University Examination will be conducted for 60 Marks.
4. The students has a right to choose any one of the optional paper for Vth semester either CH-356(A) OR CH-356(B) Similarly The students has a right to choose any one of the optional paper for VI th semester either CH-366(C) OR CH-366(D)
5. A student is expected to submit a journal certified by the Head of the Department /Head of the Institution for each semester.
6. A student will not be permitted to appear at the practical examination unless he / she produces a certified journal. If the journal is lost ,the student should produce a certificate from Head of the department / Head of the Institution stating that he /she has satisfactorily completed the practical work.
7. Industrial tour is compulsory for all the students. The tour report will be evaluated in Organic Chemistry practical CH-369.

Rules for personal safety in Chemistry Laboratory:

1) For eye protection, safety goggles must be worn in the laboratory at all times. If the student wears contact lenses, full protection goggles, which provide total seal around eyes, must be worn. All students are expected to wear safety goggles.
2) A long sleeved, knee length laboratory coat/ apron is recommended. Long pants and closed toed shoes must be worn for individual safety. Loose clothing, open style shoes and sandals are prohibited. Long hair must be tied up. Each student will have to get his / her own necessary protection items.
3) Prior to the practical examination, the teacher-in-charge will check all protective equipment to ensure that they are in order.
4) Pipetting by mouth should be avoided. Use of pro-pipette bulbs is recommended.
5) All laboratories should be equipped with safety chart, adequate first aid requirements and fire extinguishers.

T.Y.B.Sc. Chemistry

Sem. -V **Course No:- CH-351**

Subject: Physical Chemistry.

Chapter-1:-Electrochemical Cell and its Applications. (L-18)(M-18)

Introduction, Classification of electrochemical cell, Liquid junction potential, Chemical cell with and without transference, concentration cell, electrode concentration cell without transference, electrolyte concentration cell with transference, electrolyte concentration cell with and without transference Determination of junction potential of concentration cell with transference. Reversible with cation and reversible with anion.

Application of emf measurement, Determination of solubility product, Determination of pH using Hydrogen gas electrode, Quinhydrone electrode and Glass electrode, Potentiometric titrations, Related numerical.

Ref.-1:-Page Nos. 497-519

Chapter-2:-Photochemistry (L-12)(M-12)

Introduction, Difference between photochemical and thermo chemical reactions, Laws of Photochemistry, Grotthus-Drapper Law, Einstein's Law of Photochemical equivalence, Quantum yield, Causes for high and low quantum yield, primary and secondary process, Consequence of light absorption by atoms and molecules, Jablonski diagram, Fluorescence, phosphorescence, Quenching of fluorescence. Experimental Study of Photochemical reactions, Photochemical gas reactions, Photolysis of ammonia, Combination of H_2 and Cl_2 reaction, Photosensitized gas reaction H_2 and O_2, H_2 and CO, Chemiluminescence, related numerical.

Ref.1:-Page Nos.:- 775-781,784-790,796-797.

Ref.2:-Page Nos.:-1154-1172.

Chapter-3:- Phase Rule : **(L-12)(M-12)**

Definitions, Gibb's phase rule, derivation of phase rule , Terms involved in the phase rule- the phase, Degree of Freedom, Number of Components, one component system for sulphur and water system, two component system for silver-lead, Three Component system.

Ref. 1 : Pages 344-355. 773-791

Ref. 3. Pages 244-246.

Chapter-4:- Radioactivity and its Applications **(L-18) (M-18)**

Introduction, Radioactive elements, types of radioactive decay, decay schemes , General characteristic of radioactive decay, Decay kinetics-Decay constant, half life period ,mean life, Units of radioactivity, **α** decay-The range and ionizing power of **α** decay, The **α** particle energy spectrum, Geiger-Nuttals law, **β** decay-Types of **β** decay. Detection and measurement of nuclear radiation, G. M. Counter. End Window and Liquid counter, Related numerical.

Application of radioactivity – Radiochemical principle of tracer technique; application of tracer technique – Chemical investigation reaction mechanism- esterification, hydrolysis, Oxidation - decomposition of H_2O_2 and Oxidation of CO , structure determination - PCl_5 molecules, Thiosulphate ion, C-14 dating and Age determination of the Earth,

Medical applications- Thyroditis, Bone fracture Healing, Brain tumor location, Defects in Blood Circulation.

Ref.-4:-Page Nos. 117-125, 140-142, 148-150, 299-305,402-404, 407-410,

Reference Books:-

1. Fundamental of Physical Chemistry - Moron and Prutton, 4th edition, Oxford and IBH Publishing Co. Pvt. Ltd.

2. Essential of Physical Chemistry – Arun Bahl, B. S. Bahl, G.D. Tuli, S., Chand Publication, revised edition-2012.

3. Advance Physical Chemistry - Gurtu and Gurtu, 18th Edition, Pragati Prakashan

4. Essentials of Nuclear Chemistry – H.J. Arnikar, 4th Edition. New Edge International Publication.

5. Principles of Physical Chemistry- Puri, Sharma and Pathaniy-46thEddn.

6. Electrochemistry - C.H.Hanman, John Wiley (1998)

7. An Introduction to Electrochemistry - Samuel Glasstone, Affiliated to East-west press.

T.Y.B.Sc. Chemistry

Sem. –VI **Course No:- CH-361**

Subject: Physical Chemistry.

Chapter-1:-Investigation of Molecular Structure. (L-18)(M-18)

Introduction, Molar refraction, Dipole Moment, induced dipole moment, Electrical polarization of molecules. Orientation of dipole in an electric field, Debye equation. Method of determination of dipole moment, vapour-temperature method, Dilute solution method, molecular structure and dipole moment.

Molecular Spectroscopy – Introduction, Electromagnetic radiation, types of spectra, Rotational, Vibration and Electronic energy levels; Region of Spectra, Fluctuation in dipole moment due to rotational, Vibration and electronic excitation. Rotational Spectra of a rigid diatomic molecule, non rigid diatomic molecule-Moment of inertia, Energy Levels, Selection Rules, Nature of Spectrum, Determination of Bond Length, Isotopic Substitution, effect on rotational Spectra. Mathematical interpretation of rotational spectra in terms of bond length, reduced mass and moment of inertia of HCl and CO molecule and related numerical.

Ref.-1:-Page Nos.:-691-697

Ref.-3.:-Page Nos.:-5-9,34-41.

Chapter-2:-Chemical kinetics (L-18)(M-18)

Introduction, Rate laws, Measurement of reaction rate, Order and molecularity, Distinction between order and Molecularity, First order reaction , Derivation of integrated rate law for first order reaction, characteristics and example Thermal decomposition of azo-isopropane,

Second order reaction, Derivation of integrated rate law for Second Order reaction with equal and unequal initial concentration. Characteristics of Second

order reaction, example of second order reaction, Decomposition of acetaldehyde.

Third order reaction, Derivation of integrated rate law for with equal initial concentration, characteristics of third order reaction, examples of third order reaction, Pseudo molecular reaction, Hydrolysis of Methyl acetate, Inversion of cane sugar, Methods to determine order of reaction using Integrated rate equation method, Graphical method, Half life method, Differential method. Effect of temperature on reaction rate, Arrhenius equation, related numerical.

Ref.-1:-Page Nos.-548-565,571-574.
Ref.-2:-Page Nos.-731-755.

Chapter-3:-Solid State: (L-12)(M-12)

Introduction, Unit Cell, Weiss and Miller indices, Inter planar distance in cubic crystals, Properties of crystal, anisotropic, isotropic, etch figure, polymorphism, X rays, Use of X-ray in determination of crystal structure, Bragg's Equation, Braggs of X ray spectrometer, Powder method of crystal

analysis, x-ray analysis of NaCl, Position of Na^+ and Cl^- ions in lattice, Calculation of inter-planer distance (d) and wavelength (λ)of X rays, Number of molecules in unit cell, Determination of Avogadro's number, related numerical.

Liquid Crystals, and applications of liquid crystal.

Ref 1:-Page Nos.:-70-73, 76-87.

Ref.2:-Page Nos.:-450-451, 471-473.

Chapter-4:- Elementary Quantum Mechanics (L-12)(M-12)

Black body radiation Planks radiation law, Photoelectric effect, Compton effect, Debroglies hypothesis, Heisnbergs uncertainty principals, Interpretation of wave function, Operators in quantum mechanics, Postulate of Quantum mechanics,

Ref 4. :-Page No .:-. 24,33-35, 38, 43-45.

Ref 5. :-Page No .:-. 3-8, 16,20,36-39,43-49.

Reference Books:-

1. Fundamental of Physical Chemistry - Moron and Prutton-4th edition,Oxford and IBH Publishing Co.Pvt.Ltd.

2. Essential of Physical Chemistry – Arun Bahl, B. S. Bahl, G. D. Tuli, S. Chand Publication revised edition-2008.

3. Fundamental of Molecular Spectroscopy by C.N. Banwell and McCash, 4th edition/5th edition,Tata McGraw Hill Publishing Co.Ltd.

4. Principles of Physical Chemistry, Puri, Sharma and Phthania, Vishal Publishing Co.

5. Quantum Chemistry - R. K. Prasad, New Edge Publication, 4th Edittion.

6. Chemical Kinetics-K.J.Laidler

7. Basic Chemical Kinetics - G.L.Agrawal (1990),Tata McGraw Hill Publishing Co.Ltd., NewDelhi.

T.Y.B.Sc. Chemistry

Sem. -V **Course No:- CH-352**

Subject: Inorganic Chemistry.

Chapter - 1: Basic concepts of coordination Chemistry. (L-12, M-12)

Double salts and coordination compounds, co-ordination complexes and complex ions, coordination number, Unidentate, bidentate and polydentate ligands, chelating ligand and chelates, physical methods used in study of complex, Nomenclature of coordination compounds.

Ref. - 1: Page Nos. 729-735, 738-741.

Ref. - 2: Relevent Pages.

Chapter - 2: Werner's coordination theory. (L-12, M-12)

Assumptions, Werner theory and isomerism, EAN, Stability of complex ion, Factors affecting stability of complex ion, stereochemistry of coordination compound with C.N. 4 and 6, isomerism in coordination compounds.

Ref. - 1: Page Nos. 735-737, 742-745, 750, 751, 752-757.

Ref. - 2: Relevent Pages.

Chapter - 3: Modern Theories of M-L Bonds: V.B.T. (L-10, M-10)

The main points of V.B.T., Examples of square planar, tetrahedral and octahedral complexes, short coming of V.B.T.

Ref. 1: Page Nos. 760 - 779.

Chapter - 4: Modern Theories of M-L Bonds: C.F.T. (L-14, M-14)

Assumptions, Degeneracy of 'd' orbitals, Application of CFT to square planer, tetrahedral and octahedral complexes. C.F.S.E., Calculation of C.F.S.E. in weak field and strong field complexes, Evidences of C.F.S.E., Factor's affecting 10 Dq, CFT and magnetic properties, spin only magnetic moments, equation, Electron occupancy in CFT, Problems related to calculation of spin only magnetic moment for square planer, tetrahedral and octahedral complexes, (' ' for high spin and low spin complexes) spectrochemical series, John Teller distortion, limitations.

Ref.1: Page Nos. 760 - 779.

Ref.2: Page Nos. 194-236.

Chapter - 5: Modern Theories of M-L Bond - M.O.T. (L-12, M-12)

Introduction, Assumptions, Molecular orbital treatment of octahedral complexes, effect of pi bonding, charge transfer spectra, comparison of VBT, CFT and MOT.

Ref. 1: Page no. 878- 880.

Ref. 2: Page Nos. 227-230.

References:

1. Principle of Inorganic Chemistry by B.R. Puri, L.R. Sharma, K.C. Kalia, Milestone Publisher and distributor.
2. Concise Inorganic Chemistry, 5th Edition - J.D. Lee.

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T.Y.B.Sc. Chemistry

Sem. -VI **Course No:- CH-362**

Subject: Inorganic Chemistry.

Chapter - 1: The Copper group Coinage Metals (L-08, M-08)

Introduction, Electronic structure, Extraction and uses of Cu, Ag and Au, Oxidation states, Biological role of Cu.

Ref. - 1 : Page Nos. 816-820, 832, 833.

Chapter - 2: Solvents, Solutions, Acids and Bases. (L-14, M-14)

Donor and Acceptor properties, molten salts, solvents for electrochemical reactions, purity of solvents. Definition and approaches, solvent system concept, Lux-flood concept, Lewis concept, Generalized Acid-base concepts. Differentiating and leveling solvents. Co-solvating agents. Hard and soft acids and bases: definitions, Pearson HSAB concept, theories of Hardness and softness, application and limitation of HSAB concepts.

Ref. - 2 : Page Nos. 220, 221, 223-229, 234-236.

Ref. - 3 : Page Nos. 238-245, 255-258, 263, 266, 269, 270.

Ref. - 4 : Page Nos. 374-386.

Chapter -3: Corrosion and passivity (L-12, M-12) Types of corrosion - Atmospheric corrosion, Immersed corrosion, microbiological corrosion, Theories of corrosion, Protection of metals from corrosion. Passivity: Definition, types, causes.

Ref. - 5 : Page Nos. 609 to 619.

Chapter – 4: Structure and Reactivity of Molecules. (L-14, M-14)

VSEPR theory, Structure of molecules containing lone pair of electrons- Sulphur tetrafluoride , Bromine trifluoride, Dichloroiodate(I)anion, Pentafluorotelluurate(IV) anion, Tetrachloroiodate(III) anion, Nitrogen dioxide, Phosphorus trihalides, Carbonyl fluoride, Summary of VSEPR rules.

Ref. 6: Relavant pages.

Chapter - 5: Some Transition and Inner Transition Elements. (L-12, M-12)

Occurrence, Extraction, properties and uses of Transition elements Ti and Cr.

Occurrence, Extraction of thorium, properties and uses of Th and U.

Ref. 7: Page Nos. 305-312, 466-472.

References :

1. Concise Inorganic Chemistry 5th edition by J.D. Lee.
2. Basic Inorganic chemistry 3rd edition by F.A. cotton, G. Wilkinson, Paul Guss John Wiley and Sons.
3. Theoretical principals of Inorganic chemistry by G.S. Manku, Tata Mc. Graw Hill edition.
4. Advanced Inorganic chemistry by Gurudeep Raj., Vol. I, 23rd Edition, Goel publishing House Meerut.
5. Advanced Inorganic Chemistry, Fifth Aug. edition by Dr. S.K. Agrawal and Dr. Keemtila Pragati Prakashan.
6. Inorganic Chemistry Principles of Structure and Reactivity, 4^{th} Edition; James E. Huheey, Ellen A. Keiter. Richard L.Keitler.
7. Advanced Inorganic Chemistry, Vol - II, Satya Prakash, G.D. Tuli, S.K. Basu, R.D.Madan.

T.Y.B.Sc. Chemistry

Sem. -V **Course No:- CH-353**

Subject: Organic Chemistry.

Chapter 1: Structural Effects (10 L, 10 M)

Inductive effect, resonance effect, steric effect, hyper conjugation.

Application of all these effects in deciding the strength of acids and bases with examples.

Ref.2-Relevant Pages.

Ref.3-Pages 21-28.

Chapter 2: Nucleophilic Substitution at Saturated Carbon (10 L, 10 M)

Introduction, relation between kinetics and mechanism.

SN^1, SN^2 and SN^i mechanisms.

Stereo chemical implications of mechanisms: SN^2 mechanism-Inversion of configuration, SN^1mechanism-Racemisation, SN^i mechanism-Retention of configuration

Effect of structure, nucleophile, leaving group and solvent on $SN^1$and SN^2mechanism.

Ref.3- Pages 77-92 and 95-99.

Ref.2- Relevant Pages.

Chapter 3: Electrophilic Addition to C=C (10 L, 10 M)

Introduction, addition of halogens, addition of HX to C=C with mechanism and its stereochemistry.

Other addition reactions (with mechanism): hydration, hydroxylation, hydrogenation, ozonolysis.

Ref.3 -Pages 175-190.

Ref.1,2- Relevant Pages.

Chapter 4: Nucleophilic Addition to C=O (10 L, 10 M)

Structure and Reactivity, Addition of water, alcohol, thiol, hydride ion, derivatives of ammonia, semicarbazide. Addition of nucleophile to C=O examples like -Aldol Condensation, Cannizzaro reaction, Perkin reaction, Claisen ester condensation.

Ref.3 - Pages 202-226.

Ref.2,4,5- Relevant Pages.

Chapter 5: Aromatic Substitution (12 L, 12 M)

Electrophilic Aromatic Substitution- Introduction, general mechanism, orientation of substitution in monosubstituted benzene.

Mechanism of nitration, sulphonation , halogenation, Friedal Craft alkylation and its Limitations, Friedal Craft acylation, Diazo coupling reactions.

Nucleophilic Aromatic Substitution- Introduction,

Mechanisms: Addition – Elimination mechanism,

Elimination-Addition mechanism (Benzyne intermediate)

Ref. 2,3,4-Relevant Pages.

Chapter 6: Rearrangement reactions (08 L, 08 M)

Introduction, classification, 1) migration to carbon : Pinacol- pinacolone rearrangement 2) migration to nitrogen : Beckmann rearrangement

3) migration to oxygen :Baeyer Villiger rearrangement.

Reference Books:

1) Organic Chemistry by F.A. Carey (IIIrd Edn).

2) Organic Chemistry by Morrison and Boyd, VI thEdn.

3) A guide book to Mechanism in Organic Chemistry by Peter Sykes

4) Organic Chemistry by S. H.Pine,VthEdn.

5) Organic Chemistry by Jerry March.

6) Reactions and rearrangements by S N Sanyal

T.Y.B.Sc. Chemistry

Sem. -VI **Course No:- CH-363**

Subject: Organic Chemistry.

Chapter-1: Spectroscopy

Introduction (2 L, 2 M)

Meaning of spectroscopy, nature of electromagnetic radiations, wavelength, frequency, energy, amplitude, wave number, units of measurement. Different regions of electromagnetic radiations.

Interaction of radiation with matter, excitation of molecules to different energy levels i.e. rotational, vibrational and electronic.

Ref.-1,2,3-Relevant pages.

Ultraviolet spectroscopy (08 L, 08 M)

Introduction, nature of UV curve, electronic excitations and their types, effect of solvent on electronic transition.

Terms used in UV spectroscopy: chromophore, auxochrome, bathochromic shift and hypsochromic shift, hyperchromic shift, hypochromic shift.

Effect of conjugation on UV bands, calculation of λ max by using Woodward Fieser rules: for diene system and enone system.

Applications of UV spectroscopy.

Ref.-1,2,3-Relevant pages.

Infrared Spectroscopy (10 L, 10 M)

Introduction, principles of IR spectroscopy, fundamental modes of vibrations, types of vibrations, fundamental group regions.

Characteristic IR absorption of following groups-

Alkanes, alkenes, alkynes, alcohols , ethers, alkyl halides, amines, aldehydes, ketones, acids, esters, amides, aromatic compounds and their substitution pattern.

Factors affecting IR spectroscopy : inductive effect, resonance effect, hydrogen bonding.

Applications of IR spectroscopy : Structure determination, Study of chemical reactions, hydrogen bonding.

Ref.-1,2,3-Relevant pages.

NMR Spectroscopy (10 L, 10M)

Introduction, principles of NMR spectroscopy, magnetic and nonmagnetic nuclei, nuclear resonance, chemical shift, molecular structure, shielding and deshielding, measurement of chemical shift, δ scale and τ scale, TMS as reference and its advantages. Peak area, spin-spin coupling, coupling constant, J values (only first order coupling).

Applications of NMR spectroscopy.

Ref.-1,2,3-Relevant pages.

Problems based on UV, IR and NMR Spectroscopy (10 L, 10 M)

Spectral data such as λ max values, IR frequencies, chemical shift (δ values) and coupling constant should be provided to students.

Ref.-1,2,3-Relevant pages.

Chapter 2: Designing Organic Synthesis (10 L, 10 M)

Introduction, different terms used: disconnection, synthon, synthetic equivalence, FGI, TM.

One group disconnection: disconnection of simple alcohols

Ref-4. Relevant pages

Chapter 3: Natural products (10 L, 10M)

a) Terpenoids

Introduction, occurrence, isolation, classification, isoprene rule, general methods of structure determination of terpenoids.

Citral: structure determination, Barbier- Bouvealt synthesis

b) Alkaloids

Introduction, occurrence, isolation , general properties, general methods of structure determination.

Atropine: structure determination, synthesis of tropine, synthesis of atropine (Fischer Speier esterification)

Reference Books:

1. Spectroscopic Methods in Organic Chemistry by Willams Fleming, 4th Edn.
2. Spectroscopy of Organic Compounds by P.S.Kalsi,WileyEastern Publication.
3. Spectrometric Identification of Organic Compound by Silverstein, Bassler and Morrill 4th Edn.
4. Designing Organic Synthesis by Stuart Warren, 1983.
5. Organic Chemistry by Jerry March.
6. Stereochemistry of Organic Compounds by P.S.Kalsi,WileyEastern Publication.
7. Stereochemistry of Organic Compounds by E.L.Eliel.
8. Organic chemistry By finar vol.II, Vth ed.
9. Spectroscopy by Y R Sharma
10. Chemistry of natural products by G R Chtwal

T.Y.B.Sc. Chemistry

Sem. -V **Course No:- CH-354**

Subject: Analytical Chemistry.

Chapter-1 :-Solvent Extraction **(14L, 14M)**

The Distribution Co-efficient, The Distribution Ratio, Percent Extracted,
Solvent Extraction of Metals - Ion Association Complex and Metal Chelates,
The Extraction Process, The Separation Efficiency of Metal Chelates, Analytical Separations, Multiple Batch Extractions, Countercurrent Distribution, Simple numerical problems on Percent Extracted and Multiple Extraction

Ref.1:-Pages 484 to 498.
Ref. 2-6:- Relevant Pages

Chapter-2:- Ion Exchange Chromatography **(12L, 12M)**

Introduction, Cation Exchange Resins, Anion Exchange Resins, Cross-linkage, Effect of pH-Separation of Amino Acids, Effect of Complexing Agents-Separation of Metal ions on Anion Exchange Columns, Applications of Ion Exchange Chromatography

Ref.1:-Pages 517 to 522
Ref. 2-6:- Relevant Pages

Chapter-3:- Size Exclusion Chromatography **(6L, 06M)**

Introduction, Principles, Exclusion Limit, Types of Gels, Applications

Ref.1:-Pages 515 to 517
Ref. 2-6:- Relevant Pages

Chapter-4:-Gas chromatography **(12L, 12M)**

Introduction, Principles, Gas chromatography Columns, Gas Chromatography Detectors, Column Efficiency in Chromatography- Theoretical Plates, 1) Van Deemter Equation,
2) Capacity Factor and 3) Resolution

Ref.1:-Pages 522 to 528, 511 to 515
Ref.2-6:- Relevant Pages

Chapter-5:-High-performance Liquid Chromatography **(08L, 08M)**

Introduction, Principles, Equipment for HPLC, Choice of Column Materials for HPLC

Ref.1:-Pages 537 to 545
Ref.2-6:-Relevant Pages

Chapter-6 :-Electrophoresis **(08L, 08M)**

Introduction, Principles of Electrophoresis, Properties of Charged Molecule, Theory of Electric Double layer, Classification of Electrophoresis Methods, Techniques of electrophoresis, Applications in Inorganic chemistry

Ref. 3:- 223 to 230, 232 to 233
Ref :- 1-2, 4-6 Relevant Pages

Reference Books:-

1. Analytical chemistry, by G.D. Christian, 5th Edition
2. Instrumental Methods of chemical analysis- Chatwal and Anand
3. Basic Concept of Analytical Chemistry-2nd edition S.M. Khopkar
4. Chemical analysis by A. K. Shriwastawa, P. C.Jain, S. Chand and company.
5. Quantitative analytical chemistry, 5th Edition, by James S. Fritz, George H.Schenk
6. Vogel's Text Book of Quantitative Chemical Analysis by J. Mandham, R.C.Denney, J. D. Barnes, M. Thomas, B. Shivashankar 6th Edition

T.Y.B.Sc. Chemistry

Sem. -VI **Course No:- CH-364**

Subject: Analytical Chemistry.

Chapter-1:-Spectrometry (20L, 20M)

Interaction of electro-magnetic radiation with matter, Electro-magnetic Spectrum, The Absorption of Radiation, Absorption by Inorganic Compounds, Solvents for Spectrometry, Quantitative Calculations, Beer's Law, Principles of instruments - Sources, Monochromators (prism, diffraction grattings, Optical filters), Cells, detectors, Slits Width, Single Beam Spectrometer, Spectrometric Errors, Deviation from Beer's Law - Chemical deviation, Instrumental deviation.

Ref.-1:-Pages 398-401, 410-411, 413--435, 439-443.

Ref. 2 -6:-Relevant Pages

Chapter-2: Emission Spectrometry (08L, 08M)

Flame Emission Spectroscopy, Plasma Emission Spectrometry, Distribution between Ground and Excited States,

Ref.-1:-Pages 462 - 467

Ref. 2-6:-Relevant Pages

Chapter-3:-Atomic Absorption Spectrophotometry (10L, 10M)

Principles, Instrumentation – Sources, Burners, Flames, Interferences – Spectral Interferences, Ionization Interferences, Refractory Compound Formation, Physical Interferences, Use of Organic Solvents, Sample Preparation, Applications of AAS.

Ref.-1:-Pages 467 - 475

Ref. 2-6:-Relevant Pages

Chapter-4:-Nephelometry and Turbidimetry (10L, 10M)

Introduction, Turbidimetry and Colorimetry, Nephelometry and Fluorimetry, Choice between Nephelometry and Turbidimetry, Theory, Instrumentation, Comparison of spectrometry, Turbidimetry and Nephelometry, Applications of Turbidimetry and Nephelometry

Ref.-3:-Pages 2.389 - 2.397.

Ref. 1,2,4,5,6,:-Relevant Pages

Chapter-5:-Thermal Methods (12L, 12M)

General Discussion,

Thermogravimetry- Instruments for thermogravimetry, Applications of thermogravimetry

Differential Techniques- Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC), Instruments for DTA and DSC, Experimental and Instrumental Factors, Applications of DTA and DSC

Ref.-7:-Pages 503 - 519

Ref. 1,2,3,4,5,6,:-Relevant Pages

Reference Books:-

1. Analytical Chemistry by G.D. Christian, 5th Edition.
2. Analytical Chemistry, An Introduction: Skoog, West and Holler, 6 th Edition
3. Instrumental method of Chemical Analysis by Chaitwal and Anand, 5th Edition.
4. Basic Concept of Analytical Chemistry- S.M. Khopkar
5. Instrumental Methods of chemical analysis- 6th edition Willard, Merritt, Dean and Settle
6. Introduction to instrumental analysis- R.D. Braun
7. Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas

T.Y.B.Sc. Chemistry

Sem. -V **Course No:- CH-355**

Subject: Industrial Chemistry.

Chapter-1: General Aspects of industrial Chemistry (M-12, L-12)

Introduction, Basic requirements of industrial chemistry, chemical production, raw materials, unit process and unit operations, quality control, quality assurance, process control, research and development, pollution control, human resource, safety measures, classification of chemical reactions, batch and continuous process, Conversion, selectivity, yield, copy right act, patent act and trade marks.

Ref.1:- Chapter 2(pp. 26, 27, 31 to 36)

Ref. 2:-Chapter 2 (Relevant Pages)

Ref: Websites–www.wikipedia.org/wiki/patent act and www.wikipedia.org/wiki/trademarks

Chapter-2: Sugar Industry. (M-12, L-12)

Introduction, Sugar Industry in Maharashtra and India, Manufacture of cane sugar- [Refining (with flow sheet)], general idea of Sulphitation and Carbonation, Concentration /Evaporation, Crystallization Separation of crystals. Grades, Baggase, Cellotex.

Ref.5:-Chapter 38 (Relevant Pages)

Chapter-3: Fermentation Industry. (M-12, L-12)

Introduction, Alcohol Fermentation, Uses of alcohol, Theory underlying process of making alcohols beverages, Manufacture of Beer, Manufacture of Spirit, Alcohol from Cane Sugar Molasses, Theory of fractional distillation – Coffey'still, Rectified spirit, Absolute alcohol, Fusel oil, Proof spirit, Denatured alcohol.

Ref.2:-pp. 578-596.

Ref.5:-Chapter 36 (Relevant Pages)

Chapter-4:Fertilizers. (M-12, L-12)

Plant Nutrients, Nutrient functions, Fertilizer types, Need for fertilizers, Essential requirements, Classification of fertilizers, Natural inorganic fertilizers, Artificial-fertilizers- Nitrogenous fertilizers- Ammonium sulphate, Urea.(Manufacture of Urea & Ammonium Sulphate), Action of Ammonium Sulphate & Urea as Fertilizer, Phosphatic Fertilizers- Triple Super Phosphate (Manufacturing Process

Only),Potassium fertilizer, Importance of Bio-fertilizers.

Ref.5:-Chapter 26 (Relevant Pages)

Chapter-5: Small Scale Industries . **(M-12, L-12)**

Introduction and Aspects of Small Scale Industries, Safety Matches, Agartbatties, Naphthalene balls, Wax Candles, Shoe Polishes, Gum Paste, Writing and fountain Pain ink, Plaster of Paris, Silicon Carbide Crucibles, How to Remove Stains and Liquid Phenyl Manufacturing.

Ref.5:-Chapter 60 (Relevant Pages)

Reference Books:-

1. Principles of Industrial Chemistry, by Chris A Clausen III and Guy Mattson

   A Wiley –Inter Science Publication .John Wiley and sons, New York

2. Shreve's Chemical Process Industries 5 th Edition by George T. Austin

3. Drug and pharmaceutical Chemistry by Gurudeep Chatwal 2nd Edition, Himalaya Publishing House.
4. Comprehensive Industrial Chemistry - P.G. More, First Edition, 2010,
5. Industrial Chemistry by B. K. Sharma, 16th Edition, 2011.

T.Y.B.Sc. Chemistry

Sem. -VI **Course No:- CH-365**

Subject: Industrial Chemistry.

Chapter-1: Petroleum Industry. (M-12, L-12)

Occurrence, Petroleum producer countries in the world, Exploration Methods, Composition of Petroleum, Refining or Distillation of Petroleum, Anti-Knock Compounds, Octane number, Cetane number, petrohol (their definitions only), Manufacture of Petrol or Gasoline by Bergius Method, Cracking process- Thermal, Catalytic, Hydro cracking.

Ref.1: pp 340 to 352, 356 to358 and 363 to 368.

Ref.5:-Chapter 4 and 5(Relevant Pages)

Chapter-2: Industrial Organic Synthesis from Petroleum (M-10, L-10)

Manufacture of methanol from synthesis gas, Isopropanol from propylene, Glycerol from propylene via allyl chloride, Acetone by catalytic dehydrogenation of isopropanol. (with flow sheet diagram), Unsaturated Hydrocarbon –preparation of Acetylene from Natural gas (with flow sheet), Aromatic hydrocarbon-Preparation of toluene (with flow sheet)

Ref.5:-Chapter 14 (Relevant Pages)

Chapter-3: Soaps and Detergents: (M-12, L-12)

Soaps, Surfactants and its Importance, Raw Materials used in Soap Manufacture, Manufacture of Soaps (Continuous Process), Cleansing action of Soap, Classification of Soaps, Detergents, Principal group of Synthetic Detergents, Detergents builders and Additives, Comparison between Soap Detergent.

Ref. 6: Relevant pages

Ref.5:-Chapter 39 and 40 (Relevant Pages)

Chapter-4. Drugs and Pharmaceuticals: (M-12, L-12)

Introduction, Importance, Qualities of good drugs, Functional and chemotherapeutic drugs, Meaning of the terms: Prescriptions, Doses, Analgesic, Antipyretics, Diuretic Anesthetics, Antibiotics, Anti-inflammatory, Anti-viral, Tranquilizer, Antiulcer, Antiallergic, and Bronchodilators, Cardiovasculars, Cough And Cold Preparations Antihypertensive, Anti-

neoplastics, Sedatives And Hypnotics, Steroidal contraceptive Histamine and Antihistamines. Synthesis, uses, manufacture and properties of Paracetamol, Aspirin, Chloramphenicol.
Ref. 1 Relevant pages.
Ref. 2 Relevant pages.
Ref. 3 Relevant pages.
Ref. 4 Chapter 8 (Relevant pages.) Page No.144-194

Chapter-5: Dyes, Pigments and paints (M-14, L-14)

(a) **Dyes:** Introduction, properties of dyes, Otto Witts theory only, Classification of dyes according to their mode of application and Chemical Constitution. Synthesis and Uses of dyes:- Congo red, Methyl orange, Phenolphthalein, Erichrome Black-T and Indigotin from aniline.
Ref.5:-Chapter 54 (Relevant Pages)

(b) **Paints:** Introduction of paints, ingredients and classification, new technologies; properties of coatings; solvents, plasticizers, dyes and bioactive additives.
(c) **Pigments:** Introduction, classification and general physical properties.
Ref.1: pp777-814

Ref.5:-Chapter 43 (Relevant Pages)

Reference Books:-

1. Principles of Industrial Chemistry, by Chris A Clausen III and Guy Mattson

A Wiley –Inter Science Publication .John Wiley and sons, New York

2. Shreve's Chemical Process Industries 5 th Edition by George T. Austin

3. Drug and pharmaceutical Chemistry by Gurudeep Chatwal 2nd Edition, Himalaya Publishing House.
4. Comprehensive Industrial Chemistry - P.G. More, First Edition, 2010,
5. Industrial Chemistry by B. K. Sharma, 16th Edition, 2011.

6. Surfactants and Interfacial Phenomenon by M. J. Rosen, John Wiley and Sons, New York

T.Y.B.Sc. Chemistry

Sem. -V **Course No:- CH-356(A)**

Subject: Biochemistry.

Chapter 1:Carbohydrates (L12, M 12)

a) Introduction,definition, classification.b) Monosaccharides:structure of glucose (open chain and ring structures). Reactions of glucose: oxidation with bromine water and nitric acid, reduction, acetylation, addition of HCN, NH_2OH and phenyl hydrazine,mutarotation.c) Disaccharides: structure of sucrose, lactose and maltose.d) Polysaccharides:storage polysaccharides:structure of starch, Structural polysaccharides: structure of cellulose.
Ref 1 and 2- Relevant pages

Chapter 2 Amino Acids and Proteins (L12, M12)

a) Introduction, Structure of ammo acids with zwitterion structure, classification of amino acids based on nature of R group, amphoteric nature of amino acids, reaction ofamino acids with FDNB and Dansyl chloride, formation ofpeptide bondb) Classification of proteins: based on functions and based on shape,structure of proteins: primary, secondary, tertiary and quaternary structure.c) Separation of amino acids and proteins by paper electrophoresis and dialysis

Ref 1 and 2- Relevant pages

Chapter -3Enzymes (L6, M6)

Introduction, classification, role of enzymes in biochemical reactions,Michaelis Menten equation (no derivation). Effect of substrate concentration,pH and temperature on enzyme catalyzed reaction.Enzyme inhibitors: introduction and types.

Ref 1 and 2- Relevant pages

Chapter -4Lipids (L5, M5)

Introduction,classification of lipids, fatty acids, nomenclature of fatty acids, triacyl glycerols,phospholipids and waxes.

Ref 1 and 2- Relevant pages

Chapter 5: Nucleic Acids * (L7, M7)

Introduction, Components of nucleic acids: sugars, bases, nucleosides and nucleotides.Watson and Crick model of DNA, types of RNA (structure not expected)
Ref 1 and 2- Relevant pages

Chapter 6: Energy rich compounds(L6, M6)

Introduction, Pyrophosphates, acyl phosphates, enolic phosphates, thiol esters (structure, hydrolytic reaction and energetics)Ref 1 and 2- Relevant pages

Chapter7: Metabolism (L12, M12)

Definition of metabolism,

Carbohydrate metabolism: Glycolysis: reactions involved and energeticsTCA cycle (Kreb cycle) : Reactions involved and energetic

Amino acid Metabolism: Transamination, deamination (by enzymes - glutamic dehydrogenase, ammonia lyases, deaminases and deamidases), decarboxylation

Lipid Metabolism:β- oxidation , reactions involved in β –oxidation, energetics of β –oxidation of palmitic acid.

Reference Books

1. Outlines of Biochemistry - Conn and Stumpf (4^{h}Edition)
2. Principles of Biochemistry - A L Lehninger (2nd Edition

T.Y.B.Sc. Chemistry

Sem. -V **Course No:- CH-356(B)**

Subject: Environmental Chemistry

Chapter 1: Atmosphere and Air Pollution **(M-14 L-14)**

1.1 Composition and structure of atmosphere

1.2 Chemical and photochemical reactions in atmosphere

1.3 Chemistry of O_3, SOx, NOx and chlorides in atmosphere

1.4 Primary air pollutants

1.5 Particulate matter: Inorganic and Organic

1.6 Smog: Reducing and Photochemical

1.7 Mechanism of ozone depletion

1.8 Stability and reactions of CFCs

1.9 Harmful effects of CFCs

1.10 CFCs substitutes

Ref. 1, Ref. 3, Ref. 4 (Relevant Pages)

Chapter 2: Hydrosphere and water pollution **(M-12 L-12)**

2.1 Water resources

2.2 Microbially mediated aquatic reactions, nitrogen cycle, iron and manganese bacteria

2.3 Classification of water pollutants

2.4 Organic and Inorganic pollutants: Pesticides, Detergents, Eutrophication, Marine, Oil, Acid mine drainage, remedial measures and sediments

2.5 Thermal pollution

2.6 Water quality parameters: pH, D.O. (Winkler Method), COD, TOC, Total hardness, free chlorine.

Ref. 1, 2, 3, and 4 (Relevant Pages)

Chapter 3: Water treatment and effluent management **(M-12 L-12)**

3.1 Domestic sewage, waste water treatment: primary, secondary and tertiary treatments, aerobic, anaerobic and upflow anaerobic sludge bed treatment processes

3.2 Industrial waste water treatment i) filtration method ii) ion-exchange method iii) membrane techniques: ultra filtration, reverse osmosis and electrodialysis

3.3 Treatment of drinking water

Ref. 1, 2, 3, and 4 (Relevant Pages)

Chapter 4: Instrumental methods in environmental analysis (M-12 L-12)

4.1 Atomic absorption spectroscopy: determination of Hg, As, Zn, Ag, Pb, Mn, Fe, Cu, Cr, Cd

4.2 Gas chromatography: detection and determination of CO, HC and pesticides

4.3 Spectrophotometry: determination of NOx, SO_2, NH_3, CN, PO_4, Cd, Pb, Hg

Ref. 1, Ref. 2 (Relevant Pages)

Chapter 5: Green House Effect and Global Warming (M-10 L-10)

5.1 Introduction

5.2 Greenhouse gases

5.3 Radiative forcing

5.4 Sources and sinks of CO_2

5.5 Causes of fluctuations in global temperature

5.6 Global warming and climate changes

5.7 Implications of climate changes

Ref. 1, Ref. 2(Relevant Pages)

Reference Books:

1: Environmental Chemistry – A. K. De, 5th Edition (New age international publishers)

2: Environmental Chemistry – J. W. Moore and E. A. Moore (Academic Press, New York)

3: Environmental Chemistry – A. K. Bhagi and C. R. Chatwal (Himalaya Publishing House)

4: Environmental Chemistry – H. Kaur 2nd Edition 2007, PragatiPrakashan, Meerut, India

T.Y.B.Sc. Chemistry

Sem. -VI **Course No:- CH-366(C)**

Subject: Polymer Chemistry

Chapter-1 Basic concepts of polymers (M-12, L-12)

Brief history, definition, functionality and reactivity, degree of polymerisation, polydispersity index , monomers, polymers, homopolymers, copolymers, types of copolymers. Tacticity (stereochemistry) of polymers: isotactic, syndiotactic and atactic polymers.Molecular weights of polymer, types of molecular weights.

Classification of polymers based on origin, native backbone chain, thermal response, applications and physical properties (Plastics, elastomers, fibres and liquid resins)

Degradation, types of degradation: chain end degradation, random degradation.

Ref-1: Relevant pages

Ref–2: Relevant pages

Chapter-2 Chemistry of polymerisation (M-10, L-10)

Introduction, chain growth polymerisation, Addition polymerization (initiation, propogation , termination and kinetics): free radical polymerisation, ionic polymerisation, step growth polymerisation , condensation polymerization (mechanism and kinetics), ring opening polymerisation.

Ref-1: Relevant pages

Ref - 2: Relevant pages

Chapter-3 Polymerisation techniques (M-08, L-08)

Bulk polymerisation, solution polymerisation, suspension polymerisation, emulsion polymerisation, interfacial condensation polymerisation.

Ref-1: Relevant pages

Ref -2: Relevant pages

Chapter-4 Study of some important polymers (M-20, L-20)

Preparation, properties and applications of following polymers-

Polyethylene, Polypropylene, Polyvinyl chloride, Polystyrene, Polyacrylonitrile, Polycarbonates, Phenol-formaldehyde resins, Epoxy resins, Polyester (PET), Polyamides (nylon 6 and nylon 66), Polyvinyl alcohol, Polylactic acid and Polyaniline.

Ref-1: Relevant pages

Ref - 2: Relevant pages.

Chapter-5 Glass transition temperature (M-10, L-10)

Glass transition temperature - Definition and explanation, importance of glass transition temperature, factors affecting glass transition temperature, Glass transition temperature and molecular weight, Glass transition temperature and melting point ,determination of glass transition temperature by dilatometry or specific volume technique.

Ref-1: Relevant pages

Ref -2: Relevant pages.

Reference Books:

1. Polymer Science - V. R. Govarikar.

2. Text books of Polymer Science – F. W. Billmeyer.

T.Y.B.Sc. Chemistry

Sem. -VI **Course No:- CH-366(D)**

Subject: Chemistry in Everyday Life

Chapter-1 Chemistry in day-to-day life (15 L, 15M)

Types of water, desalination, Fresh water, Dissolved Oxygen and water quality. Milk: Definition, Chemical composition of milk of different species such as cow, buffalo and goat. Adulteration in milk like Sugar, Urea, Starch. Essential nutrients for plants, Classification, Major, minor & trace their sources and forms. Importance of Inorganic Compounds as Medicine- Antacid products Na2CO3,Al(OH)3, AlPO4, Mg(OH)2.

Chapter- 2 Cosmetic Chemistry (15L, 15 M)

A] - Hair Care Products

Principle constituents of Shampoos (thickeners and foam stabilizers , perfumes, preservatives , conditioning agents , antidandruff shampoos.), Hair cream, hair dye, dye removals.

B] Skin Care Product and bleaching agents

Principle constituents of Skin cleansers , cold cream , moisturizers , body lotions – sun screen lotions .

C] Colour Cosmetics

Principle constituents of Lipstick , lip glosses , nail polish, face powder .

D] Dental Product

Principle constituents of , toothpaste , toothpowder , oral rinses

E] Perfumes :

Definition, Synthesis and uses of (1) Phenyl alcohol (2) Linalool (3) Musk Ketone (4) Vanilline

Chapter-3. Surfactants in Detergents (10 L, 10 M)

Soaps – Introduction, detergent action of soap. Toilet soap, bathing bars, washing soaps, liquid soap, additives, fillers and flavours, Significances of acidity and alkalinity.

Detergents – Surface active agents, types of detergents – cationic, anionic, amphiphilic detergents. Common detergent chemicals, Additives, colours and flavours, Enzymes used in commercial detergents, Environmental Hazards.

Chapter-4. Synthetic Drugs and Dyes: (10 L, 10 M)

A] Synthetic Drugs:

a) Introduction.

b) Definition: i) Pharmacy ii) Pharmacology iii) Chemotherapy iv) Metabolites and anti- metabolites v) Bacteria vi) Gram positive and Gram negative. c) Define on the basis of: Antimalerials, Antiseptic, Antibacterial, Antibiotics, Antifungal, Anticancer, Analgesics, Antipyretics, Sedatives, Anaesthetics

B] Synthetic Dyes:

Introduction, properties of good dye and application.

Chapter-5 Chemistry of food products (10 L, 10 M)

Introduction, Packed food, Bread, Butter, cheese, Synthetic food, juice, jam and jelly, squash, sauce- preparation, preservative and adulteration.

References

1. T.P. Coultate, Food – The Chemistry of its components. Royal Society of Chemistry London, (paperback)
2. Shashi Chowls, Engineering Chemistry, Darpat Rai Publication.
3. B.K. Sharma, Industrial Chemistry.
4. CNR Rao, Understanding Chemistry, Universities Press.
5. A text book of Pharmaceutical Chemistry –II : Dr. A V Kasture & Dr. S G Wadodkar : Nirali Prakashan (2) Organic Pharmaceutical Chemistry : Harkishan Singh & V K Kapoor : Vallabh Prakashan, Delhi
6. Synthetic Organic Chemistry: O.P.Agarwal
7. Modern Technology of Cosmetics, Asia Pacific Business Press Inc., New Delhi, 2004

T.Y.B.Sc. Chemistry

Sem. -V **Course No:- CH-357**

Subject: Physical Chemistry Practical.

Instructions

1. During preparation of solutions use molar solutions where ever possible.
2. Take minimum volume of solution (10 ml for titrations) and dilute concentration as per as possible.
3. Take at least 10 experiments from each semester.

Colorimeter / Spectrophotometer (At least 2)

1. To obtain the calibration curve of $KMnO_4$ using Colorimeter and determine λ max for of $KMnO_4$ and concentration of $KMnO_4$ unknown solution. Hence verify the beers law.
2. Determination of λ max and concentration of unknown Cu^{2+} solution and verify the beers law.
3. To determine the amount of Fe^{3+} ion present in the given solution by using salicylic acid by colorimetric titration(λ max= 525)

Potentiometer (At least 2)

1. Determine Ecal and pH of buffer solution (Citric acid + Na_2HPO_4) using quinhydrone electrode.
2. Determine the pKa and Ka of weak monobasic acid by potentiometric titration.
3. Determine formal redox potential of Fe^{2+} to $Fe^{3+}$by potentiometric titration.

Refractometer (At least 2)

1. Determine the refractive index of four liquids, hence specific and molar refraction.
2. Determine the molar refraction of homologous methyl, ethyl and propyl alcohol and show that constancy configuration to molar refraction by $–CH_2$ group.

3. Determination of unknown concentration of A and B by using mixture law.

Radioactivity

1. Determine the E_{max} of Beta particle.

Turbidimetry

1. Determine the molecular weight of a given polymer by turbidimetry.

Non-Instrumental

1. Molecular weight determination by steam distillation.
2. Draw five graphs using Microsoft excel or Origin and find out slope and intercepts of the graphs.

Partition coefficient

1. Study molecular condition of benzoic acid in toluene and water by determining its partition between toluene and water.

Viscosity (At least 1)

1. Determine the molecular weight of high polymer using its solution of different concentration.
2. Determine the radius of glycerol molecule by viscosity measurement.

T.Y.B.Sc. Chemistry

Sem. -VI **Course No:- CH-367**

Subject: Physical Chemistry Practical.

Conductometry (At least 2)

1. Conductometric titration of mixture of acid and hence determine the strength of acid.
2. Determine the relative strength of monochloro acetic acid and acetic acid conductometrically.
3. Determine the basicity of organic acid by conductometric measurement.

Chemical Kinetics (At least 2)

1. To investigate the reaction between H_2O_2 and KI by gas burette method.
2. Study the hydrolysis of methyl acetate in presence of hydrochloric acid.
3. Determine the energy of activation of the reaction between $K_2S_2O_8$ and KI.
4. To study the effect of concentration and temperature on the rate of reaction between iodic acid and sodium bisulphite

Polorimeter (At least 2)

1. To study the kinetics of inversion of cane sugar by polorimeter.
2. Determine the concentration of given solution of an optically active substance (cane sugar) by polorimetric measurement

pHmetry(At least 2)

1. Determine the pKa and Ka of weak monobasic acid by pH metric titration.
2. Determine the degree of hydrolysis of aniline hydrochloride pH metrically.
3. Determine the pKa of various mixtures of sodium acetate and acetic acid in aqueous solution and hence to find the dissociation constant.

Flame Photometry.

1. Estimation of Na, K, Li and Ca by flame photometer in given sample (any two metals).

Adsorption

1. Investigate the adsorption of acetic acid in aqueous solution by using activated charcoal.

Thermochemsitry.

1. Determine the integral heat of dilution of H_2SO_4 starting with solution of different concentration.
2. To determine the heat of hydration of $CuSO_4$
3. ΔG, ΔH, $\Delta S$of silver benzoate by solubility product and by conductometery.

Spectroscopy

1. To determine rotational constant by analysis of rotational spectra of CO and HCl molecule.

Application of Microsoft Excel or Origin

1. To draw graphs of different experiments which are performed and find out there slope, intercept using Microsoft Excel or Origin (at least 5 graphs).

Reference Books:-

1. Advanced Practical Physical Chemistry by J.B.Yadav, Goel publishing House Meerut.
2. Systematic experimental Physical Chemistry by Rajboj& Chondekar, Anjali Publication.
3. Experimental Physical Chemistry by R.C. Das &B.Behhra, Tata McGraw Hill.
4. Experiments of Physical Chemistry by Wilson, NewCombe, DenaroPergaman Press Rickett.
5. Findlay's Practical Physical Chemistry. Revised By J.A.Kitchener and B.P.Lavitt.
6. Applied Chemistry Theory and Practices by O. P. Vermani, A. K. Narula, New Edge International Publications, Second Edition

Course No:- CH-357 and CH-367

Subject: Physical Chemistry Practical

Scheme of marks for Internal Examination:-

Q. 1 :- Experiment Instrumental or Non Instrumental	**30**
Q. 2 :-Journal	**10**
	Total - 40

Scheme of marks for University Examination:-

Q. 1 :- Experiment Instrumental or Non Instrumental	**50**
Q. 2 :- Oral-	**10**
	Total - 60

T.Y.B.Sc. Chemistry

Sem. -V **Course No:- CH-358**

Subject: Inorganic Chemistry Practical.

1. **Gravimetric Estimations: (Any Two)**
   i) Fe as Fe_2O_3
   ii) Zn as ZnP_2O_7
   iii) Pb as $PbSO_4$
2. **Volumetric Analysis: (Any Two)**
   i) Manganese by Volhards method.
   ii) Estimation of Nickel by EDTA method.
   iii) Determination of strength of NaOH andNa_2CO_3 in a given solution.
3. **Inorganic Preparations:(Any Three)**
   i) Bis (ethylenediamine) copper (II) sulphate.
   ii) Potassium trioxalato chromate (III).
   iii) Tris (acetylacetonato) Iron (III).
   iv) 8-hydroxyqunoline Nickel (II)
4. **Colourimetric Analysis: (Any One)**
   i) Estimation of Titanium using H_2O_2.
   ii) Estimation of Iron using thiocyanate method.
5. **Paper Chromatography : (Any Two mixtures)**

   Separation and identification of binary mixture of cations. ($Fe^{3+,}$ Ni^{2+}, $Cu^{2+,}$ Co^{2+})

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References:

1. A Text Book of Quantitative Inorganic Analysis by A.I.Vogel,4th Edition.
2. Vogel's Qualitative Inorganic Analysis by A.I.Vogel.
3. Practical Chemistry-O.P.Pandey,D.N.Bajpai,S.Giri,by S.Chand Publication New Delhi.
4. Post Graduate Practical Chemistry by H.N.Patel,S.P.Turakhia,S.S.kelker,S.R.Puniyani. Himalaya Publishing House.

5. College Practical Chemistry by H.N.Patel,S.P.Turakhia,S.S.kelker,S.R.Puniyani. Himalaya Publishing House.
6. Practical Chemistry by K.K.Sharma,D.S.Sharma .Vikas Publications.

IMPORTANT NOTE:

- For volumetric analysis pipette solution should be 10 ml instead of 25 ml.
- Preparation of stock solution or standard solution should be in 100 ml measuring instead of 250 ml in order to avoid wastage of chemicals.

Inorganic Chemistry Practicals CH-358

Semester – V

External Examination Pattern

Time Allowed: 3 Hrs. **Max. Marks: 60**

1. Gravimetric Estimations / Volumetric Analysis / Colorimetric Analysis / Inorganic Preparation and Paper Chromatography **50 Marks**
2. Oral **05 Marks**
3. Journal (Completed and Certified) **05 Marks**

Internal Examination Pattern

Time Allowed: 3 Hrs. **Max. Marks: 40**

1. Gravimetric Estimations / Volumetric Analysis / Colorimetric Analysis / Inorganic Preparation and Paper Chromatography **30 Marks**
2. Oral **05 Marks**
3. Journal (Completed and Certified) **05 Marks**

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T.Y.B.Sc. Chemistry

Sem. -VI **Course No:- CH-368**

Subject: Inorganic Chemistry Practical.

1. **Inorganic Qualitative Analysis: (Six binary Mixtures containing common anions)**

   (Excluding phosphates and borates)

2. **Ore Analysis: (Any Two)**

   Heamatite ore - Estimation of Iron volumetrically

   Pyrolusite ore- Estimation of Manganese volumetrically

   Dolamite ore **-** Estimation of Calcium volumetrically

3. **Alloy Analysis : (Any Two)**

   i) Estimation of Zinc from Brass Alloy by EDTA method.

   ii) Estimation of Tin gravimetrically as SnO_2 from solder alloy.

   iii) Estimation of Copper iodometrically from nichrome alloy.

*****

References:

1. A Text Book of Quantitative Inorganic Analysis by A.I.Vogel,4th Edition.
2. Vogel's Qualitative Inorganic Analysis by A.I.Vogel.
3. Practical Chemistry-O.P.Pandey,D.N.Bajpai,S.Giri,by S.Chand Publication New Delhi.
4. Post Graduate Practical Chemistry by H.N.Patel,S.P.Turakhia,S.S.kelker,S.R.Puniyani. Himalaya Publishing House.
5. College Practical Chemistry by H.N.Patel,S.P.Turakhia,S.S.kelker,S.R.Puniyani. Himalaya Publishing House.
6. Practical Chemistry by K.K.Sharma,D.S.Sharma. Vikas Publication

Inorganic Chemistry Practicals CH- 368

Semester – VI

External Examination Pattern

Time Allowed: 3 Hrs. **Max. Marks: 60**

1. Inorganic Qualitative Analysis / Ore Analysis / Alloy Analysis **50 Marks**
2. Oral **05 Marks**
3. Journal (Completed and Certified) **05 Marks**

Internal Examination Pattern

Time Allowed: 3 Hrs. **Max. Marks: 40**

1. Inorganic Qualitative Analysis / Ore Analysis / Alloy Analysis **30 Marks**
2. Oral **05 Marks**
3. Journal (Completed and Certified) **05 Marks**

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T.Y.B.Sc. Chemistry

Sem. -V **Course No:- CH-359**

Subject: Organic Chemistry Practical.

I) Separation of Binary Mixtures and Qualitative Analysis (Any 7)

Any five mixtures from the following types should be given 1) acid – phenol, 2) acid – base, 3) acid – neutral, 4) phenol – base, 5) phenol – neutral, 6) base – neutral 7) neutral – neutral

(Two mixture must be insoluble in water)

II) Organic Estimations (Any 3)

1) Estimation of acetamide
2)Estimation of basicity (number of COOH groups) of acid
3) Estimation of glucose
4) Estimation of glycine
5) Saponification value of oil

T.Y.B.Sc. Chemistry

Sem. -VI **Course No:- CH-369**

Subject: Organic Chemistry Practical.

]

I) Organic Preparations (Any 5)

1) Quinone from Hydroquinone
2) Preparation of Sudan
3) Dibenzal propanone from Benzaldehyde and Acetone using $LiOH.H_2O$.
4) β-naphthymethyl ether from β-naphthol
5) Meta nitro aniline from m-dinitro benzene
6) Para iodo nitrobenzene from para nitro aniline
7) Glucosazone from glucose
8) Acetanilide to para nitroacetanilide

II) Preparation of Derivatives (Any 5)

1) Oxime derivative of aldehydes or Ketones
2) Aryloxyacetic acid of Phenol
3) 2, 4 DNP derivative of aldehydes or Ketones
4) Acetyl derivative of Aniline by using Zn dust / Acetic acid
5) Benzylidene devative of primary aromatic amine
6) Annilide derivative of acid
7) Amide derivative of acid

Reference Books

1) Practical organic chemistry – A I Vogel
2) Practical organic chemistry – O P Agarwal
3) University practical chemistry – P C Kamboj
4) Comprehensive practical organic chemistry – V K Ahluwalia and Renu Aggarwal (university press, 2016)

STRUCTURE OF EXTERNAL PRACTICAL EXAMINATION

Time allowed – 3 Hours **Marks – 60**

Semester V (CH-359)

Q.1 Separation of Binary Mixtures and Qualitative Analysis of anyone Compound. **50 Marks**

OR

Organic Estimations

Q.2 Oral **10 Marks**

Semester VI (CH-369)

Q.1 Organic Preparation / Preparation of derivative **40 Marks**
Q.2 Oral **10 Marks**
Q.3 Industrial Tour Report **10Marks**

Instructions

1) **In case of binary mixture experiment, examinee should identify type of mixture and should separate the mixture. After separation, examiner should ask the examinee to analyse any one compound of the mixture.**
2) **In case of organic preparation and preparation of derivative, product should be purified by recrystallisation.**
3) **Industrial tour is necessary for every student.**

STRUCTURE OF INTERNAL PRACTICAL EXAMINATION

Time allowed – 3 Hours **Marks – 40**

Q.1 Any one experiment **30 Marks**

Q.2 Journal **10 marks**

Equivalent courses for TYBSc Chemistry:

Semester	Course Title (Old)	Semester	Course Title (New)
V	CH-351: Physical Chemistry	V	CH-351: Physical Chemistry
	CH-352: Inorganic Chemistry		CH-352: Inorganic Chemistry
	CH-353: Organic Chemistry		CH-353: Organic Chemistry
	CH-354: Analytical Chemistry		CH-354: Analytical Chemistry
	CH-355: Industrial Chemistry		CH-355: Industrial Chemistry
	CH-356-A: Biochemistry **or** CH-356-B: Environmental Chemistry		CH-356-A:Biochemistry **or** CH-366-B: Environmental Chemistry
VI	CH-361: Physical Chemistry	VI	CH-361: Physical Chemistry
	CH-362: Inorganic Chemistry		CH-362: Inorganic Chemistry
	CH-363: Organic Chemistry		CH-363: Organic Chemistry
	CH-364: Analytical Chemistry		CH-364: Analytical Chemistry
	CH-365: Industrial Chemistry		CH-365: Industrial Chemistry
	CH-366-C:Polymer Chemistry **or** CH-366-D: Chemistry in Every Day Life		CH-366-C:Polymer Chemistry **or** CH-366-D: Chemistry in Every Day Life
	CH-307: Physical Chemistry Practical(Annual)		CH-357 & CH-367: Physical Chemistry Practical
	CH-308: Inorganic Chemistry Practical(Annual)		CH-358 & CH-368: Inorganic Chemistry Practical
	CH-309: Organic Chemistry Practical(Annual)		CH-359 & CH-369: Organic Chemistry Practical

Job opportunities for B.Sc. (Chemistry) students

- The course helps the students in improving their diverse skills in various areas such as laboratory skills, numerical and computing skills, ability to approach to the problems both analytically and logically, time management skills, etc.
- As a Chemist in the Sugar, Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Rubber, Petroleum, Pesticide, Food industries.
- As a Chemist in Municipal Corporation, Water treatment plant.
- For Research and Development department of Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Rubber, Petroleum, Pesticide, Food, Plastic, Ceramic, Perfumery, Agrochemical industries.
- In the Q.C. department of pharmaceutical, chemical, soap, detergent, surfactant, cement, fermentation, dye, rubber, petroleum and pesticides industries.
- In the Q.A. Executive in Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Rubber, Petroleum, Pesticide, Food industries.
- In the Production section and plant operator in Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Paper Rubber, Petroleum, Pesticide, Food industries.
- As an analyst in synthetic labs, Forensic Science Department, etc.
- As a Marketing Representative (M.R.) for the Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Paper, Rubber, Petroleum, Pesticide, Food products.
- As a Analytical Chemist, Biomedical Chemist, Chemical Engineering Assistant, Industrial Research Scientist, Lab Chemist, Materials Technologist, Production Chemist, Production Officer, Quality Controller, R&D Chemist, Research & Development, Safety Health And Environment Specialist, Teacher.

Kavayitri Bahinabai Chaudhari

North Maharashtra University

'A' Grade NAAC Re-Accredited (3rd Cycle)

Jalgaon-425001, Maharashtra, (India)

B.O.S. in Chemistry

B.Sc. First Year (Chemistry)

Semester I & II

C B C S

With effect from **June-2018**

FOREWORD

As per the directive from the North Maharashtra University, Jalgaon the chemistry syllabus for F.Y.B.Sc. (CBCS) had to be prepared. Guidelines for this were provided by the university.

Teachers of the affiliated colleges and university department were participated in workshop keeping in view of the aims of the UGC model curriculum in developing chemistry skill in students linking theory and practical courses and allowing both vertical and horizontal mobility and also catering to local needs the syllabus was prepared.

Teachers of different branches of chemistry namely Physical, Inorganic, Analytical and Organic had separate and joint brainstorming session and arrived at a draft of syllabus in chemistry for I & II semester of F.Y.B.Sc..

The final draft incorporating the suggestion was placed before the Board of Studies in Chemistry on 23-06-2018.for approval.

Chairman

Board of Studies in Chemistry

North Maharashtra University, Jalgaon

North Maharashtra University, Jalgaon

B.O.S. in Chemistry

Skeleton of Choice Based Credit System

w.e.f. 2018-19

For Theory	**1 Credit**	**1 Hour**
	1 Credit	**15 Hours/Semester**
	2 Credits	**30 Hours/Semester**
	2 Credits	**45 Lectures of 40 Minutes/Semester**
For Practical	**1 Credit**	**2 Hours**
	2 Credits	**60 Hours/Semester**
	2 Credits	**90 Lectures of 40 Minutes/Semester**

F.Y.B.Sc. Chemistry C.B.C.S. Pattern

Semester	Core Course	Paper No.	Name of Course	No. of Credits	No. of Hours per week	No. of Lectures per week	Int. Exam. Marks	Ext. Exam. Marks	Total Marks
I	CC-A-1	Paper I (Section A) CH-101	Physical & Inorganic Chemistry-I	2	2	3	40	60	100
		Paper II (Section B) CH-102	Organic & Inorganic Chemistry-I	2	2	3	40	60	100
		Paper III (Section A & B) CH-103	Chemistry Practical-I (Based on Section A & B)	2	4	6	40	60	100
II	CC-A-II	Paper I (Section A) CH-201	Physical & Inorganic Chemistry-II	2	2	3	40	60	100
		Paper II (Section B) CH-202	Organic & Inorganic Chemistry-II	2	2	3	40	60	100
		Paper III (Section A & B) CH-203	Chemistry Practical-II (Based on Section A& B)	2	4	6	40	60	100
			Total Credits	**12**					

CC- Core Course

S.Y.B.Sc. Chemistry C.B.C.S. Pattern

Semester	Core Course	Paper No.	Name of Course	No. of Credits	No. of Hours in per week	No. of Lectures per week	Int. Exam. Marks	Ext. Exam Marks	Total Marks
III	CC-A-III	Paper I (Section A) CH-301	Physical & Inorganic Chemistry	2	2	3	40	60	100
		Paper II (Section B) CH-302	Organic & Inorganic Chemistry	2	2	3	40	60	100
		Paper III (Section A & B) CH-303	Chemistry Practical (Based on Section A & B)	2	4	6	40	60	100
	SEC-1	CH-304	Basic Analytical Chemistry	2	2	3	40	60	100
IV	CC-A-IV	Paper I (Section A) CH-401	Physical & Inorganic Chemistry	2	2	3	40	60	100
		Paper II (Section B) CH-402	Organic & Inorganic Chemistry	2	2	3	40	60	100
		Paper III (Section A & B) CH-403	Chemistry Practical (Based on Section A & B)	2	4	6	40	60	100
	SCE-2	CH-404	Analytical Methods in Chemistry	2	2	3	40	60	100
			Total Credits	**16**					

CC- Core Course, SEC-Skill Enhancement Course

T.Y.B.Sc. Chemistry, C.B.C.S. Pattern

Semester	Discipline Sub. Elective Paper	Paper No.	Name of Course	No. of Credits	No. of Hours in terms of Credit per week	No. of Lectures per week	Int. Exam. Marks	Ext. Exam. Marks	Total Marks
V	DSE-A-1	Paper I (Section A) CH-501	Fundamental Physical Chemistry	2	2	3	40	60	100
		Paper II (Section B) CH-502	Fundamental Inorganic Chemistry	2	2	3	40	60	100
		Paper VIII (Section A & B) CH-508	Chemistry Practical (Based on Section A & B)	2	4	6	40	60	100
	DSE-A-2	Paper III (Section A) CH-503	Organic Reaction Mechanism	2	2	3	40	60	100
		Paper IV (Section B) CH-504	Fundamental Analytical Chemistry	2	2	3	40	60	100
		Paper IX (Section A & B) CH-509	Chemistry Practical (Based on Section A & B)	2	4	6	40	60	100
	DSE-B-1	Paper V (Section A) CH-505	Theory Course	2	2	3	40	60	100
		Paper VI (Section B) CH-506	Theory Course	2	2	3	40	60	100
		Paper X (Section A &	Chemistry Practical (Based on Section A & B)	2	4	6	40	60	100

		B) CH-510							
	SEC-3	Paper VII CH-507	Molecules of life / Industrial Chemicals and Environment	2	2	3	40	60	100
VI	DSE-A-4	Paper I (Section A) CH-601	Advanced Physical Chemistry	2	2	3	40	60	100
		Paper II (Section B) CH-602	Advanced Inorganic Chemistry	2	2	3	40	60	100
		Paper VIII (Section A & B) CH-608	Chemistry Practical (Based on Section A & B)	2	4	6	40	60	100
	DSE-A-5	Paper III (Section A) CH-603	Spectroscopic Methods of Structure Determination	2	2	3	40	60	100
		Paper IV (Section B) CH-604	Instrumental Methods of Analysis	2	2	3	40	60	100
		Paper IX (Section A & B) CH-609	Chemistry Practical (Based on Section A & B)	2	4	6	40	60	100
	DSE-B-2	Paper V (Section A) CH-605	Theory Course	2	2	3	40	60	100
		Paper VI (Section B) CH-606	Theory Course	2	2	3	40	60	100
		Paper X (Section A & B) CH-610	Chemistry Practical (Based on Section A & B)	2	4	6	40	60	100
	SEC-4	Paper VII CH-607	Polymer Chemistry / Green Chemistry	2	2	3	40	60	100
			Total Credits	**58**					

DSE- Discipline Specific Elective, SEC-Skill Enhancement Course

Salient features

- Cover an important theoretical and practical topic of physical, inorganic, analytical and organic chemistry.
- The course is self-contain and broadly covers the fundamental concept in chemistry.
- The syllabus provides logical sequencing of the “units” of the subject matter with proper placement of concepts with their linkage for better understanding.
- Promote understanding of basic principles in chemistry while retaining the excitement in chemistry.
- Develop an interest in student to study the chemistry as discipline.
- Emphasis has been promoting processes skills, problem solving abilities and applications of concept of chemistry for making learning of chemistry more relevant meaningful and interesting.
- Develop positive scientific attitude and appreciate contribution of chemistry towards the improvement of quality of human life.

Utility

- Describe and explain processes phenomenon in chemistry
- An ability to communicate chemical understanding
- Recall and interpret concept, theories and principles in chemistry
- Determine analyses and evaluate the interpretation ships involve in chemistry.
- Develop thirst of chemical knowledge, become flexible and persistence learners and appreciate the need for lifelong learning.
- Operate chemical equipment and technology safely.
- Make use of chemical data, concept, principles and terminology in communicating chemical information.
- Understand basic chemical concept in sufficient depth to provide an adequate foundation for specialization.

Learning objective

- To expose & develop interest in the field of chemistry
- To develop ability & to acquire the knowledge of terms, facts concept processes techniques & principles of subject
- To develop problem solving skills in students
- To develop proper aptitude towards the subject.
- To develop ability to apply the knowledge of contents of principles of chemistry
- To develop skills required in chemistry such as the proper handling of apparatus & chemical analysis.
- To understand the fundamental principle and chemical analysis

Pre-requisites

- To develop interest in learning chemistry.
- To develop practical skill in student.
- To develop scientific approach in student.
- To correlate theoretical concept of chemistry with practical approach.

North Maharashtra University, Jalgaon

Class- F. Y. B. Sc. Chemistry Syllabus (Semester Pattern)

Choice Base Credit System (With effect from June 2018).

The course structure and title of the courses for F. Y. B. Sc. (Chemistry) are as given below.

Semester I						
Core Course CC-A-I		**No of Credits**	**Hours/ Semester**	**Lectures/ Semester**	**Marks**	
Code	**Title**				**Ext.**	**Int.**
CH-101	Physical and Inorganic Chemistry-I (Section A)	2	30	45	60	40
CH-102	Organic and Inorganic Chemistry-I (Section B)	2	30	45	60	40
CH-103	Chemistry Practical-I (Based on Section A and B)	2	60	90	60	40
Semester II						
Core Course CC-A-II						
CH-201	Physical and Inorganic Chemistry-II (Section A)	2	30	45	60	40
CH-202	Organic and Inorganic Chemistry-II (Section B)	2	30	45	60	40
CH-203	Chemistry Practical-II (Based on Section A and B)	2	60	90	60	40

Note

1. Each theory course has weightage of 6 lectures per week. (Each Section is of 3 Lecture/ week)
2. Each practical course has weightage 6 lectures per week.
3. Each practical batch should consist of maximum 15 students.
4. Each Lecture is of 40 min duration.
5. Examination of practical course shall be held at the end of the each semester.
6. Calculation of credits and Hrs for theory and practical

For Theory	1 Credit	1 Hour
	1 Credit	15 Hours/ Semester
	2 Credits	30 Hours/ Semester
	2 Credits	45 Lectures of 40 Minutes/ Semester
For Practical	1 Credit	2 Hours
	2 Credits	60 Hours/ Semester
	2 Credits	90 Lectures of 40 Minutes/ Semester

IMPORTANT NOTE

***In volumetric analysis, volume of pipette solution should be 10 ml instead of 25 ml. Similarly preparation of 100 ml solution by using 100 ml volumetric flask instead of**

250 ml. (To avoid wastage of chemicals)

External Examination Pattern
Chemistry Practical Semester I/ II CH-103 /CH-203

Time: 3 Hrs. **Marks 60**

Instructions

1. Duration of examination 3 hrs (Batch-I: 10.00 am to 1.00 pm. and Batch-II: 2 to 5 pm)

2. All the students in a batch should be divided in three equal groups.

Note- Distribution of Experiments - ¼ of the students in a batch will be given Physical chemistry experiment, ¼ will be given an Analytical chemistry experiment and ½ will be given an Inorganic / Organic qualitative analysis.

3. Students should bring complete certified journal at the time of practical examination.

Q. 1. Physical Chemistry / Analytical Chemistry experiment	40 Marks
OR	
Inorganic/ Organic Qualitative analysis	
Q. 2. Oral	10 Marks
Q. 3. Journal	10 Marks

Total: 60 Marks

Internal Examination Pattern
Chemistry Practical Semester I/ II CH-103 / CH-203

Time: 3 Hrs. **Marks 40**

Q. 1. Physical Chemistry/ Analytical Chemistry experiment	30 Marks
OR	
Inorganic/ Organic Qualitative analysis	
Q. 2. Oral	05 Marks
Q. 3. Attendance and Behavior	05 Marks

Total: 40 Marks

NORTH MAHARASHTRA UNIVERSITY, JALGAON

Syllabus of F. Y. B. Sc. Chemistry

Choice Based Credit System, Semester System

Core Course-A-1(Semester I)

CH: 101 Physical and Inorganic Chemistry -I (Section A)

Chapter 1: Electrolytic conductance. **(L: 10, M: 13)**

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

Applications of conductance measurements.

a) Solubility of sparingly soluble salts\
b) Determination of degree of ionization.\
c) Determination of Ionic product of water\
d) Conductometric titration, Acid-Base Titrations,

Numerical problems relevant to the topic are expected.

Ref. 1, 2 (Relevant pages)

Chapter 2: Surface Chemistry . **(L: 06, M: 08)**

Introduction, Adsorption, Mechanism of adsorption, Factors affecting adsorption of gases by solids, Difference between adsorption and absorption, Types of adsorption: Physical and Chemical adsorption, Adsorption of gases by solid, Types of adsorption isotherms: 1. Freundlich Adsorption Isotherm, 2. Langmuir Adsorption Isotherm (Derivation).

Ref. 3, 4 (Relevant pages)

Chapter 3: Mathematical Preparation in Chemistry **(L: 14, M: 19)**

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)

Chapter 4: Periodic properties **(L: 08, M: 10)**

a) Atomic and ionic size

Definition and explanation of atomic radius, ionic radius, covalent radius and Van der Waal radius. Variation of atomic size along a period and a group.

b) Ionisation energy

Definition and explanation, factors affecting ionisation energy. Variation of ionisation energy along a period and a group. Applications of I. E. to chemical behavior of an element.

c) Electron affinity

Definition and explanation, factors affecting electron affinity. Variation of electron affinity along a period and a group. Applications electron affinity to chemical behavior of an element. Difference between I.E. and E.A.

d) Electronegativity

Definition and explanation, factors affecting electronegativity. Variation of electronegativity along a period and a group. Pauling's electronegativity scale, Mullikan's approach of electro negativity, electro negativity and percent ionic character.

Ref.6, 7 (Relevant pages)

Chapter 5: S block element (L: 07, M: 10)

Electronic configuration, variation in properties of S block elements: atomic radii, ionization energy, colour of flame, reducing property, metallic property. Complexes of alkali metals with salicylaldehyde, acetyl acetone, wrap around complexes with polydentate ligands such as crown ether and cryptate. Complexes of alkali metals such as beryllium oxalate ion, chlorophyll, complexes of Ca and Mg with EDTA.

Ref. 6, 7 (Relevant pages)

Reference Books

[1] Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli, Arun Bahl (S. Chand and Co Ltd.) (25^{th} edition).

[2] Elements of Physical Chemistry, S. Glasstone and D. Lewis (The Macmillan Press Ltd. (2nd edition).

[3] Principles of Physical Chemistry, S. H. Maron and C. F. Prutton (4^{th} edition).

[4] Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, M.S. Pathaniya

[5] Mathematical Preparation for Physical Chemistry, Farrington Daniels, Mc Graw- Hill Publication.

[6] Advanced inorganic chemistry volume 1 – Satyaprakash Tuli, Basu, Madan(S Chand publications)

[7] Concise inorganic chemistry – J D Lee (5^{th} edition)

Core Course-A-1(Semester I)

CH: 102 Organic and Inorganic Chemistry-I (Section B)

Chapter 1: Introduction to Organic Chemistry (L: 08, M: 10)

Introduction, general properties of organic compounds, applications of organic compounds in everyday life.

Benzene and its stability, Huckel's rule of aromaticity, nomenclature of derivatives of benzene (mono and disubstituted benzene only)

Structural effects: Inductive effect, resonance, hyper conjugation, steric effect, electromeric effect

Fission of covalent bond: homolytic and heterolytic fission, types of reagents: electrophiles and nucleophiles, types of organic reactions: addition, elimination, substitution and rearrangement reactions.

Ref. 1,2,3,4 (relevant pages)

Chapter 2: Hydrocarbons (L: 08, M: 10)

Alkanes: Introduction, nomenclature (common and IUPAC system)

Preparation of alkanes: by Wurtz reaction, by hydrogenation of alkenes. Reactions of alkanes: halogenation, combustion.

Alkenes: Introduction, nomenclature (common and IUPAC system)

Preparation of alkenes: by dehydration of alcohols, dehydrohalogenation of alkyl halides, Reactions of alkenes: Addition of halogen, hydrogen halide and hydration.

Alkynes: Introduction, nomenclature (common and IUPAC system)

Preparation of alkynes: by Double Dehydrohalogenation of vicinal and geminal dihalides, by alkylation of acetylene.

Reactions: Addition of halogens, hydrogen halides, hydration.

Ref. 1,2,3,4 (relevant pages)

Chapter 3: Haloalkanes and haloarenes (L: 06, M: 10)

Haloalkanes: Introduction, classification, nomenclature (common and IUPAC system) Monohalogen derivatives: Classification, methods of preparation- from alcohols (using HX, PX_3, PX_5, $SOCl_2$). 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 aq. NaOH.

Haloarenes: Introduction, nomenclature, reactions of haloarenes: nucleophilic substitution reactions with $NaNH_2$/ KNH_2, NaOH, NH_3, CuCN, Ullman reaction.

Ref. 1,2,3,4 (relevant pages)

Chapter 4: Alcohols, phenols and ethers (L: 08, M: 10)

Alcohols: Introduction, classification, nomenclature (common and IUPAC system), methods of preparation: from Grignard's reagent (using aldehydes and Ketones), by reduction of aldehydes and ketones. Physical properties of alcohols. Reactions of alcohols: reaction with active metals, dehydration, oxidation.

Phenols: Introduction, nomenclature, acidity of phenols, Preparation of phenol from benzene sulphonic acid, benzene diazonium chloride, Reactions of phenols: ester formation (acylation), formation of aryl ethers.

Ethers - Introduction, classification, nomenclature (common and IUPAC system), methods of preparation: by Williamson's synthesis, by dehydration of alcohols, from diazomethane. Reactions of ethers: reaction with hot and cold HI, hydrolysis with dil. H_2SO_4.

Ref. 1,2,3,4 (relevant pages)

Chapter 5: Ionic equilibria (L: 06, M: 08)

Strong and weak acids and bases, degree of dissociation, dissociation constants of acids and bases, P^H and P^{OH}, ionic product of water, numericals.

Buffer solutions: Definition, types, Henderson equation, buffer action, buffer capacity, numericals, applications of buffer solutions.

Ref.5, 6, 7 (relevant pages)

Chapter 6: VSEPR theory and shapes of covalent molecules (L: 09, M: 12)

Sidgwick – Powell theory, VSEPR theory: assumptions, need of the theory, effect of lone pairs and electronegativity.

Applications of VSEPR theory to explain a) Geometry of molecules containing bond pair of electrons: BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7 b) Geometry of molecules containing lone pairs as well as bond pair of electrons: $SnCl_2$, NH_3, H_2O, SF4, ClF_3, XeF_2, XeF_4, IF_5.

Limitations of VSEPR theory.

Ref.5, 7, 8 (relevant pages)

Reference Books

[1] Organic Chemistry - Francis A Carey (3rd Edition)
[2] Organic Chemistry - Morrison and Boyd (6th Edition)
[3] Organic Chemistry - Stanley H pine (5th Edition)
[4] A Text Book of Organic Chemistry Arun Bahl and B S Bahl, S Chand publication.
[5] Advanced Inorganic Chemistry, Volume 1 – Satyaprakash Tuli, Basu, Madan (S Chand publications)
[6] Analytical Chemistry – G D Christian (6th Edition)
[7] Principles of Inorganic Chemistry – Puri, Sharma, Kalia
[8] Concise Inorganic Chemistry – J D Lee (5th Edition)

NORTH MAHARASHTRA UNIVERSITY, JALGAON
F. Y. B. Sc. Semester I
CH-103 Chemistry Practicals –I (Based on Section A and B)

A) Physical Chemistry Experiments (Any three)

1. Calibration of volumetric apparatus Pipette / Volumetric flask.
2. To investigate the adsorption of oxalic acid from aqueous solution by activated charcoal and examine the validity of Freundlich and Langmuir's adsorption isotherms.
3. To standardize commercial sample of HCl using Borax and to write material safety data of the chemicals involved.
4. To determine the equivalent weight of Mg metal by Eudiometer method.
5. Determination of dissociation constant of weak monobasic acid (CH_3COOH) by conductance measurement.
6. Determination of the solubility of sparingly soluble salt by conductometery.

B) Analytical Chemistry Experiments (Any three)

[Instruction- Prepare solutions using 100 ml volumetric flask]

1. Preparation of std.0.1N oxalic acid solution and standardization of KOH solution.
2. Preparation of std. 0.1N $K_2Cr_2O_7$ solution and standardization of ferrous ammonium sulphate solution.
3. Preparation of std.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 Qualitative Analysis (Any Four compounds)

Analysis of inorganic compound containing one cation and anion

NORTH MAHARASHTRA UNIVERSITY, JALGAON

Syllabus of F. Y. B. Sc. Chemistry

Choice Based Credit System, Semester System

Core Course-A-II (Semester II)

CH: 201 Physical and Inorganic Chemistry-II (Section A)

Chapter 1: The Gaseous State (L: 14, M: 19)

The kinetic theory of ideal gases. Assumptions of kinetic theory of gases. Kinetic gas equation and its Significance (Derivation not expected), Deductions of Avogadro's principle, Graham's law, kinetic energy of translation. Deviation of real gases from ideal behavior. Reasons for deviation, compressibility factor, Van der Waal's equation, its applications. Andrew's isotherms of CO_2, relation between critical constants and Van der Waal's constants, liquification of Gases, Joule Thomson effect, related numericals

Ref. 1, 2 (Relevant pages)

Chapter 2: Liquid State (L: 06, M: 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 stalagnometer method. Viscosity of liquid, units of viscosity, measurement of viscosity of liquid by Ostwald's method, related numerical.

Ref. 2, 3 (Relevant pages)

Chapter 3: Second Law of Thermodynamics (L: 10, M: 13)

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 4: Metals and metallurgy (L: 07, M: 10)

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

Ref.4, 5 (Relevant pages)

Chapter 5: P block elements (L: 08, M: 10)

Electronic configurations of P block elements. Variation in properties: atomic radius, ionisation energy, electron affinity, electro negativity, metallic character, oxidation state, reactivity. Acidic and basic character of hydroxides of P block elements. Bonding and shapes of following molecules: Al_2Br_6, diamond and graphite, P_4, S_8, ClF_3.

Ref.6, 7 (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 Inorganic Chemistry – Puri, Sharma, Kalia
[5] Theoretical Principles of Inorganic Chemistry – G S Manku
[6] Advanced Inorganic Chemistry, Volume 1 – Satyaprakash Tuli, Basu, Madan (S Chand Publications)
[7] Concise Inorganic Chemistry – J D Lee (5th edn)

Core Course-A-II (Semester II)

CH: 202 Organic and Inorganic Chemistry-II (Section –B)

Chapter 1: Aldehydes and ketones **(L: 12, M: 15)**

Introduction, structure of carbonyl group, nomenclature of aldehydes and ketones (common and IUPAC system)

Aliphatic Aldehydes: Preparation of aliphatic aldehydes- by reduction of acid chlorides, from Grignard' reagent and HCN, from terminal geminal dihalides and from calcium salt of acids.

Aliphatic Ketones: Preparation from Grignard's reagent and R-CN, from nonterminal geminal dihalides, from calcium salt of acids.

Reactions of aliphatic aldehydes & Ketones: Reducing properties of aldehydes: reaction with Tollen's reagent and Fehling's solution, Clemmenson reduction, Wolff Kishner reduction, Aldol condensation, crossed Aldol, Cannizzaro reaction, crossed Cannizzaro reaction, addition of HCN, $NaHSO_3$, addition of derivatives of ammonia (hydroxyl amine, phenyl hydrazine, 2,4 DNP, semicarbazide).

Aromatic aldehydes and ketones: Preparation of benzaldehyde by Gatterman Kotch reaction, by oxidation of toluene. Reactions of benzaldehyde: addition of HCN, addition of Grignard's reagent, benzoin condensation.

Preparation of acetophenone: by oxidation of ethyl benzene, by F C acylation. Reactions of acetophenone: addition of HCN, addition of Grignard's reagent, oxime formation.

Ref. 1,2,3,4 (relevant pages)

Chapter 2: Carboxylic acids and their derivatives **(L: 10, M: 13)**

Carboxylic acids: Introduction, nomenclature (common and IUPAC system), preparation of carboxylic acids: by carbonation of Grignard's reagent, and by hydrolysis of nitriles. Physical properties of acids, acidity of carboxylic acids. Reactions of carboxylic acids: formation of salt (with NaOH, KOH, Na_2CO_3, $NaHCO_3$, NH_4OH and active metals), Hell- Volhard- Zelinsky reaction, formation of acid anhydrides.

Aromatic carboxylic acids: Preparation of benzoic acid: by hydrolysis of phenyl cyanide and by carbonation of Grignard's reagent. Reactions of benzoic acid: formation of salt, benzoyl chloride, benzamide and reduction to benzyl alcohol.

Esters: Preparation of esters- from alcohol & acid, alcohols & acid chloride, alkaline and acidic hydrolysis of esters.

Acid chlorides: preparation of acid chlorides from carboxylic acids by using PCl_3, PCl_5, $SOCl_2$. Reactions of acid chlorides with benzene and with sodium salt of acids.

Amides – Preparation of amides from acid and ammonia and from acid chloride and ammonia. Reactions of amides – hydrolysis and Hofmann rearrangement.

Ref. 1, 2, 3, 4 (relevant pages)

Chapter 3: Amines **(L: 08, M: 12)**

Aliphatic amines: Introduction, classification, nomenclature (common and IUPAC system), preparation of amines: by reduction of nitro alkanes, nitriles and oximes, by alkylation of primary and secondary amines, by reduction of isocyanides. Basicity of amines, reactions: action of nitrous acid, acylation, carbyl amine test, Hinsberg's test.

Aromatic amines

Preparation of aniline: from chlorobenzene and from nitrobenzene. Basicity of aromatic amines. Reactions: benzoylation, N- alkylation. Preparation of benzene diazonium chloride, reactions of benzene diazonium chloride: formation of iodobenzene, Sandmeyer reaction, azo coupling reaction: formation of methyl orange.

Ref. 1, 2, 3, 4 (relevant pages)

Chapter 4: Volumetric analysis (L: 09, M: 12)

Molecular weight, formula weight, equivalent weight, calculation of equivalent weight of acids, bases, oxidizing and reducing agents, units of concentration – molarity, normality, formality, molality and parts per million (ppm), numerical, standard solution, primary and secondary standards, titrant, analyte, milimoles and miliequivalents, equivalence point, end point.

Measurement of volume, effect of temperature on volume, apparatus for precise measurement of volume : pipette, burette, volumetric flask, calibration of pipette, burette and volumetric flask.

Ref. 5, 6 (relevant pages)

Chapter 5: Chemical bonding and structure (L: 06, M: 08)

Attainment of stable configuration, types of bonds: a) ionic bond- NaCl and $CaCl_2$ b) Covalent bond (Lewis concept) H_2, Cl_2, HF, O_2 and N_2 c) Co ordinate bond- NH_4^+ and H3N: BF_3 d) metallic bond- free electron theory, limitations of Lewis concept. Theories of bonding: valence bond theory, Heitler- London theory and Pauling- Slater theory. Types of overlap: s-s, s-p and p-p overlap with examples like H_2, Cl_2, HF, O_2, N_2 Limitations of valence bond theory.

Ref. 7, 8, 9 (relevant pages)

Reference Books

1. Organic Chemistry - Francis A Carey (3^{rd} Edition)
2. Organic Chemistry - Morrison and Boyd (6^{th} Edition)
3. Organic Chemistry - Stanley H pine (5^{th} Edition)
4. A Text Book of Organic Chemistry- Arun Bahl and B S Bahl, S Chand publication.
5. Analytical Chemistry – G D Christian (6th edn)
6. Vogel's Textbook of Quantitative Chemical Analysis
7. Advanced Inorganic Chemistry, Volume 1 – Satyaprakash Tuli, Basu, Madan(S Chand publications)
8. Principles of Inorganic Chemistry – Puri, Sharma, Kalia
9. Concise Inorganic Chemistry – J D Lee (5th edn)

NORTH MAHARASHTRA UNIVERSITY, JALGAON
F. Y. B. Sc. Semester II

CH-203 Chemistry Practicals-II (Based on Section A and B)

A) Physical Chemistry Experiments (Any three)

1. Determination of surface tension by drop number method of given liquid by using stalagnometer.
2. To compare the cleaning power of different samples of soap and detergent by surface tension measurement.
3. Determination of heat of solution of KNO_3 / NH_4Cl by water equivalent method.
4. Determination of relative viscosity of liquid A and B by viscometer.
5. Determination of percentage composition (v/v) of given mixture of ethyl alcohol and water by viscometer.
6. Determination of normality and strength of acid (HCl / CH_3COOH) conductometrically

B) Analytical Chemistry Experiments (Any three)

1. Preparation of std. 0.05 N potassium hydrogen phthalate solution and standardization of NaOH solution
2. Preparation of std.0.1N $ZnSO_4$ solution and standardization of EDTA solution.
3. Preparation of 0.1 N $K_2Cr_2O_7$ solution and standardization of $Na_2S_2O_3$ solution.
4. Estimation of aniline / phenol.
5. Determination of number of molecules of water of crystallization in sample of crystalline barium chloride / magnesium sulphate.

C) Organic Qualitative Analysis (Any Four compounds)

1. Type determination
2. Preliminary tests
3. Physical constant
4. Functional group tests

(Structural formula not expected)

KavayitriBahinabaiChaudhari
North Maharashtra University, Jalgaon
Syllabus
S.Y.B.Sc.
Subject: Chemistry
Choice Based Credit System

'A' Grade
NAAC Re-accredited
(3rd Cycle)

With Effect from June 2019

Prepared By
Chairman, Members of Board of Studies
And The Experienced Teachers in Chemistry,
North Maharashtra University, Jalgaon

KavayitriBahinabaiChaudhari
North Maharashtra University, Jalgaon
Revised Syllabus of S.Y.B.Sc. Chemistry (w.e.f. June 2019)
Choice Based Credit System (CBCS) Pattern

In the Faculty meeting chaired by Hon. Dean of Science faculty, the revised syllabus for S.Y.B.Sc. (Chemistry) is accepted and finalized as per guidelines of Academic Council and with reference to the U.G.C. model curriculum.
The course structure for S.Y.B.Sc. (Chemistry) is given below.

Course	Semester-III	Lectures	Marks		Credits
			Internal	External	
CH -301	Physical And Inorganic Chemistry (Core Course)	30	40	60	02
CH -302	Organic and Inorganic Chemistry (Core Course)	30	40	60	02
CH -303	Practical Chemistry	60	40	60	02
CH- 304 (SEC-1)	Basic Analytical Chemistry (Skill Enhancement Course)	30	40	60	02
	Semester- IV				
CH -401	Physical And Inorganic Chemistry (Core Course)	30	40	60	02
CH -402	Organic and Inorganic Chemistry (Core Course)	30	40	60	02
CH -403	Practical Chemistry	60	40	60	02
CH -404 (SEC-1I)	Advanced Analytical Chemistry (Skill Enhancement Course)	30	40	60	02

Note:
1. Each lecture is of one hour duration.
2. Each theory paper has two lectures per week.
3. Each practical course has four lectures per week.

Chairman B.O.S.Dean Science Faculty

KavayitriBahinabaiChaudhari
North Maharashtra University, Jalgaon
Revised Syllabus of Chemistry (w.e.f. June 2019)
Choice Based Credit System (CBCS) Pattern

Semester I

Core Course: CH - 301
Physical and Inorganic Chemistry

1. Solutions (L-10, M-20/30)

Introduction, Solubility,Factors affecting solubility, Types of solutions,Different way of expressing the concentration of solution , Ideal and non-ideal solutions, Raoults law and its limitation, The vapour pressure of actual liquid pairs the vapour pressure of ideal solution. Classification of binary solution of completely miscible liquids (Type-I, Type-II and Type-III) on the basis of Raoults law), Boiling point diagrams of miscible binary mixtures, Distillation of binary miscible solutions, Azeotropes, the fractionating column, Solubility of partially miscible liquid pairs, Phase diagram Phenol-water system, Tri ethyl amine-water and Nicotine-water system

Ref.1: Pages 261-264,270-286,288-291
Ref. 2, 3, 4 Relevant Pages

2.Colligative Properties (L-10, M-20/30)

Introduction, lowering of vapour pressure of solvent, Calculation of molecular weight of solute from Lowering of vapour pressure of solvent. Boiling point elevation of solution, Calculation of molecular weight of solute from boiling point elevation of solution, Freezing point depression of solution, Calculation of molecular weight of solute from depression in Freezing point, Osmosis and osmotic pressure, Relation of osmotic pressure to vapour pressure, Van't –Hoff equation for osmotic pressure, Landberger's method for the determination of elevation of boiling point, Beckman's method for determination of depression in freezing point ,Berkley and Hearty's method, Solution of electrolyte, Colligative properties of electrolyte (Qualitative concept only), related numerical.

Ref.-1:- Pages 312-324, 325-330
Ref. 2, 3, 4 Relevant Pages

3. The d-block elements (L-10, M-20/30)

Elements of first, second and third transition series, General characteristics of d-block elements

a) Metallic character b) Molar volume and densities c) Atomic radii d) Ionic Radii

e) Melting and boiling points f) Ionization Energies g) Reactivity h) Oxidation states

i) Standard electrode potential j) Reducing Properties k) Colour l) Magnetic properties

m) Catalytic Properties n) Tendency to form complexes

Ref. 5-653-671
Ref. 6 -615 -624
Ref. 7-1128-1143

Reference books

1. Principles of Physical Chemistry by S. H. Maron and C. F. Prutton (4th edition) 2015

2. Essentials of Physical Chemistry by B. S. Bahl, G. D. Tuli, ArunBahl, S. Chand (25th edn) Dec. 2010

3. Elements of Physical Chemistry S. Glasstone and D. Lewis (Macmillan Press Ltd.) (2nd edn) 2014

4. Physical Chemistry by Robert A. Alberty (John Willey and Sons) (7th edition) 1992

5. Concise Inorganic Chemistry by J.D.Lee.5th Edition. 2014

6. Principles of Inorganic Chemistry By Sharma, PuriKalia 30th edition Milestone Delhi. 2017

7. Advanced Inorganic Chemistry Volume - I, by Gurdeep Raj 23rd edition, Goel Publishing House, Meerut. 2016

Semester I

Core Course: CH - 302

Organic and Inorganic Chemistry

1: Stereoisomerism(L-12, M-24 / 36)

a) Isomerism, classification of isomerism, stereoisomerism, types of stereoisomerism.

b) **Projection formulae**

Fischer projection formula, Newman projection formula, Saw horse formula.

c) **Optical isomerism**

Optical activity, enantiomerism, chiral centre and chirality, elements of symmetry, dextrorotatory, laevorotatory, Configuration: R and S nomenclature system.

d) **Geometrical isomerism**

Geometrical isomers, condition for geometrical isomerism, nomenclature systems: Cis and Trans, E and Z, Syn and Anti.

e) **Conformational isomerism**

Conformational isomers, conformational isomerism in ethane and n- butane with energy profile diagrams.

f) Stereochemistry of Cyclohexane

Conformations of cyclohexane: chair and boat forms, axial and equatorial bonds in cyclohexane, factors affecting stability of conformations. Mono substituted cyclohexane.

(Use of models / ICT is expected for teaching this chapter)

Ref 2, 3, 4 (Relevant pages)

2: Heterocyclic and polycyclic aromatic compounds (L-08, M-16/24)

a) Five membered ring with one heteroatom

Introduction, preparation of furan, pyrrole and thiophene. Reactions: nitration, sulphonation, F C acylation, Reimer Tiemann reaction, catalytic hydrogenation.

b) Six membered ring with one heteroatom

Preparation of pyridine: from acrolein and from acetylene. Reactions: nitration, sulphonation, bromination, catalytic hydrogenation.

b) Polycyclic aromatic compounds

Introduction, structure of naphthalene, Haworth synthesis. Reactions: oxidation, reduction, nitration, halogenations, sulphonation, F C acylation.

Ref. 1, 2, 5, 6, 8 (Relevant pages)

3: Solvents, solutions Acids and Bases (L-10, M-20 / 30)

a) Donar and acceptor properties.

b) Molten salts, solvents for electrochemical reactions, purity of solvents.

c) Definition and approaches, solvent system concept, Lux-flood concept, Lewis concept, Generalized Acid-base concepts.

d) Differentiating and levelling solvents.

e) Co-solvating agents.

f) Hard and soft acids and bases: definitions, Pearson HSAB concept, theories of Hardness and softness, application and limitation of HSAB concepts.

Ref. - 9 : Page Nos. 220, 221, 223-229, 234-236.
Ref. - 10 : Page Nos. 238-249, 255-258, 263, 266, 269, 270.
Ref. - 11 : Page Nos. 374-386.

Reference Books

1) Organic chemistry - Francis A Carey (3rd Edition) 2017
2) Organic chemistry - Morrison and Boyd (6thEdition) 2018
3) Stereochemistry of organic compounds- E L Eliel 2008
4) Stereochemistry of organic compounds- P S Kalsi 2009
5) Organic chemistry - Stanley H pine (5th Edition) 1987
6) A Text book of Organic chemistry- ArunBahl and B S Bahl, S Chand publication.2016
7) A guide book to reaction mechanism in organic chemistry by Peter Sykes.5th Ed. 2003
8) Heterocyclic compounds by Leo Packet. 2006
9) Basic Inorganic chemistry 3rd edition by F.A. cotton, G. Wilkinson, Paul Guss John Wiley and Sons. 2007
10) Theoretical principals of Inorganic chemistry by G.S. Manku, Tata Mc. Graw Hill edition.
11) Advanced Inorganic chemistry by Gurudeep Raj., Vol. I, 23rd Edition, Goel publishing House Meerut.2015

Semester II

Core Course: CH- 401
Physical and Inorganic Chemistry

1.Electrochemistry (L-10, M-20/30)

Introduction, Electromotive force and its measurements , Reversible and Irreversible Cells, Standard cell ,Cell reaction and EMF, convention regarding sign of EMF, Single electrode potential, Standard hydrogen and calomel reference electrodes, Calculation of single electrode potential, Calculation of cell EMF from single electrode potential, Thermodynamics and EMF, ΔG, ΔH,ΔS from EMF data, Thermodynamics of electrode potential (Nernst equation), Standard potential and equilibrium constant, Classification of electrodes, Related numericals.

Ref.-1:- Pages 481-497
Ref.-2:- Relevant Pages.
Ref.-3:- Relevant Pages.

2.Chemical Thermodynamics (L-10, M-20/30)

Introduction, The Helmholtz free energy, ΔA for reactions, Gibb's free energy and, ΔG for reactions, Properties and significance of Gibb's free energy changes, Calculation of free energy changes, Fugacity and activity concepts, The reaction isotherm, Standard free energy change of formation, Criteria of equilibrium .

Physical equilibria involving pure substances, Clapeyron equation and its use, Vapour pressure of liquid and variation of vapor pressure with temperature**,** Clausius-Clapeyron equation, Different form of ClausiusClapeyron equation and is applications, Related numerical.

Ref.-1:- Pages 189-203, 206-213, 215-218
Ref.-2:- Relevant Pages.
Ref.-3:- Relevant Pages.
Ref.-4:- Relevant Pages.

3: Basic concepts of coordination chemistry(L-07, M-14 / 21)

Double salts and coordination compounds, co-ordination complexes and complex ions, coordination number, Unidentate, bidentate and polydentate ligands, chelating ligand and chelates, physical methods used in study of complex, Nomenclature of coordination compounds.

Ref. - 5:Page Nos. 729-735, 738-741.
Ref. -6: Relevent Pages.

4: Conductors, Insulators & Semiconductors(L-03, M-07 / 09)

General Properties of metals. Conductors, insulators and semiconductors. Intrinsic and extrinsic semiconductors. Applications of semiconductors.

Ref. 6 -121 - 144
Ref. 7-220-231
Ref. 8-175-179
Ref. 9-259-264

Reference books

1. Principles of Physical Chemistry

S. H. Maron and C. F. Prutton (4th edition) 2012

2. Essentials of Physical Chemistry

B. S. Bahl, G. D. Tuli, ArunBahl (S. Chand and Co Ltd.) (25th edition) 2010

3. Elements of Physical Chemistry

S. Glasstone and D. Lewis (The Macmillan Press Ltd.) (2nd edition) 2014

4. Physical Chemistry

Robert A. Alberty (John Willey and Sons) (7th edition) 1992

5. Principals of Inorganic Chemistry by B.R.Puri, L.R. Sharma, K.C. Kalia, Milestone publishers and distributors. 2017
6. Concise Inorganic Chemistry by J. D.Lee. 5th Edition. 2014
7. Theoretical Principles of Inorganic chemistry by G.S.Manku Tata McGraw Hill edition.1982
8. Principles of Inorganic Chemistry By Sharma, PuriKalia 30th edition Milestone Delhi. 2017
9. Advanced Inorganic Chemistry Volume - I , by Gurdeep Raj 23rd edition , Goel Publishing House, Meerut. 2016

Semester II

Core Course:CH - 402
Organic and Inorganic Chemistry

1: Synthetic Reagents (L-10, M-20 / 30)

Introduction, active methylene group

a) Acetoacetic ester

Preparation of acetoacetic ester. Synthesis of- alkyl acetic acid, dialkyl acetic acid, succinic acid, adipic acid, ∝-β unsaturated acid, methyl ketone (butanone).

b) Malonic ester

Preparation of malonic ester. Synthesis of- alkyl acetic acid, dialkyl acetic acid, succinic acid, glutaric acid, β keto acid(acetoacetic acid), ∝-β unsaturated acid.

Ref. 1, 2, 5, 6 (Relevant pages)

2:Organometallic compounds(L-10, M-20 / 30)

a) Nomenclature of organometallic compounds, carbon-metal bond in organometallic compounds.

b)**Organolithium compounds**

Preparation of organolithium compounds, Preparation of alcohols from organolithium compounds.

c) **Organomagnesium compounds**

Preparation of Grignard's reagent, reactions of Grignard's reagent with- esters, acid chlorides, with compounds containing active hydrogen.

d) **Organocopper compounds**

Preparation of organocopper compounds (Lithium dialkylcuprate) and synthesis of alkanes.

e) **Organozinc compounds**

Preparation of organozinc compounds, synthesis of cyclopropanes (Simmon Smith reaction), Reformatsky reaction.

Ref. 1, 2, 5, 6 (Relevant pages)

3. Molecular Orbital Theory (MOT) (L-10, M-20 / 30)

a) Molecular orbital method

b) LCAO Method

c) s-s, s-p, p-p, p-d and d-d combination of orbitals
d) Non Bonding combination of orbitals
e) Rules for linear combination of orbitals
f) Molecular orbital treatment for Homo nuclear Diatomic species – H_2, He_2, He_2^+, B_2, N_2 ,O_2 , O_2^- and O_2^{--}
g) Molecular orbital treatment for Hetero nuclear diatomic molecules –CO, NO, and HCl

Ref-9 Pages-89-102,104-112
Ref-10 Pages-333,334, 337-342,344-346,349-351,353,354,357,358,361,362

Reference Books

1)Organic chemistry - Francis A Carey (3rd Edition) 2017
2) Organic chemistry - Morrison and Boyd (6thEdition) 2018
3)Stereochemistry of organic compounds- E L Eliel 2008
4)Stereochemistry of organic compounds- P S Kalsi 2009
5)Organic chemistry - Stanley H pine (5th Edition) 1987
6) A Text book of Organic chemistry- ArunBahl and B S Bahl, S Chand publication. 2016
7)A guide book to reaction mechanism in organic chemistry by Peter Sykes.5th Ed.2003
8) Heterocyclic compounds by Leo Packet. 2006

9) Concise Inorganic Chemistry By J. D. Lee, 5th edition 2014
10) Advanced Inorganic Chemistry Volume-I by SatyaPrakash, G.D. Tuli, S.K. Basu, R. D. Madan S. Chand & Company Ltd (2004)

Semester I

Skill Enhancement Course
SEC-1: Basic Analytical Chemistry

Chapter 1: Introduction to Analytical Chemistry(L-08, M-16/24)

a) Introduction: Analytical chemistry, its interdisciplinary nature, importance of analytical chemistry, types of analysis: qualitative and quantitative analysis

b) Concept of sampling, definition, procedure of sampling, types of sampling

c) Accuracy, precision, significant figures, significance of zero, rounding off

d) Errors: Definition, types and sources of errors, minimisation of errors.

e) Good laboratory practices: Material safety data sheet (MSDS), fire safety, Handling of chemicals

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

Chapter 2: Acid base titrations (L-08, M- 16/24)

a) Principle,Acid–base indicators, Henderson-Hasselbalch equation, transition range of indicators.

b) Study of following acid base titrations with respect to: neutralization curve, selection of indicators and calculation of P^H

i) Strong acid versus strong base

ii) Weak acid versus strong base

c) Applications of acid base titrations.

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

Chapter 3: Precipitation titrations (L-06, M- 12/18)

a) Principle, precipitation titration curve**,**use of indicators in detectionof end point.

b) Preparation of $AgNO_3$ solution, its standardisation by Mohr's method.

c) Estimation of halides by Fajan's method

d) Applications of precipitation titrations.

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

Chapter 4: Chromatography (L-08, M-16/24)

a) Definition, Introduction, advantages and disadvantages of chromatography.
b) Principle of chromatography, classification of chromatography - partition, adsorption and ion exchange chromatography.
c) Paper chromatography: principle, technique, Rf value, ascending and descending techniques, paper chromatographic separation of metal ions, applications.
d) Thin layer chromatography (TLC): principle, technique and applications.
e) Ion exchange (Column) chromatography- cation and anion exchange resins, principle, technique and applications.

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

Semester II

Skill Enhancement Course

SEC-2: Advanced Analytical Chemistry

Chapter 1: Redox titrations (L-10, M-20/30)

a)Oxidation, reduction, redox reaction, oxidising agents, reducing agents, redox titrations.

b) Titration of Ce (IV) versus Fe (II), nature of titration curve, calculation of emf during titration.

c) Detection of end point- redox indicators, self indicator and starch indicator.

d) Titrations involving iodine: Iodimetry and Iodometry.

e) Determination of dissolved oxygen (DO) of a water sample.

f) Applications of redox titrations.

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

Chapter 2: Complexometric titrations (L-08, M- 16/24)

a)Complexes, ligands, types of ligands, chelates, chelating agents.

b) Formation of complex, formation constant.

c) Chelating agent EDTA, EDTA equilibria, EDTA titration curve.

d) Detection of end point- use of indicators, principle involved in colour change of indicator, characteristics of metal ion indicators.

e) Applications of complexometric titration with reference to analysis of soil: Estimation of calcium and magnesium ions by complexometric titrations.

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

Chapter 3: Gravimetric analysis (L-12, M- 24/36)

a) Introduction, advantages of gravimetric analysis

b) Solubility product (with problems), conditions for precipitation.

c) Steps of gravimetric analysis: Preparation of solution, precipitation, digestion.

Impurities in the precipitate: co-precipitation and post precipitation. Filtration, washing, drying or ignition, weighing

d) Applications – estimation of Ba as $BaSO_4$, Ni as Ni-DMG, Pb as $PbCrO_4$

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

Reference Books

1) Analytical chemistry – G D Christian (5^{th} Edition). 2006
2) Quantitative chemical analysis- J Mendham, R C Denny, Barnes, Thomas 2009
3 Analytical chemistry- D A Skoog, D M West, F J Holler 1992
4) Vogel's text book of quantitative inorganic analysis- Bassett, Denney, Jeffrery 1989
5) Basic concepts of analytical chemistry- S M Khopkar. 2008

Semester I
CH-303 Chemistry Practical

A) PHYSICAL CHEMISTRY EXPERIMENTS (Any Two)

1. Determination of molecular weight of solute (acetanilide / m- dinitrobenzene / sulphur) by depression of freezing point method.
2. Determination of molecular weight of non-volatile solute (KCl/ $BaCl_2$/ Urea) by using Landsberger apparatus.
3. Determination of standard electrode potential of Cu/Cu^{+2} or Ag/Ag^{+}, Zn/Zn^{+2} electrodes potentiometrically.

4. Conductometric titration of $Pb(NO_3)_2$Vs Na_2SO_4

B) VOLUMETRIC ANALYSIS (Any Five)

1. Estimation of acetic acid in commercial vinegar using NaOH.
2. Estimation of aspirin in drug sample.
3. Estimation of chloride by Mohr's method.
4. Estimation of Fe (II) by redox titration with $KMnO_4$.
5. Estimation of copper iodometrically.
6. Estimation of Mg^{+2} by complexometric titration with EDTA.
7. Determination of dissolved oxygen (DO) in water sample.

C) CHROATOGRAPHY (Any One)

1. Separation of mixture of o-nitro aniline and p-nitro aniline by Thin Layer Chromatography and to determine their Rf values.
2. Separation of mixture of any two amino acids by paper chromatography.

D) ORGANIC PREPARATIONS (Any Two)

1. Aniline to acetanilide by using Zn / Acetic acid.
2. Semicarbazone derivative of Aldehydes / Ketones.
3. Benzoyl derivative of – OH/ - NH_2.

Semester II
CH-403 Chemistry Practical

A) PHYSICAL CHEMISTRY EXPERIMENTS (Any Two)

1. Determination of critical solution temperature of phenol-water system
2. Determination of normality and strength of HCl titrating with standard NaOHPotentiometrically.
3. Construction of Daniel cell and determination of thermodynamic parameters. ΔG, ΔH, ΔS of the cell
4. Determination of molecular weight of liquid by steam distillation technique

B) ORGANIC QUALITATIVE ANALYSIS (Any five compounds)

Determination of a) Type b) Preliminary tests
c) Physical constant d) Elements (Sodium fusion test)
e) Functional groups f) Structure

C) GRAVIMETRIC ANALYSIS (Any Two)

1. Estimation of Ni as Ni-DMG (by Counterpoise method)
2. Estimation of Ba as $BaSO_4$ (by Ignition using filter paper)
3. Estimation of Pb as $PbCrO_4$ (by Gooch crucible / counterpoise method)

D)INORGANIC PREPARATIONS (Any One)

1. Tetramine Cu (II) sulphate.
2. Hexamine Ni (II) chloride.
3. Ferrous ammonium sulphate (Mohr's salt).

NOTE:
1) In all volumetric experiments it is expected from students to calculate quantity of primary standard substances and to prepare its solution. Then the other solution should be standardised.
2) Before starting the experiment, students must study Material safety data sheet (MSDS) of all chemicals used in experiments. Possibly the experiment should be declared one week earlier, so that it will be easy for students to do so.

Structure ofInternalPractical Examinations

Time:3Hours **Maximum Marks: 40**

1. Any one of the following experiments **30 Marks**

Physical chemistry experiment / Volumetric analysis / Chromatography / Organic Preparation

(For semester I)

Physical chemistry experiment / Gravimetric analysis / Organic qualitative analysis / inorganic Preparation**(For semester II)**

2. Oral **10 Marks**

Structure ofExternal PracticalExaminations

Time:3Hours **Maximum Marks: 60**

1. Any one of the following experiments 40 Marks

Physical chemistry experiment / Volumetric analysis / Chromatography / Organic Preparation**(For semester I)**

Physical chemistry experiment / Gravimetric analysis / Organic qualitative analysis / inorganic Preparation**(For semester II)**

2. Oral	**10 Marks**
3. Journal	**10 Marks**

Note: A student will not be permitted to appear at the practical examination unless he / she have performed the practicals and produced a certified journal.

EquivalencefortheS.Y.B.ScSyllabus

New Syllabus		Old Syllabus	
Course	**Semester-III**	**Course**	**Semester-III**
CH -301	**Physical And Inorganic Chemistry (Core Course)**	**CH -231**	**Physical And Inorganic Chemistry**
CH -302	**Organic and Inorganic Chemistry (Core Course)**	**CH -232**	**Organic and Analytical Chemistry**
CH -303	**Practical Chemistry**	**CH -233**	**Practical Chemistry**
CH- 304 (SEC-1)	**Basic Analytical Chemistry (Skill Enhancement Course)**		
	Semester- IV		**Semester- IV**
CH -401	**Physical And Inorganic Chemistry (Core Course)**	**CH -241**	**Physical And Inorganic Chemistry**
CH -402	**Organic and Inorganic Chemistry (Core Course)**	**CH -242**	**Organic and Analytical Chemistry**
CH -403	**Practical Chemistry**	**CH -243**	**Practical Chemistry**
CH -404 (SEC-1I)	**Advanced Analytical Chemistry (Skill Enhancement Course)**		

Kavayitri Bahinabai Chaudhari

North Maharashtra University, Jalgaon

Syllabus

T.Y.B.Sc.

Subject: Chemistry

Choice Based Credit System

With Effect from June -2020

As Per U.G.C. Guidelines

Prepared By

Board of Studies

Chemistry,

Kavayitri Bahinabai Chaudhari

North Maharashtra University, Jalgaon

Syllabus

Class- T.Y.B.Sc. Subject- Chemistry

Choice Based Credit System (CBCS) (60-40) Pattern

with effect from June-2020

Structure of Curriculum of T.Y.B.Sc. (Chemistry)

Semester – V

Course Type	Course code	Course Title	Credits	Hours per week	Teaching Hours
Core I	CH – 501	Principles of Physical Chemistry-I	3	3	45
Core II	CH – 502	Inorganic Chemistry	3	3	45
Core III	CH – 503	Organic Reaction Mechanism	3	3	45
Core IV	CH – 504	Industrial Chemistry	3	3	45
Skill Enhancement (SEC)	CH – 505	Analytical Instrumentation	3	3	45
Elective **(Any One)**	CH – 506 (A)	Biochemistry	3	3	45
	CH – 506 (B)	Green Chemistry	3	3	45
Core course **(Practical)**	CH – 507	Physical Chemistry Practical	2	4 (Per Batch)	60
	CH – 508	Inorganic Chemistry Practical	2	4 (Per Batch)	60
	CH – 509	Organic Chemistry Practical	2	4 (Per Batch)	60
Non-Credit Audit Course **(Any One)**	AC-510	NSS	No Credit	2- Batches	60
	AC-511	NCC		2- Batches	60
	AC-512	Sports		2- Batches	60

Note:

1. Each lecture is of one hour (60 Minutes) duration.
2. Each theory paper has three lectures per week.
3. Each practical course has four lectures per week.
4. An industrial study tour is compulsory for the T.Y.B.Sc. Students. The students should submit their tour reports at the time of practical examination of VIth Semester.

5. Use of Chart/Text book/Hand book of practical is allowed during examination.
6. Scientific calculator (non-programmable) is allowed during theory and practical examination.
7. All units should be in SI unit.

Semester VI

Course Type	Course code	Course Title	Credits	Hours per week	Teaching Hours
Core I	CH – 601	Principles of Physical Chemistry-II	3	3	45
Core II	CH – 602	Chemistry of Inorganic Solids	3	3	45
Core III	CH – 603	Spectroscopic Methods of Structure Determination	3	3	45
Core IV	CH – 604	Chemistry of Industrially Important Products	3	3	45
Skill Enhancement	CH – 605	Analytical Techniques	3	3	45
Elective **(Any One)**	CH – 606 (A)	Polymer Chemistry	3	3	45
	CH – 606 (B)	Research Methodology for Chemistry	3	3	45
Core course **(Practical)**	CH – 607	Physical Chemistry Practical	2	4 (Per Batch)	60
	CH – 608	Inorganic Chemistry Practical	2	4 (Per Batch)	60
	CH – 609	Organic Chemistry Practical	2	4 (Per Batch)	60
Non-Credit Audit Course **(Any One)**	AC-610	Soft Skill	No Credit	2- Batches	60
	AC-611	Yoga		2- Batches	60
	AC-612	Practicing Cleanliness		2- Batches	60

Note:

1. Each lecture is of one hour (60 Minutes) duration.
2. Each theory paper has three lectures per week.
3. Each practical course has four lectures per week.

4. An industrial study tour is compulsory for the T.Y.B.Sc. Students. The students should submit their tour reports at the time of practical examination of VI Semester.
5. Use of Chart/Text book/Hand book of practical is allowed during examination.
6. Scientific calculator (non-programmable) is allowed during theory and practical examination.
7. Values required for spectral problems should be provided in the question paper.
8. All units should be in SI unit.

Chairman B.O.S. **Dean Science Faculty**

Aims and 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 their 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 develop 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 skills required in chemistry such as the proper handling of apparatus and chemicals.

NOTE:

1. There are in all Six theory courses (4 Core courses, 1 Skill Enhancement course, 1 Elective) and Three practical (Core course practical) courses for each semester.
2. Each theory paper carry 100 Marks out of which 40 Marks are allotted for internal assessment and 60 Marks for external assessment.

3. As per the directions given by University, at the end of each semester internal examination will be conducted for 40 marks and University Examination will be conducted for 60 Marks.
4. The student has a right to choose any one of the optional paper for V^{th} semester either CH-506 (A) OR CH-506 (B), Similarly The students has a right to choose any one of the optional paper for VI^{th} semester either CH – 606 (A) OR CH – 606 (B).
5. A student is expected to submit a journal certified by the Head of the Department/Head of the Institution for each semester.
6. A student will not be permitted to appear for the practical examination unless he/she produce a certified journal. If the journal is lost, the student should produce a certificate from Head of the department / Head of the Institution stating that he/she has satisfactorily completed the practical work.
7. Industrial tour is compulsory for all the students.

Rules for Personal Safety in Chemistry Laboratory:

- A long sleeved, knee length laboratory coat/ apron is recommended. Long pants and closed toed shoes must be worn for individual safety. Loose clothing, open style shoes and sandals are prohibited. Long hair must be tied up. Each student will have to get his / her own necessary protection items.
- For eye protection, safety goggles must be worn in the laboratory whenever necessary. If the student wears contact lenses, full protection goggles, which provide total seal around eyes, must be worn. All students are expected to wear safety goggles.
- Prior to the practical examination, the teacher-in-charge will check all protective equipment to ensure that they are in order.
- Pipetting by mouth should be avoided. Use of pro-pipette bulbs is recommended.
    - All laboratories should be equipped with safety chart, adequate first aid requirements and fire extinguishers.

Kavayitri Bahinabai Chaudhari

North Maharashtra University, Jalgaon

T.Y.B.Sc Chemistry Syllabus

(CBCS) Pattern

Semester V **Core Course I**

CH-501

Subject- Principles of Physical Chemistry-I

(Theory: Lectures = 45 hrs. Marks 60) **(Credits: 03)**

Course objectives

- To orient and acquaint the students towards the basic concepts of Quantum Chemistry
- To acquire knowledge about rates of chemical reactions and distinguishing the reaction of different order and their characteristics.
- To understand the basic principles of phase rules and phase diagrams.
- To learn the underlying principles of electrode reactions, electrochemical cells and applications of EMF.

Learning outcomes

After successful completion of this course, students are expected to:

- Understand the significance of wave function and postulates of quantum mechanics.
- Deduce rate equations and half-life equations for first and second order reactions
- Draw and explain the one and two component system phase diagrams.
- Explain the principles of electrode processes and apply them during Practicals.

UNIT-1. Basic Quantum Chemistry **(L-11, M-15)**

Failures of Classical Mechanics, Origin of quantum mechanics, Particle aspect of radiation: Blackbody radiation, Photoelectric effect, Compton Effect, de Broglie's hypothesis: Matter waves, Heisenberg uncertainty principle, Application of Heisenberg's principle,

Interpretation of wave function, Significance of ψ and ψ^2, Normalization of wave function Operators and operator algebra, Eigen functions and Eigen values, various operators in quantum mechanics: Linear momentum, Kinetic energy and Total energy operator (only equations no derivations), Postulates of quantum mechanics.

Ref. 1: 3, 5-10, 12, 13, 30, 31, 36, 37, 79-84, 115-121

Ref. 2: 3-9, 18, 27-29, 36-39, 43-48

Ref. 4: 21, 24, 32-36, 38-44

UNIT-2. Chemical Kinetics (L-11, M-15)

The concept of reaction rates. Effect of temperature, Pressure, Catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal initial concentrations of reactants) Half–life of a reaction, Pseudo order reactions, General methods for determination of order of a reaction. Effect of temperature on reaction rate, Arrhenius equation (exponential and integrated form), Collision theory, Concept of activation energy and its calculation from Arrhenius equation, Related numerical.

Ref. 3: 732, 734-744, 751-759

Ref. 4: 970-971, 975-978, 984, 988-990, 992, 993

UNIT-3. Phase Equilibrium (L-11, M-15)

Phases, Components and Degrees of freedom of a system, Criteria of phase equilibrium. Gibbs Phase rule and its thermodynamic derivation. Derivation of Clausius –Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, Congruent and Incongruent melting points (lead-silver, $FeCl_3$-H_2O only), Related Numerical.

Ref. 3: 697-714, 719-721

Ref. 4: 605-607, 609-614, 616, 617, 623, 626, 627, 631, 632

UNIT- 4. Electrochemical Cell (L-12, M-15)

Introduction, overview of electrode processes, Faradaic and Non-Faradaic Processes, Introduction to electrical double layer, Factors affecting electrode reaction rate and current.

Classification of electrochemical cell, EMF expression for chemical cell with and without transference, Liquid junction potential, Types of liquid junction potential, Minimization of liquid junction potential.

Application of EMF measurement for pH using Hydrogen gas electrode, Quinhydrone electrode and Glass electrode, Related numerical.

Ref. 5: 1-4, 9, 10, 12-14, 23, 24, 64, 72, 73, 74

Ref. 4: 807, 808, 811, 812, 816-818

References and Suggested Readings

1. *Quantum Chemistry, Donald A. McQuarie, , Viva student edition, Viva Books*
2. *Quantum Chemistry, 4th edition, R. K. Prasad, New Age international Publishers.*
3. *Essentials of Physical Chemistry, Arun Bahl, B. S. Bahl, G. D. Tuli, S., Multicolor edition, S. Chand Publication.*
4. *Principles of Physical Chemistry, 44th edition, Puri, Sharma and Pathaniya, Vishal Publishing Co.*
5. *Electrochemical Methods Fundamentals and Applications, 2nd edition, Allen J. Bard and Larry R. Faulkner, John Wiley & Sons.*
6. *Chemical Kinetics, 2nd edition, K. J. Laidler,*
7. *An Introduction to Electrochemistry, S. Glasstone, East-West Press.*

Semester VI **Core Course I**

CH-601

Subject- Principles of Physical Chemistry-II

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course objectives

- To learn the basics of molecular spectroscopy and rotational spectra.
- To understand the basic principles and applications of nuclear chemistry.
- To learn the consequences of light absorption by atoms and molecules and photochemical reactions.
- To learn the laws of crystallography and basics of crystal structure.

Learning outcomes

After successful completion of this course, students are expected to:

- Analyze the rotational spectra of diatomic molecules and determine the bond length.
- Explain and apply the radioactivity principles for various chemical and biological investigations.
- Describe the mechanism of fluorescence, phosphorescence and photochemical reactions.
- Analyze the given crystal structure and determine the indices of planes, inter-planer distances and type of crystal structure.

UNIT-1. Investigation of Molecular Structure **(L-11, M-15)**

Introduction, Dipole Moment, Induced dipole moment, Electrical polarization of molecules. Orientation of dipole in an electric field, Debye equation. Method of determination of dipole moment, Vapour temperature method, Molecular structure and dipole moment

Interaction of electromagnetic radiation with molecules, Various types of spectra Rotational, Vibration and Electronic energy levels; with principle and example of each type.

Rotational spectroscopy: Rigid and non-rigid rotor diatomic molecule-Moment of inertia, Energy Levels, Selection rule, Intensities of spectral lines, Determination of bond lengths of diatomic and linear triatomic molecules, Isotopic substitution. Related numerical

Ref. 1: 253-257, 259-261

Ref. 3: 5-9, 33-46

UNIT-2. Nuclear Chemistry (L-12, M-15)

Introduction, Radioactive elements, Types of radioactive decay, Decay schemes, General characteristic of radioactive decay, Decay kinetics, Decay constant, Half-life period, Mean life, Units of radioactivity.

Application of radioactivity – Radiochemical principle of tracer technique; Application of tracer technique – Chemical investigation reaction mechanism- esterification, hydrolysis, Oxidation - Oxidation of CO, Structure determination - PCl_5 molecules, Thiosulphate ion, C-14 dating and tritium dating, Medical applications- Thyroditis, Bone fracture Healing, Brain tumor location, Defects in Blood Circulation.

Nuclear Fusion / Fission as source of energy with example

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management with case study. Related numerical

Ref. 4: 118-125, 225, 247, 248, 373-378, 402, 403, 407-411

Ref. 1: 103-105, 108-110, 113-115, 120-122, 136-138

Ref 6: 87-94, 108-112

UNIT-3. Photochemistry (L-11, M-15)

Laws of photochemistry, Quantum yield, Examples of low and high quantum yields, Consequence of light absorption by atoms and molecules, Jablonski diagram, Fluorescence, Phosphorescence, Quenching. Experimental setup for determination of quantum yield with actinometer as detector

Photochemical gas reactions, Photolysis of ammonia, Combination of H_2 and Cl_2 reaction, Reaction between H_2 and Br_2, Photosensitized gas reaction, H_2 and O_2, H_2 and CO, Chemiluminescence, Related numerical.

Ref. 1: 1045-1055

Ref. 2: 1044, 1045, 1048, 1049, 1054, 1055, 1059-1061

UNIT-4. Crystal Structure (L-11, M-15)

Forms of solids. Symmetry elements, 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. X–Ray diffraction by crystals, Bragg's law and Bragg's method. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects

in crystals: Shottkey and Frenkel defects. Liquid Crystal, Types and Applications. Related numerical

Ref. 1: 449-454, 456-463, 472-474

Ref. 2: 1085-1087, 1099, 1100, 1104-1107, 1123, 1130, 1131

References and Suggested Readings

1. *Essentials of Physical Chemistry, Arun Bahl, B. S. Bahl, G. D. Tuli, S. Multicolor edition, S. Chand Publication.*
2. *Principles of Physical Chemistry, 44th edition, Puri, Sharma and Pathaniya, Vishal Publishing Co.*
3. *Fundamentals of Molecular Spectroscopy, 4th Edition, C. N. Banwell and E. M. McCash, Tata McGraw-Hill: New Delhi*
4. *Essentials of Nuclear Chemistry, Revised 4th Edition, H. J. Arnikar, New Age International Publishers.*
5. *Advance Physical Chemistry, Gurtu and Gurtu, Pragati Publication.*
6. *Environmental Pollution and Health, V. K. Ahluwalia, The Energy and Resources Institute (TERI), 2005.*

Semester V **Core Course II**

CH-502

Subject-Inorganic Chemistry

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course objectives:

- To describe the VSEPR theory to predict shape of molecules from electron pairs.
- To describe the bonding in simple compounds using VBT.
- To describe the principles of VBT to predict hybridization of orbitals.
- To understand how CFT explains electronic structure, colour and magnetic properties of co-ordination compounds.
- To introduce the basic principles of MOT and electronic geometry of molecules.

Learning outcomes:

- Learn about the VSEPR theory and how it can be used to explain molecular shapes.
- Learn about the VBT to describe the formation of covalent bonds in terms of atomic orbital overlap.
- Learn about stability of complexes using CFSE.
- Learn about MOT to draw energy diagrams and to predict bond order.

UNIT-1: Structure and Reactivity of Molecules **(L-09, M-12)**

Valence Shell Electron Pair Repulsion Theory (VSEPR), Shapes of simple molecules and ions containing lone-and bond-pairs of electrons multiple bonding, prediction of shapes of irregular molecules and ions like - Sulphur tetra fluoride, Bromine trifluoride, Dichloroiodate (I) anion, Penta fluoro telluurate (IV) anion, Tetrachloroiodate (III) anion, Nitrogen dioxide, Phosphorus trihalides, Carbonyl fluoride, Summary of VSEPR rules Drawbacks of VSEPR theory.

Ref.1: 206-207

Ref. 3: Relevant pages.

UNIT 2: Modern Theories of Coordination Compound Part –A (L-09, M-12)

Assumptions, Werner theory and isomerism, EAN, Stability of complex ion, Factors affecting stability of complex ion, Irving William series, Stabilization of unstable oxidation state, Stereochemistry of coordination compound with C.N. 4 and 6, Isomerism in coordination compounds.

Ref. - 1: 735-737, 742-745, 748--757.

Ref. - 2: Relevant Pages.

UNIT 3: Modern Theories of Coordination Compound Part –B (L-09, M-12)

Assumptions of V.B.T., V.B. Theory as applied to structural and bonding in complexes of 3d series elements. Examples of square planar, Tetrahedral and Octahedral complexes, inner and outer orbital complexes, Magnetic properties of complexes of 3d series elements, limitations of V.B.T., Assumptions of CFT, Degeneracy of 'd' orbital's, Application of CFT to octahedral complexes, Weak and strong ligand field splitting, spectrochemical series.

Ref. 1: 759 - 766

Ref.2: Relevant Pages

UNIT 4: Modern Theories of Coordination Compound Part –C (L-09, M-12)

Definition of C.F.S.E., Calculation of C.F.S.E. in weak and strong field octahedral complexes, Evidences of C.F.S.E., Factor's affecting 10 Dq, CFT and magnetic properties, spin only magnetic moment equation, Electron occupancy in CFT, Application of CFT to tetrahedral a nd Calculation of C.F.S.E. in tetrahedral complexes. Tetragonal distortions from octahedral geometry, Jahn-Teller theorem Application of CFT to square planer complexes, Problems related to calculation of spin only magnetic moment for square planer, tetrahedral and octahedral complexes (for high spin and low spin complexes).

Ref.1: 766 -772,

Ref.2: Relevant pages

UNIT 5: Modern Theories of Coordination Compound Part –D (L-09, M-12)

Crystal field effects- Variation of lattice energies, enthalpies of hydration and crystal radii variations in halides of first and second row transition metal series and spinel structures, limitations of CFT, experimental evidences in support of metal ligand bond overlaps. ACFT,

Assumptions of Molecular orbital theory, composition of ligand group orbitals, Molecular orbital treatment (Qualitative) of octahedral complexes (strong & weak field), Effect of pi-bonding, Charge transfer spectra, Comparison of VBT, CFT and MOT.

Ref. 1: 794-796,774-778

Ref. 2: Relevant Pages

References:

1. *Principle of Inorganic Chemistry, B. R. Puri, L. R. Sharma, K. C. Kalia, Milestone Publisher and distributor.*
2. *Concise Inorganic Chemistry, 5th Edition, J. D. Lee.*
3. *Inorganic Chemistry Principles of Structure and Reactivity, 4th Edition, James E. Huheey,*
4. *Ellen A. Keiter. Richard L. Keitler.*

Semester VI **Core Course II**

CH-602

Subject- Chemistry of Inorganic Solids

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course Objectives:

- To describe basic principles of nanomaterials.
- To describe basic synthesis of nanoparticles.
- To describe composition and technological importance of inorganic solids.
- To describe composition of cement, lime and alloys.
- To describe manufacture of fertilizers.

Learning Outcomes:

- Learn about basic principles and synthesis of nanomaterials.
- Learn about classification, composition and processing of cement.
- Learn about classification and composition of alloys.
- Learn about types manufacture and applications of fertilizers.

UNIT 1: Synthetic Methods of Nanomaterials **(L-09, M-12)**

Introduction to Nano science, nanostructure and nanotechnology (basic idea), Size dependent properties of nanomaterials (basic idea) a) Semiconducting nanoparticles b) Metallic nanoparticles. Synthesis routes of nanomaterials: a) Bottom up approaches i) Chemical vapor deposition (CVD) ii) Spray pyrolysis iii) Sol gel process b) Top down approaches: mechanical alloying, Role of surfactant in shape and size control of nanomaterials

Ref:1: 602-604, 624, 653-655.

Ref:2: 66-70,74-77, 79,85-87.

Ref.3: 656-658, 707-712,721-724

UNIT 2: Inorganic Solids of Technological Importance **(L-09, M-12)**

Inorganic pigments, Coloured solids**,** White and black pigments, Molecular materials and fullerides, Molecular material chemistry – One dimensional metals, Molecular magnets,

Inorganic liquid crystals, Solid electrolytes (a) solid cationic electrolytes (b) solid anionic electrolytes .

Ref:- 1: 607-609,642-644,647-650.

Ref.3: 661-664,696-699,703-707.

UNIT 3: Cement and Lime **(L-09, M-12)**

Classification of cement, Ingredients and their role, Manufacture of cement and the setting process, Quick setting cements. Manufacture of lime and applications

Ref.4: Relevant pages

Ref.5: Relevant pages

UNIT 4: **Fertilizers** **(L-09, M-12)**

Plant Nutrients, Different types of fertilizers, need for fertilizers, requisite qualities of fertilizers, symptom of deficiency, Manufacture of following fertilizers:- Urea, Ammonium nitrate, Calcium ammonium nitrate, Ammonium phosphate, Super phosphates, Compound and Mixed fertilizers, Potassium chloride and Potassium sulphate.

Ref.5: Relevant pages

Ref.6: Relevant pages

UNIT 5: **Alloys** **(L-09, M-12)**

Classification of alloys, Ferrous and Non-ferrous alloys, Specific properties of elements in alloys, Manufacture of steel, Removal of silicon, decarburization, demagnetization and desulphurization. Composition and properties of different types of steels

Ref.7: Relevant pages

Ref.8: Relevant pages

Reference:

1. *Inorganic Chemistry, 4^{th} /5^{th} edition, Shriver and Atkins*
2. *Textbook of Nano Science and technology, B. S. Murthy, P. Shankar, Badev Raj, B. B. Rath and James Murday, University Press III M, Metallurgy and Material Sciences.*
3. *Inorganic Chemistry, 6^{th} Edition, Weller, Overton, Rourke & Armstrong.*
4. *Shriver Chemical Process Industry, 5^{th} edition, George T. Austin.*
5. *Industrial Chemistry, 14^{th} edition, B. K. Sharma,2004.*
6. *Riegels Handbook of Industrial chemistry, 9^{th} Edition, James A. Kent, CBS Publishers and Distributors*

7. *Engineering Chemistry, S. S. Dara.*
8. *Engineering Chemistry, B. K. Sharma, Goel Publishing House, Meerut.*
9. *Engineering Chemistry, P. C. Jain and M. Jain Dhanpat Rai and Sons Delhi.*

Semester V **Core Course III**

CH-503
Subject- Organic Reaction Mechanism

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Learning Objectives

- To study different types of organic reactions.
- To understand the mechanisms of different types of reactions.
- To distinguish between types of substrates and types of reagents.
- To understand ways of attack of reagent, breaking and formation of bonds in different reaction mechanisms.
- To study kinetics, evidences and factors affecting different types of reactions.
- To study stereochemistry of different reactions.
- To understand role of different reagents in different reactions.

Course Outcomes

- Students will learn organic reactions like nucleophilic substitution, electrophilic substitution, nucleophilic addition, electrophilic addition and elimination.
- Students will be able to write/ explain mechanisms of those types of reactions.
- Students will understand how a reaction takes place in one or more steps.
- Students will understand the types of intermediates formed in different reactions.
- Students will learn how reagent attacks the substrate molecule and accordingly how bonds break and formed.
- Students will learn how change in structure of substrate, reagent and solvent changes the product formed and its stereochemistry.

- Students will be able to predict the products and to suggest the mechanisms.

UNIT 1. Nucleophilic Substitution at Saturated Carbon (9 L, 12M)

SN^1, SN^2 and SN^i reactions, Mechanism and stereochemistry, regioselectivity and stereo specificity of substitution reaction. Scope at saturated carbon, allylic carbon and vinylic carbon. Factors affecting rate of SN^1, SN^2 and SN^i reactions (Effect of nature of substrate, nucleophile, leaving group and solvent).Neighboring group participation (norbornyl & norbornenyl systems), Non-classical carbocation's.

Ref:- 1: 328-359, 931-937.

Ref:- 2: 293-369.

Ref: - 3: 257-328.

Ref: - 4: 179-200.

UNIT 2. Electrophilic Addition to C=C (9 L, 12M)

Introduction, Mechanism of electrophilic addition to C=C bond ($Ad_{2}{}_{E}$Mechanism)**,** addition of hydrogen halides, orientation of addition: Markownikoff's and Anti Markownikoff's addition (peroxide effect), stereochemistry, addition of halogens: experimental evidences for two step mechanism, mechanism of addition of bromine, factors affecting anti-stereoselectivity, effect of substituents on rate of addition, addition of hypohalous acids (HOX), Hydroxylation (Mechanism of formation of cis and trans 1,2-diols), Hydroboration- Oxidation (Formation of alcohol), Hydrogenation (Formation of alkane), Ozonolysis (formation of aldehydes & ketones).

Ref:- 1: 427-447.

Ref:- 2: 734-742, 783-788.

Ref: - 4: 323-360, 425-440

UNIT 3. Nucleophilic Addition to C=O (9 L, 12M)

Introduction, Structure of carbonyl group, reactivity of carbonyl group,

Addition of Hydrogen cyanide, alcohols, thiols, water, ammonia derivatives.

Aldol and Cannizzaro Reaction, Perkin reaction, Wittig reaction, Reformatski reactions,

Reduction reactions using $NaBH_4$, $LiAlH_4$ with mechanism.

Ref:- 1: 222-239.

Ref:- 2: 879-919.

UNIT 4. Aromatic Substitution Reactions **(09 L, 12M)**

Electrophilic substitution

Introduction, arenium ion mechanism, Effect of substituent group (Orientation, o/p directing and meta directing groups). Classification of substituent groups (activating and deactivating groups) Mechanism of: Nitration, Sulfonation, Halogenation, Friedal-Crafts reactions (alkylation and acylation), Diazo Coupling reactions, Ipso-substitution.

Nucleophilic substitution

Addition- elimination (SNAr), Elimination-addition (Benzyne) mechanism with evidences, Chichibabin reaction

Ref:- 1: 471-527.

Ref:- 2: 501-521, 641-653.

Ref: - 4: 517-545, 943-967.

UNIT 5. Elimination Reactions: **(9 L, 12M)**

Introduction, The reaction mechanisms: E1, E2, E1CB with evidences and factors affecting the reaction.E1 v/s E2 and Elimination v/s substitution. Anti and Syn elimination, Stereo electronic factors. Bredt's rule. Dehydrohalogenation, Dehalogenation, Dehydration, Hoffmann and Saytzeff's elimination, Pyrolytic elimination.

Ref:- 1: 382-406.

Ref:- 2 : 982-1010.

Ref: -4 : 273-310.

References

1. *Organic Chemistry, Second Edition. J. Clayden, N. Greeves & S. Warren and P. Wothers (Oxford).*
2. *Advanced Organic Chemistry-Reactions, Mechanisms and Structure, 5th Edition, Michael B. Smith, Jerry March.,Wiley-VCH, Weinheim, 2000,*
3. *Advanced Organic Chemistry Part A- Structure and Mechanisms, 3rd Edition, A. Carey and R.J. Sundberg. Springer US, Third Edition*
4. *Organic Chemistry, 6th Edition, R. T. Morrison and R. N. Boyd.*
5. *Web- Organic Chemistry Portal*

Semester VI **Core Course III**

CH-603

Subject- Spectroscopic Methods of Structure Determination

(Theory: Marks 60 Lectures = 45 hrs) **(Credits: 03)**

Course Objectives

- To study principle of spectroscopy and to understand wave parameters and terms involved in spectroscopy.
- To study different types of spectroscopy.
- To understand principle, concept and the terms used in each type of spectroscopy.
- Interpretation of UV, IR, NMR spectra.
- Use of spectral data for determination of structure of unknown organic compounds.
- To study different applications of each type of spectroscopy.

Learning Outcomes

- Students will learn interaction of radiations with matter. They will understand different regions of electromagnetic radiations. They will know different wave parameters.
- Students will learn principle of mass spectroscopy, its instrumentation and nature of mass spectrum.
- Students will understand principle of UV spectroscopy and nature of UV spectrum. They will learn types of electronic excitations.
- Students will be able to calculate maximum wavelength for any conjugated system. And from the value of λ-max they will be able to find out extent of conjugation in the compound.
- Students will understand principle of IR spectroscopy, types of vibrations and the nature of IR spectrum.

- From IR spectrum, they will be able to find out IR frequencies of different functional groups. And thus, they will be able to find out functional groups present in the compound.
- Students will understand principle of NMR spectroscopy and will understand various terms used in NMR spectroscopy. They will learn measurement of chemical shift and coupling constants.
- Students will be able to interpret the NMR data and they will be able to use it for determination of structure of organic compound.
- Students will be able to determine structure of simple organic compounds on the basis of spectral data such as λ max values, IR frequencies, chemical shift (δ values).

UNIT 1. A) Introduction to Spectroscopy (9L, 12M)

Introduction, meaning of spectroscopy, nature of electromagnetic radiation, wave length, frequency, energy, amplitude, wave number, and their relationship, different units of measurement of wavelength and frequency, different regions of electromagnetic radiations. Interaction of radiation with matter. Excitation of molecules with different energy levels, such as rotational, vibrational and electronic level. Types of spectroscopy, advantages of spectroscopic methods

Ref:- 2: 1-19.

Ref:- 4 : 13-19.

B) Mass spectroscopy

Basic theory, Nature of mass spectrum, Importance of molecular ion peak, isotopic peaks, base peak, nitrogen rule, rule of 13 for determination of empirical formula and molecular formula.

Ref:- 1: 170-186.

Ref:- 2: 415-424.

Ref:- 3 : 2-15.

Ref:- 4 : 401-417.

UNIT 2. Ultra Violet Spectroscopy (9L, 12M)

Introduction, nature of UV spectrum, Beer's law, absorption of UV radiation by organic molecule leading to different excitations. Terms used in UV Spectroscopy: Chromophore,

Auxochrome, Bathochromic shift (Red shift), hypsochromic shift (Blue shift), hyperchromic and hypochromic effect. Effect of conjugation on position of UV band. Calculation of λ-max by Woodward and Fisher rules: for dienes and enone system, Applications of UV Spectroscopy: Determination of structure, determination of stereo chemistry (cis and trans), problems.

Ref:- 1: 1-27.

Ref:- 2: 9-53.

Ref:- 4: 367-398.

UNIT 3. Infra-red Spectroscopy (9 L, 12M)

Introduction, Principle of IR Spectroscopy, fundamental modes of vibrations (3N-6, 3N-5) Types of vibrations (Stretching and bending), Regions of IR Spectrum: functional group region, finger print region and aromatic region, Characteristic IR absorption of functional groups: Alkanes, alkenes, alkynes, alcohol, ethers, alkyl-halides, carbonyl compounds (-CHO, C=O, -COOR, -COOH), amines, amides and Aromatic Compounds and their substitution Patterns. Factors affecting IR absorption: Inductive effect, resonance effect, hydrogen bonding. Applications of IR Spectroscopy: determination of structure, chemical reaction and hydrogen bonding, Problems.

Ref:- 1 : 28-57.

Ref:- 2 : 65-154.

Ref:- 3 : 71-109.

Ref:- 4 : 26-93.

UNIT 4. NMR Spectroscopy (9L,12M)

Introduction, Principles of NMR Spectroscopy, Magnetic and nonmagnetic nuclei, Precessional motion of nuclei without mathematical details, Nuclear resonance, chemical shift, shielding, & deshielding effect. Measurement of chemical shift, delta and Tau-scales. TMS as reference and its advantages, peak area, integration, spin-spin coupling, coupling constants, *J*-value (Only first order coupling be discussed), problems.

Ref:- 1: 63-145.
Ref:- 2 : 185-356.
Ref:- 3 : 144-216.
Ref:-4 : 108-160.

UNIT 5. Combined Problems Based on UV, IR, NMR & Mass (9 L, 12M)

Determination of structure of simple organic compounds on the basis of spectral data such as λ max values, IR frequencies, chemical shift (δ values), coupling constant, peak values provided to the students.

Reference Books:

1. *Spectroscopic Methods in Organic Chemistry, D. H. Williams & I. Fleming, 5th Ed.*
2. *Spectroscopy of Organic Compounds, P. S. Kalsi, New Age Int. Pub., 6th Ed., 2007*
3. *Spectrometric Identification of Organic Compounds, R. M. Silverstein and F. X. Webster , John Wiley and Sons Inc, 7th Edition.*
4. *Introduction to Spectroscopy, Donald L. Pavia, Gary M. Lampman, George S. Kriz and J. R. Vyvyan. Indian Edition. Cengage Learning; 5th edition (2015)*

Semester V **Core Course IV**

CH-504

Subject- Industrial Chemistry

(Theory: Lectures 45 hrs, Marks 60) **(Credits: 03)**

Course objectives

- To produce graduates with enhanced skills, applied knowledge, aptitude to carry out higher studies or research and development in the various industrial areas.
- To make the student cognizant about important aspects of Chemical Industries, Industrial work culture and environment.
- To prepare the students for immediate entry to the workplace with sound theoretical knowledge and some basic experimental concepts in the area of various industries viz. Sugar Industry, Fermentation Industry, Petroleum and Petrochemicals.
- To offers the synergism between basic concepts of Chemistry with Industrial applications.
- To equip the students with knowledge of some industrial organic synthesis as requirement of diverse chemical industries.
- Empower the students to understand the concepts in chemical processing, engineering and industrial development.

Learning outcomes

From the course CH: 504 Industrial Chemistry**,** the student will be able to understand….

- Basic requirements of Chemical Industry, different terms, operations and processes involved in chemical Industry.
- Describe Copy Right Act, Patent Act and Trade Marks, Bureau of Indian Standards (BIS) and International Organization for Standardization (ISO).

- Basic requirements, raw materials, different processes and operations involved in Sugar Industry and also different grades of sugar and uses of by-products of sugar industry.
- Importance of fermented products, basic requirements, theory and process of alcohol making, fractional distillation and various terms involved in Fermentation Industry.
- Understand Occurrence of Petroleum, theories of formation of Petroleum and different terms Viz. Knocking, Anti-Knock Compounds, Octane number, Cetane number, Gasohol and Power alcohol etc.
- Manufacturing processes involved in Industrial Organic Synthesis such as Methanol, Isopropanol, Glycerol, Acetylene and Aromatic hydrocarbon i.e. Toluene from petroleum with their uses.

UNIT 1: General Aspects of Industrial Chemistry (L-9, M-12)

Introduction, Basic Requirements of Industrial Chemistry, Chemical Production, Raw Materials, Unit Process and Unit Operations, Quality Control, Quality Assurance, Process Control, Research and Development, Pollution Control, Human Resource, Safety Measures, Classification of Chemical Reactions, Batch and Continuous Process, Conversion, Selectivity, Yield, Copy Right Act, Patent Act and Trade Marks. Bureau of Indian Standards (BIS), International Organization for Standardization (ISO)

Ref.1: Chapter 2(26, 27, 31 to 36)

Ref.4: Chapter 1 and 2 (Relevant Pages)

Ref.6: Chapter 1, 2 and 3 (Relevant Pages)

Ref: Websites and Web Pages

www.wikipedia.org/wiki/patentact , www.wikipedia.org/wiki/trademarks, www.wikipedia.org/wiki/trademarks,www.wikipedia.org/wiki/bis www.wikipedia.org/wiki/iso

UNIT 2: Sugar Industry (L-9, M-12)

Introduction, Sugar Industry in Maharashtra and India, Manufacture of Cane Sugar- [Refining (with flow sheet)], General Idea of Sulphitation and Carbonation, Concentration /Evaporation, Crystallization Separation of crystals. Grades, Baggase, Cellotex

Ref.3: Chapter 38 1208 to 1218 (Relevant Points Only)

UNIT 3: Fermentation Industry (L-9, M-12)

Introduction, Alcohol fermentation, Uses of alcohol, Theory underlying process of making alcohols beverages, Manufacture of Beer, Manufacture of Spirit, Alcohol from Cane Sugar Molasses, Theory of fractional distillation – Coffey'still, Rectified spirit, Absolute alcohol, Fusel oil, Proof spirit, Denatured alcohol.

Ref.2:578-596.

Ref.3: Chapter 36, 1175-1190 (Relevant Points Only)

UNIT4: Petroleum Industry. (L-9, M-12)

Occurrence, Petroleum producer countries in the world, Exploration Methods, Composition of Petroleum, Refining or Distillation of Petroleum, Anti-Knock Compounds, Octane number, Cetane number, Petrohol (their definitions only), Manufacture of Petrol or Gasoline by Bergius Method, Cracking process- Thermal, Catalytic, Hydro cracking.

Ref.1: 340 to 352, 356 to358 and 363 to 368.

Ref.3: Chapter 4, 217 to 311 and Chapter 5, 312 to 342 (Relevant Points only)

UNIT 5: Industrial Organic Synthesis (L-9, M-12)

Manufacture of methanol from synthesis gas, Isopropanol from propylene, Glycerol from propylene via allyl chloride, Acetone by catalytic dehydrogenation of isopropanol. (with flow sheet diagram), Unsaturated Hydrocarbon –preparation of Acetylene from Natural gas (with flow sheet), Aromatic hydrocarbon- Preparation of toluene (with flow sheet)

Ref.3: Chapter 11, 439 to 451 and Chapter 14, 493 to 522 (Relevant Points Only).

References:

1. *Principles of Industrial Chemistry, Chris A Clausen III and Guy Mattson, John Wiley and Sons, Inc. Somerset, 1978, New York.*
2. *Shreve's Chemical Process Industries, George T. Austin, 5 th Edition, The McGraw-Hill, 1984, New York.*
3. *Industrial Chemistry, B. K. Sharma, 16th Edition, Goel Publishing House, Meerut,(U.P.) 2011, India.*
4. *Comprehensive Industrial Chemistry, P.G. More, 1st Edition, Pragati Prakashan, Meerut, (U.P.) 2010, India.*

5. *Chemistry and Technology of the Cosmetics and Toiletries Industry, D.F. Williams and W.H. Schmitt Blackie Academic & Professional First edition 1992 Second edition 1996 © Chapman & Hall ISBN-13 :978-94-0 10-7194-9 e-ISBN-13:978-94-009-1555-8*
6. *Handbook of Industrial Chemistry Organic Chemicals, Mohammad Farhat AIi, Bassam M. El AIi, James G. Speight, The McGraw-Hill Companies, 2005, ISBN 0-07-141037-6*

Semester VI **Core Course IV**

CH-604

Subject- Chemistry of Industrially Important Products

(Theory: Lectures 45 hrs, Marks 60) **(Credits: 03)**

Course objectives

- To make student perceptive about various commodity industries viz. Cosmetics and Perfumes, Dyes and Pharmaceuticals, Pesticides, Soaps and Detergents, related diversified and multidisciplinary fields of chemical industry.
- To produce graduates with enhanced skills, knowledge and research aptitude to carry out higher studies or research and development in the various industrial areas.
- To equip students with advance knowledge about various industrially important products.
- To makes students ready for immediate entry to the workplace with sound theoretical and basic experimental knowledge in the areas of various industries.
- To engender the substantial interest in the students to understand the concepts in chemical processing, engineering and industrial development of present era viz. Cosmetics and Perfumes Industry, Dyes and Pharmaceuticals, Pesticides, Soaps and Detergents, related multidisciplinary and diversified fields of chemical industry.
- To describe the industrial production of a number of important organic and inorganic compounds / chemicals and products of end use.
- To gain comprehensive knowledge of cutting-edge developments in a field of different chemical industries by discussions and exchange of experiences and knowledge.
- To develop proficiency in application of current aspects of industrial chemistry.

Learning Outcomes

On successful completion of the course **CH: 604 Chemistry of Industrially Important Products**, the student will be able to understand….

- Describe the industrial production of a number of important organic and inorganic compounds / chemicals and products of end use.
- Gain comprehensive knowledge of cutting-edge developments in a field of different chemical industries.
- Importance of Cosmetics Industry and a general study including preparation and uses of the Hair dye, hair spray, shampoo, suntan lotions, lipsticks, talcum powder, nail enamel, creams (cold, and shaving creams).
- Perfumes and identify the distinguishing features of its components and also an essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone etc.
- Know about pesticides both natural and synthetic, benefits and adverse effects of it, also synthesis, manufacture and uses of pesticides viz. Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Anilides (Alachlor and Butachlor).
- Definition, classification, raw material used in soaps and detergents, reaction involved in it, Manufacture of Soaps and cleansing action of soaps and detergents.
- Definition, properties of good dyes, relation between colour and constitution, classification of dyes according to their mode of application and chemical constitution.
- Importance's, definition and meaning of the different terms involved in Drugs and Pharmaceuticals Industry and also synthesis, uses, properties and industrial manufacture of Paracetamol, Aspirin, and Chloramphenicol.

UNIT 1: Chemistry of Cosmetics (L-9, M-12)

Introduction, Raw materials and general study including preparation and uses of the following: Hair dye, shampoo, suntan lotions, lipsticks, talcum powder, nails enamel, creams (cold and shaving creams).

Ref.: 6 Chapter -1, 1 to 34, Chapter -2, 36 to 100, Chapter -3, 104 to 145, Chapter - 4 149 to 181 and Chapter- 9, 290 to 309. Relevant Points Only

UNIT 2: Chemistry of Perfumes (L-9, M-12)

Essential oils A general study including properties, uses and importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone and antiperspirants and artificial flavours.

Ref. 3: Chapter 53, 1520 to1544 Relevant Points Only.

Ref.6: Chapter 8, 272 to 289, Chapter 10, 310 to 344, Relevant Points Only.

UNIT 3: Pesticide Chemistry (L-9, M-12)

General introduction to pesticides and their changing concepts (natural and synthetic), benefits and adverse effects of pesticides, structure activity relationship, synthesis and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Anilides (Alachlor and Butachlor).

Ref.3: Chapter 41, 1280 to1318 Relevant Points Only.

Ref.7: Chapter 11, 381 to 426 Relevant Points Only.

UNIT 4: Soap and Detergents (L-9, M-12)

Soaps, Surfactants and its Importance, Raw Materials used in Soap Manufacture, Manufacture of Soaps (Continuous Process), Cleansing action of Soap, Classification of Soaps, Detergents, Principal group of Synthetic Detergents, Detergents builders and Additives, Comparison between Soap Detergent.

Ref.3: Chapter 39, 1219 to1251 and Chapter 40,1252 to1279 Relevant Points Only.

Ref. 6: Chapter- 5, 123 to160 Relevant Points Only.

UNIT 5: Dyes, Drugs and Pharmaceuticals. (L-9, M-12)

(a) Dyes: Introduction, properties of dyes, Otto Witts theory only, Classification of dyes according to their mode of application and Chemical Constitution.

Ref.3: Chapter 54, 1545 to1608 Relevant Points Only.

Ref.6: Chapter 8, 259 to 288 Relevant Points Only.

(b) Drugs and Pharmaceuticals: Introduction, Importance, Qualities of good drugs, Functional and chemotherapeutic drugs, Meaning of the terms: Prescriptions, Doses, Analgesic, Antipyretics, Antibiotics, Anti-inflammatory, Anti-viral, Cardiovascular, Cough and Cold Preparations, Sedatives and Hypnotics, contraceptives. Synthesis, uses, manufacture and properties of Paracetamol, Aspirin, Chloramphenicol

Ref.4: Chapter 8, 144 to194 Relevant Points Only.

Ref.6: Chapter 10, 331 to 379 Relevant Points Only.

References:

1. *Principles of Industrial Chemistry, Chris A Clausen III and Guy Mattson, John Wiley and Sons, Inc. Somerset, 1978, New York.*
2. *Shreve's Chemical Process Industries, George T. Austin, 5 th Edition, The McGraw-Hill, 1984, New York.*
3. *Industrial Chemistry, B. K. Sharma, 16th Edition, Goel Publishing House, Meerut,(U.P.) 2011, India.*
4. *Comprehensive Industrial Chemistry, P.G. More, 1stEdition, Pragati Prakashan, Meerut,(U.P.) 2010, India.*
5. *Chemistry and Technology of the Cosmetics and Toiletries Industry, D.F. Williams and W.H. Schmitt Blackie Academic &. Professional First edition 1992 Second edition 1996 © Chapman & Hall ISBN-13 :978-94-0 10-7194-9 e-ISBN-13:978-94-009-1555-8*
6. *Handbook of Industrial Chemistry Organic Chemicals, Mohammad Farhat AIi, Bassam M. El AIi, James G. Speight, The McGraw-Hill Companies, 2005, ISBN 0-07-141037-6*

Semester V **Skill Enhancement Course**

CH-505

Subject- Analytical Instrumentation

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course Objectives

- To develop an understanding of the range and uses of analytical methods in chemistry.
- To understand and establish the role of chemistry in quantitative analysis.
- To enhance the Analytical instrumental skill of the students.

Learning Outcomes

- Explain the fundamentals of analytical methods and instruments for qualitative and quantitative Analysis.
- Express the role of analytical chemistry in science.
- Students will be able to function as a member of an interdisciplinary problem solving team.

UNIT 1:-Spectrometry **(9L, 12M)**

Origin of spectra Interaction of electro-magnetic radiation with matter, Electro-magnetic Spectrum, The Absorption of Radiation, Solvents for Spectrometry, Quantitative Calculations, Beer's Law, Principles of instruments - Sources, Monochromators (prism, diffraction gratings, Optical filters), Cells, detectors, Slits Width, Single Beam Spectrometer, Spectrometric Errors, Deviation from Beer's Law - Chemical deviation, Instrumental deviation, Problems.

Ref.-1:- 398-401, 410-411, 413--435, 439-443.

Ref. 2 -6:-Relevant Pages

UNIT 2: Infrared Spectrometry **(9L, 12M)**

Infra red Spectrometry – Principles, Theory, Instrumentation, Source, monochromator, detectors, Single beam, Double beam, Types, Sampling Technique, Solvents, Spectrometric error, FTIR introduction, General applications.

Ref.-2: 447 – 458

Ref.-4: 527-576

Ref. 2-6: Relevant Pages

UNIT 3. A: Emission Spectrometry (9L, 12M)

Flame Emission Spectroscopy – Principles, Theory, Instrumentation, Experimental techniques, Interferences and applications , Advantages and disadvantage, Plasma Emission Spectrometry – Principles, Plasma as excitation source, inductively coupled Plasma source, ICP-AES Instrumentation, Applications.

Ref.-1: 462 - 467

Ref. 2-6: Relevant Pages

B:-Atomic Absorption Spectrophotometry

Introduction, Principles, Advantages over FES, Instrumentation – Sources, Burners, Flames, Interferences – Spectral Interferences, Ionization Interferences, Refractory Compound Formation,Hallow cathode lamps, Physical Interferences, Use of Organic Solvents, Sample Preparation, Applications of AAS. Comparison of AAS with atomic emission methods

Ref.-1: 467 - 475

Ref. 2-6:Relevant Pages

UNIT 4:-Potentiometry (9L, 12M)

Potentiometer, The Cell for Potential Measurements, Combination Electrode, Theory of Glass Membrane Potential, The Alkaline Error, The Acid Error, Standard Buffers, Ion-selective Electrodes - Glass Membrane Electrodes, Precipitate Electrodes, Solid-State Electrodes, Liquid-Liquid Electrodes, Plastic Membrane/Ionophore Electrodes, Coated Wire electrodes, Enzyme Electrodes.

Ref.-1: 312-313,316-325

Ref.-2 -6: Relevant Pages

UNIT 5:-P^Hmetry (9L, 10M)

Introduction to pH meter, The Glass pH Electrode Principle, Accuracy of pH Measurements, Measurements with the pH-meter, Making the pH Measurement, Fundamental limitations, Maintenance.

Ref.-8: 327-333

Ref.-2 - 8: Relevant Pages

Reference Books:-

1. *Analytical Chemistry, G.D. Christian, 5th Edition.*
2. *Analytical Chemistry Principal- J. H. Kennedy. 2nd Edition (1990)*
3. *Analytical Chemistry, An Introduction, Skoog, West and Holler, 6 th Edition*
4. *Instrumental Method of Chemical Analysis, Chaitwal and Anand, 5th Edition.*
5. *Basic Concept of Analytical Chemistry, S.M. Khopkar*
6. *Instrumental Methods of Chemical Analysis- Willard, Merritt, Dean and Settle, 6th Edition*
7. *Introduction to Instrumental Analysis, R.D. Braun*
8. *Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas, 6th Edition,*

Important Instrument web links

Instruction Manual Operation Guide UV-1800 Shimadzu Spectrophotometer,
http://www.sustainable-desalination.net/wp-content/uploads/2013/05/UV-1800.pdf

Instruction Manual Operation Guide Agilent 5500 Series FTIR,
https://www.agilent.com/cs/library/usermanuals/public/5500_series_ftir_operation_manual.pdf

Instruction Manual Operation Guide Agilent 700 Series ICP Optical Emission Spectrometers,
https://www.agilent.com/cs/library/usermanuals/public/8510230100_700SeriesICP_UserManual.pdf

Instruction Manual Operation Guide Flame Atomic Absorption Spectrometry,
https://www.agilent.com/cs/library/usermanuals/Public/0009.pdf

Instruction Manual Operation Guide Potentiometry,
http://nhp.mowr.gov.in/docs/HP2/MANUALS/Water%20Quality/5014/-download-manuals-WaterQuality-WQManuals-32PotentiometricAna.pdf
http://shop.hannasingapore.com/media/pdf/2016-01-11-HI901C-Full.pdf

User Manual pH meter F-71, HORIBA, Ltd. 2011
http://library.metergroup.com/Manuals/Horiba/BenchtopPh/F-71%20Manual.pdf

Semester VI **Skill Enhancement Course**

CH-605

Subject- Analytical Techniques

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course Objectives

- To provide knowledge of instruments which are used in Chemical, Pharma, Petroleum, and insecticide and pesticide industry
- To increase student technical skill as per industry need.
- To develop an understanding of the range and uses of analytical methods in chemistry.

Learning Outcomes

- Compare the Instrumental methods and non instrumental methods and there advantages.
- Solve the problem of detection and separation using analytical instruments.
- Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
- Students will be able to explain why chemistry is an integral activity for addressing social, economic, and environmental problems.

UNIT 1:- Solvent Extraction **(9L, 12M)**

The Distribution Co-efficient, The Distribution Ratio, Percent Extracted, Solvent Extraction of Metals - Ion Association Complex and Metal Chelates, The Extraction Process, The Separation Efficiency of Metal Chelates, Analytical Separations, Multiple Batch Extractions, Countercurrent Distribution, Simple numerical problems on Percent Extracted and Multiple Extraction, Problems

Ref.1: 484 to 498.

Ref. 2-6: Relevant Pages

UNIT 2:- High-Performance Liquid Chromatography (9L, 12M)

Introduction, Principles, Equipment for HPLC, Choice of Column Materials for HPLC, Application

Ref.1: 537 to 545

Ref.2-6: Relevant Pages

UNIT 3:- Gas Chromatography (9L, 12M)

Introduction, Principles, Gas chromatography Columns, Gas Chromatography Detectors, Column Efficiency in Chromatography- Theoretical Plates, 1) Van Deemter Equation, 2) Capacity Factor and 3) Resolution, Problems

Ref.1: 522 to 528, 511 to 515

Ref.2-6:- Relevant Pages

UNIT 4:- Ion Exchange Chromatography (9L, 12M)

Introduction, Cation Exchange Resins, Anion Exchange Resins, Cross-linkage, Effect of pH Separation of Amino Acids, Effect of Complexing Agents-Separation of Metal ions on Anion Exchange Columns, Applications of Ion Exchange Chromatography

Ref.1: 517 to 522

Ref. 2-6: Relevant Pages

UNIT 5:-Thermal Methods (9L, 12M)

General Discussion, Thermogravimetry- Instruments for thermogravimetry, Applications of thermogravimetry, Differential Techniques- Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC), Instruments for DTA and DSC, Experimental and Instrumental Factors, Applications of DTA and DSC, Problems

Ref.-6: 503 - 519

Ref. 1-6: Relevant Pages

Reference Books:-

1. *Analytical chemistry, G.D. Christian, 5th Edition,*
2. *Instrumental Methods of Chemical Analysis, Chatwal and Anand*
3. *Basic Concept of Analytical Chemistry, S.M. Khopkar, 2nd edition,*
4. *Chemical Analysis by A. K. Shriwastawa, P. C.Jain, S. Chand and Company.*
5. *Quantitative Analytical Chemistry, James S. Fritz, George H.Schenk,5th Edition.*
6. *Vogel's Text Book of Quantitative Chemical Analysis, J. Mandham, R.C.Denney, J. D. Barnes, M. Thomas, B. Shivashankar, 6th Edition.*

Important Instrument web links

The LC Handbook Guide to LC Columns and Method Development,

https://www.agilent.com/cs/library/primers/public/LC-Handbook-Complete-2.pdf

Handbook and user manual of Gas chromatography

https://www.agilent.com/cs/library/usermanuals/Public/G3430-90011.pdf

Handbook and user manual of Ion Exchange Chromatography

https://www.agilent.com/cs/library/primers/Public/5991-3775EN_BioIEX_HowTo_LR.pdf

Handbook and user manual of Ion Differential Scanning Calorimetry

https://www.perkinelmer.com/CMSResources/Images/46-74542GDE_DSCBeginnersGuide.pdf

Semester V **Elective Course**

CH-506(A)

Subject- Biochemistry

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Learning Objectives

- To study different types of biomolecules.
- To study structure of biomolecules.
- To study classification of each type of biomolecules.
- To study reactions of the biomolecules.
- Study of metabolism and thus, study of metabolic processes and reactions involved.
- To study energetics of the metabolic processes.
- Students should understand: Structure and role of Carbohydrates, Amino acids, Proteins, Enzymes, lipids, Nucleic Acids and energy rich compounds in biochemical reactions.

Course Outcomes

- Students will study biomolecules like carbohydrates, amino acids, proteins, enzymes, lipids and nucleic acids.
- Students will understand definitions, classifications and examples of these biomolecules.
- Students will learn the detailed structure of these biomolecules along with types of bonds or linkages present in their molecules.
- Students will learn the chemical properties of these biomolecules and the action of some reagents on them in the form of reactions or graphical presentation.
- Students will understand biochemical energetics of common energy rich compounds along with hydrolytic reactions.

- Students will learn metabolisms like Glycolysis, TCA cycle, Transamination, deamination and β- oxidation through reactions, enzymes involved, outlines and energetics.

Unit 1. Carbohydrates (L-09, M-12)

a) Introduction, definition, classification.

b) Monosaccharaides: structure of glucose (open chain and ring structures). Kiliani Fischer synthesis of D-glucose. Reactions of glucose: oxidation with bromine water and nitric acid, reduction, acetylation, addition of HCN, NH_2OH and phenyl hydrazine, mutarotation.

c) Disaccharides: structure of sucrose, lactose and maltose.

d) Polysaccharides: storage polysaccharides, structure of starch, Structural polysaccharides, structure of cellulose.

Ref 1 and 2: Relevant pages

Unit 2. Amino Acids and Proteins (L-09, M-12)

a) Amino acids: Introduction, structure of ammo acids, classification of amino acids, amphoteric nature of amino acids, reactions of amino acids: with FDNB and Dansyl chloride, formation of peptide bond

b) Proteins: Introduction, classification of proteins: based on functions and based on shape, structure of proteins: primary, secondary, tertiary and quaternary structure). Study of some proteins: α keratins and hemoglobin. Separation of amino acids and proteins by paper electrophoresis and dialysis

Ref 1 and 2: Relevant pages

Unit 3. Enzymes and Lipids (L-09, M-12)

a) Enzymes: Introduction, specificity of enzymes, classification, role of enzymes in biochemical reactions, Michaelis Menten equation (no derivation). Effect of substrate concentration, P^H and temperature on enzyme catalyzed reactions. Enzyme inhibitors: introduction and types.

b) Lipids: Introduction, classification of lipids, fatty acids, nomenclature of fatty acids, triacyl glycerols, hydrogenation of oils, Saponification value and iodine value of oils, phospholipids and waxes.

Ref 1 and 2: Relevant pages

Unit 4. Nucleic Acids and Energy Rich Compounds (L-09, M-12)

a) **Nucleic acids**: Introduction, Components of nucleic acids: sugars, bases, nucleosides and nucleotides. Watson and Crick model of DNA, types of RNA (structure not expected)

b) **Energy rich compounds**: Introduction, Pyrophosphates, acyl phosphates, enolic phosphates, thiol esters (structure, hydrolytic reaction and energetics). Energy carriers in biological redox systems: NAD^+ and FAD

Ref 1 and 2- Relevant pages

Unit 5. Metabolism (L-09, M-12)

Definition of metabolism,

a) Carbohydrate metabolism: Glycolysis: reactions involved and energetics, TCA cycle (Kreb cycle): Reactions involved and energetic

b) Amino acid Metabolism: Transamination, deamination (by enzymes - glutamic dehydrogenase, ammonia lyases, deaminases and deamidases), decarboxylation

c) Lipid Metabolism: β- oxidation of fatty acids, reactions involved in β –oxidation, energetics of β –oxidation of palmitic acid.

Ref 1 and 2- Relevant pages

Reference Books

1. *Outlines of Biochemistry, Conn and Stumpf (4^{th}Edition)*
2. *Principles of Biochemistry, A. L. Lehninger (2^{nd} Edition)*

Semester V **Elective Course**

CH-506(B)

Subject- Green Chemistry

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course Objectives:

- There is rising concern since 1970 about environmental pollution, depleting resources, climate change, ozone depletion, legislation which is getting stringent with strict environmental laws, rising cost of waste deposits, health concern and so on.
- We are facing the challenge to work towards sustainable development. Since 1990, today's society is moving towards becoming more and more environmentally conscious.
- Green chemistry has been introduced in1990 for overall sustainable development against the environmental concerns.
- Green chemistry is not a new branch of chemistry, but it is a new way chemistry, which should be practiced regularly.
- Innovations and applications of green chemistry in education has helped companies not only to gain environmental benefits but at the same time to achieve economic and societal goals also.
- This is possible because these undergraduate students are ultimate scientific community of tomorrow.

Learning Outcomes:

- With this course, the graduate students will be able to understand the twelve principles of green chemistry that will help to build the basic understanding of toxicity, hazards and risk of chemical substances.
- The course will help to understand stoichiometric calculations and relate them to green chemistry metrics. The students will learn about atom economy and understand its importance over percentage yield.

- The students will learn to design safer chemicals, products and processes that are less toxic than the conventional chemistry, understand significance of catalysis, use of renewable feed stock, renewable energy sources, importance of green solvents, etc.
- The course will train the students to appreciate green chemistry and boost the students to think and develop the skills to innovate and search for the solutions to environmental problems.
- Green chemistry is only way of future chemistry to ensure sustainability with absolute zero waste. The success stories and real-world cases will motivate the young generation to practice green chemistry.

UNIT 1. Introduction to Green Chemistry (L-04, M-04)

Definition of Gr**e**en Chemistry. Drawbacks of conventional chemistry. Need of Green Chemistry, Minamata Disease. Goals of Green Chemistry

Ref:1 Relevant Pages

Ref:6 Relevant Pages

UNIT 2. Principles of Green Chemistry and Designing a Chemical Synthesis (L-12, M-18)

Twelve principles of Green Chemistry, role of Paul T. Anastas, importance of green chemistry with examples: Prevention of waste/by-products, Atom economy, Prevention or Minimization of hazardous products, Designing safer chemicals, Energy requirements for synthesis, Selection of suitable solvents, Selection of starting materials, Use of protecting groups, Use of catalysts, Designing of biodegradable products, Prevention of chemical accidents, Strengthening of analytical techniques, industrial safety.

Ref:1 Relevant Pages

Ref:2 Relevant Pages

UNIT 3. Techniques in Green Chemistry (L-12, M-16)

a) Microwave assisted synthesis- Introduction and importance, Applications- Esterification, Fries rearrangement, Orthoester Claisen Rearrangement, Diels-Alder Reaction,Hofmann Elimination.

b) Ultrasound assisted reactions- Introduction and importance, Application- Esterification, saponification, aromatic substitution reactions, alkylation, oxidation, reduction.

Ref:1 Relevant Pages

Ref:3 Relevant Pages

UNIT 4. Solvents, Reagents and Catalysts in Green Chemistry (L-14, M-18)

a) Solvents- Introduction and Importance, Examples-Michael Addition in water, Bis-indolyl methane in ionic liquid, tetrazole synthesis in deep eutectic solvent.

b) Reagents- Introduction and Importance, Examples- Alkylation using dimethyl carbonate, Solid phase peptide synthesis using Merrifield reagent.

c) Catalysts- Introduction and Importance, Examples- Reduction of carbonyl group using Baker's yeast, Esterification using Lipase enzyme, Zeolite clay and Cyclodextrin.

Ref:1 Relevant Pages

Ref 2: Relevant Pages

UNIT 5. Future Trends in Green Chemistry (L-03, M-04)

Biomimetic, Photochemical reactions, Multifunctional Reagents, Green chemistry in sustainable development.

Ref:1 Relevant Pages

Ref 3: Relevant Pages

Ref 5: Relevant Pages

Reference Books:

1. *New Trends in Green Chemistry, V.K. Ahluwalia and M.R. Kidwai: Anamalaya Publishers (2005).*
2. *Green Chemistry- Theory and Practical, P.T. Anastas and J.K. Warner: Oxford University Press (1998).*
3. *Introduction to Green Chemistry, A. S. Matlack: Marcel Dekker (2001).*
4. *Real-World Cases in Green Chemistry, M.C. Cann & M.E. Connely: American Chemical Society, Washington (2000).*
5. *Introduction to Green Chemistry, M. A. Ryan & M. Tinnesand, American Chemical Society, Washington, (2002).*
6. *Silent Spring, Rachel Carson, Houghton Mifflin Company, (1962).*

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Semester VI **Elective Course**

CH-606(A)

Subject- Polymer Chemistry

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Learning Objectives

- The course offers the basic concepts of polymer, polymerization, classes of polymers, important properties, and poly(lactic acid) as a biodegradable polymer.
- The course also offers to study preparation, properties, and applications of industrially important selected polymers.
- The course will give chance to study various mechanisms of polymerization and learn different techniques of polymerization.
- The student will be able to understand glass transition temperature and factors affecting on it and various ways to express molecular weight of polymers.

Course Outcomes

After completing this course, the graduate should be able to

- Define terms like monomer, polymer, polymerization, polydispersity index, etc., classify polymers based on their origin, native backbone chain, and thermal response.
- Know glass transition temperature and its determination, various ways to express molecular weights of polymers and polydispersity index.
- Identify different mechanisms of polymerizations *viz*. free radical, ionic, and condensation polymerizations.
- Distinguish techniques of polymerization based on physical conditions required for the preparation of polymers in laboratory or industry.
- Familiar with preparation, properties, and applications of industrially important selected polymers.

UNIT 1. Basic Concepts of Polymers **(L-09, M-12)**

Introduction, brief history, monomers and polymers, degree of polymerization, functionality, linear, branched and cross linked polymers, homopolymers, Types of copolymers:- random, alternate, block and graft copolymers, Tacticity (stereochemistry) of polymers: isotactic, syndiotactic and atactic polymers. Classification of polymers:- based on a) origin- natural and synthetic polymers b) native backbone chain – organic and inorganic polymers c) thermal response – thermoplastic and thermo setting polymers d) ultimate form and use – plastic, elastomer, fibre and liquid resin, Degradation of polymers:- types of degradation: chain end and random degradations.

Ref. 1 and 2: Relevant pages

UNIT 2. Chemistry of Polymerization **(L-09, M-12)**

Introduction, chain growth polymerization (initiation, propagation, termination, and kinetics): free radical polymerization, ionic (cationic and anionic) polymerizations, step growth polymerization (mechanism and kinetics), ring opening polymerization.

Ref. 1 and 2: Relevant pages

UNIT 3. Polymerization Techniques & Polymer Processing Techniques

(L-9, M-12)

Polymerization techniques: - Bulk polymerization, solution polymerization, suspension polymerization, emulsion polymerization, interfacial condensation polymerization.
Polymer processing techniques:- Calendaring, die casting, film casting, and compression moulding.

Ref. 1 and 2: Relevant pages

UNIT 4. Study of Some Important Polymers **(L-09, M-12)**

Preparation, properties and applications of - Polyethylene [PE], Polypropylene [PP], Poly(vinyl chloride) [PVC], Polystyrene [PS], Polyacrylonitrile [PAN], Polycarbonates [PC], Phenol-formaldehyde resins [PF], Epoxy resins, Polyester - Polyethyleneterephthalate[PET], Polyamides (Nylon-6 and Nylon-6,6), Poly(vinyl alcohol) [PVA], Poly(lactic acid) [PLA], Polyaniline, and Polybutadiene.

Ref. 1 and 2: Relevant pages

UNIT 5. Glass Transition Temperature **(L-09, M-12)**

Glass transition temperature:- Definition and explanation, factors affecting glass transition temperature, Glass transition temperature and molecular weight, Glass transition temperature and melting point, importance of glass transition temperature, determination of glass transition temperature by dilatometry.

Molecular weights of polymers:-types of molecular weights-number average molecular weight, weight average molecular weight, viscosity average molecular weight, sedimentation average molecular weight, and poly dispersity index.

Ref. 1 and 2: Relevant pages

Reference Books

1. *Polymer Science, V. R. Govarikar, N. V. Viswanathan, JayadevSreedhar, New Age International (P) Ltd., New Delhi, 1997.*
2. *Text books of Polymer Science, F. W. Billmeyer, John Wiley & Sons; 3rd edition,1984.*

Semester VI **Elective Course**

CH-606(B)

Subject- Research Methodology for Chemistry

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course Objectives:

- To familiarize students towards basics of research, process of research and methods.
- To enable the student in conducting research work and formulating research synopsis and report.
- To learn the analysis of primary research articles and peer review articles.
- To improve student understanding of how scientific questions are developed and posed through proposals and dissemination of research results.
- To learn the scientific method of collecting and analyzing information.
- To learn the presentation of scientific information
- To aware the students about proper laboratory safety and techniques.

Learning outcomes:

The learning outcomes for this course of the following Chemistry Graduate Program Goals:

- Students will learn about what is research, research methods and impact of chemical research on society through pure and applied research.
- Students will learn how to analyze research in chemistry drawn from contemporary primary chemical literature.
- Student will formulate thesis topic, explain its significance and propose the methodology to be used in the thesis topic research.
- Student will demonstrate proficiency in scientific writing which includes:

- Ability to interpret and synthesize primary research literature related to the student's thesis topic.
- Ability to write a coherent narrative that explains the significance of the thesis research with regard to the primary research literature.
- Ability to report original research results in a coherent narrative.
- Ability to explain and defend conclusions draw from original results in narrative form.
- Prepare and present scientific topics orally utilizing presentation software such as PowerPoint.

- Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.
- Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.
- Students will be able to communicate the results of scientific work in oral, written and electronic formats.
- Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behaviour in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.

UNIT 1: Introduction to Research **(L-9, M-12)**

Definition of Research, Objectives of Research, Importance, and need for Research in a related field. Motivation in Research Methods versus Methodology, Classification and types of Research, Pure and applied Research, Difference between Computational lab and wet lab research, theoretical and experimental models, Criteria of Good Research Application of theoretical knowledge in designing of experiments. Methods of Data Collection

List of National Importance Institutes and List of CSIR Laboratories

Ref. 3: 1-24.

UNIT 2: Print Literature Resources **(L-9, M-12)**

Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index with examples.

Ref. 1: 299-317;

Ref. 2: 1569-1603

UNIT 3: Digital Literature Resources (L-9, M-12)

The Internet and World Wide Web. Internet resources for chemistry. Finding and citing published information. Web resources, E-journals, Journal access, TOC alerts, Citation index, Impact factor, H-index, UGC infonet, E-books. The introduction of Search engines, Scirus, Google, Google Scholar, Chem Industry, Wiki- Databases, ChemSpider, American Chemical Society, Royal Society of Chemistry, Wiley-inter science, Science Direct, Springer, SciFinder, Scopus, C&EN News Reaxys.

Ref. 1: 299-317;

Ref. 2:1569-1603

UNIT 4: Writing Scientific Reports (L-9, M-12)

Writing Skills, Reporting practical and project work, Referencing, Organizing a poster display. Communication Skills, Body Language, Giving an oral presentation. Content of Research Papers, How to download Research Paper? How to Read Research Paper, Abstract and Summary. What are Paper, Patent and Review? Introduction of Plagiarism and self Plagiarism.

Ref. 1: 325-348; Ref. 3: 344-360.

UNIT: 5 Chemical Safety and Ethical Handling of Chemicals (L-9, M-12)

Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, incineration and transportation of hazardous chemicals.

Ref. 6: 1.31–1.36, 1.40, 2.1-2.16, 5.79-5.85, 7.41-7.50, 8.25-8.31.

Reference Books:

1. *Practical Skills in Chemistry, 2nd Ed, .Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. and Jones, A. Prentice-Hall, Harlow (2011)*
2. *APPENDIX A: The Literature of Organic Chemistry March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, Seventh Edition, by Michael B. Smith and Jerry March Copyright John Wiley & Sons, Inc. (2013)*
3. *Research Methodology: Methods And Techniques, 3rd edition, Kothari, C.R. Published by New Age International (P) Ltd., Publishers (2004),*
4. *How to Use Excel in Analytical Chemistry and in general Scientific Data Analysis. Levie, R. de, Cambridge Univ. Press (2001).*
5. *Chemical Safety Matters – IUPAC – IPCS, Cambridge University Press, (1992).*
6. *OSU Safety Manual 1.01*
7. *Laboratory Safety for Chemistry Students, Hill R. H., Finster D. C. 8th ed.; John Wiley and Sons: Hoboken, NJ, March (2017).*

T.Y.B.Sc. Chemistry

Semester -V **Course No:- CH-507**

Subject: Physical Chemistry Practical

(Practical: Lectures = 60 hrs, Marks 60) **(Credits: 02)**

Course Objectives

- To develop skills required in chemistry such as the appropriate handling of apparatus, instruments and chemicals.
- The student will learn the laboratory skills needed to design, safely conduct and interpret chemical research.
- To expose the students to an extent of experimental techniques using modern instrumentation.
- The student will develop the ability to effectively communicate scientific information and research results in written and oral formats.

Learning Outcomes

- Students will get basic analytical and technical skills to work effectively in the various fields of chemistry.
- Students will able to calibrate and handle instruments like conductometer, potentiometer, pH meter, colorimeter, spectrophotometer, polarimeter.
- They have ability to perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions.
- They get skills required in chemistry such as the proper handling of apparatus and chemicals.
- They will have ability to present scientific and technical information resulting from laboratory experimentation in both written and oral formats.

- Students will apply conductometer, potentiometer, pH meter, colorimeter, spectrophotometer, polarimetery techniques for analysis and measurement.

Instructions:

- The student should perform at least 10 experiments from each semester. It is expected to perform at least one experiment from each technique.
- Use dilute solutions and in minimum amount.
- Use 50 ml volumetric flasks for preparation of solutions
- Scientific calculators (non-programmable) and practical handbooks are allowed during practical examination.

Conductometry:

1. Conductometric titration of mixture of acids and hence determine the strength of acids.
2. Determine the degree of hydrolysis and hydrolysis constant of sodium acetate conductometrically.

Potentiometry:

1. Determine Ecal and pH of buffer solution (Citric acid + Na_2HPO_4) using quinhydrone electrode.

2. Determine the pKa and Ka of weak monobasic acid by potentiometric titration.

P^Hmetry:

1. Determine the amount of aspirin in the given tablet.
2. Determine the pKa of various mixtures of sodium acetate and acetic acid in solution and hence to find the dissociation constant.

Polarimetry:

1. To study the kinetics of inversion of cane sugar by polarimeter.
2. Determine the concentration of given solution of an optically active substance (cane sugar) by polarimetric measurement.

Flame Photometry:

3. Estimation of Na / K by flame photometer in the given sample.

Refractometery:

1. Determine the refractive indices of series of KCl solution and hence unknown concentration of given KCl solution**.**

Chemical Kinetics:

1. Study the hydrolysis of methyl acetate in presence of hydrochloric acid.
2. Determine the energy of activation of the reaction between $K_2S_2O_8$ and KI. (Equal initial concentration)
3. Investigate the kinetics of iodination of acetone (zero order reaction).

Viscosity:

1. Determine the molecular weight of high polymer using its solution of different concentration.

Partition coefficient:

1. Determine the partition coefficient of iodine between carbon tetrachloride and water**.**

T.Y.B.Sc. Chemistry

Semester -VI **Course No:- CH-607**

Subject: Physical Chemistry Practical

(Practical: Lectures = 60 hrs, Marks 60) **(Credits: 02)**

Instructions:

- The student should perform at least 10 experiments from each semester. It is expected to perform at least one experiment from each technique.
- Use dilute solutions and in minimum amount.
- Use 50 ml volumetric flasks for preparation of solutions.
- Scientific calculators (non programmable) and practical handbooks are allowed during practical examination

Conductometry:

1. Determine the relative strength of monochloro acetic acid and acetic acidconductometrically.
2. Determine the basicity of organic acid by conductometric measurement.

Potentiometry:

1. Determine the amount of sodium chloride in a given solution by potentiometric titration with silver nitrate.
2. Determine formal redox potential of Fe^{2+} to Fe^{3+} by potentiometric titration.

Colorimeter / Spectrophotometer:

1. Determination of λ max and concentration of unknown Cu^{2+} solution and verify Beer's law.
2. Verify Beer's law, determine unknown concentration and molar extinction coefficient of Potassium permanganate.

P^Hmetry:

1. Determine the pKa and Ka of weak monobasic acid by pH metric titration.
2. Determine the degree of hydrolysis and hydrolysis constant of aniline hydrochloride pH metrically.

Polarimetry:

1. Determine the percentage of two optically active substances (d- sucrose and d-tartaric acid) in a mixture polarimetrically**.**

Radioactivity:

1. Determine the E_{max} of Beta particle.

Refractometry:

1. Determine the refractive index of four liquids, hence specific and molarrefraction.
2. Determine the molar refraction of homologous methyl, ethyl and propylalcohol and show that constancy configuration to molar refraction by $–CH_2$group.

Chemical Kinetics:

1. Investigate the reaction between H_2O_2 and KI by gas burette method.
2. Determine the order of the reaction between potassium persulphate and potassium iodide by fractional change method.

Viscosity:

1. Determine the radius of glycerol/sucrose molecule by viscosity measurement.

References:-

1. *Findley's Practical Physical Chemistry, B.P.Levitt, 9th Edition, Longman group Ltd.*
2. *Advanced Physical Chemistry Experiments, J.N.Gurtu and Amit Gurtu, Pragati Prakashan*
3. *Systematic Experimental Physical Chemistry S.W. Rajbhoj, Dr. T.K. Chondekar, 3rd edition, Anjali Publication, Aurangabad.*
4. *Experimental Physical Chemistry, V.D.Athawale, P. Mathur, New age International Ltd,New Delhi.*
5. *Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publishing House, Meerut*
6. *Advanced Practical's in Physical Chemistry. Dr. Pande, Dr. Mrs. Datar, Dr. Mrs. Bhadane, 4th revised Edition, Manali Publication, Pune.*
7. *Experimental Physical Chemistry, R.C. Das, B.Behra, Tata McGrawHill.*

STRUCTURE OF INTERNAL PRACTICAL EXAMINATION

Time allowed – 3 Hours **Marks – 40**

Q.1 Any One experiment from (CH-507/607)	**30 Marks**
Q.2 Oral	**10 marks**

Total: 40 Marks

STRUCTURE OF EXTERNAL PRACTICAL EXAMINATION

Time allowed: 3 Hours **Marks: 60**

Semester V (CH-507)

Q. 1. Any One experiment from CH-507	**40 Marks**
Q.2 Oral	**10 Marks**
Q.3 Certified Journal	**10 Marks**

Total: 60 Marks

STRUCTURE OF EXTERNAL PRACTICAL EXAMINATION

Time allowed: 3 Hours **Marks: 60**

Semester VI (CH-607)

Q. 1. Any One experiment from CH-607)	**40 Marks**
Q.2 Oral	**10 Marks**
Q.3 Certified Journal	**05 Marks**
Q.4 Industrial Tour Report	**05 Marks**

-

Total: 60 Marks

T.Y.B.Sc. Chemistry

Semester -V **Course No:- CH-508**

Subject: Inorganic Chemistry Practical

(Practical: Lectures = 60 hrs, Marks 60) **(Credits: 02)**

Course Objectives:

- To analyze the inorganic mixtures.
- To determine metal from ore and alloy analysis.
- Using colorimetric analysis to determine amount of metal.

Learning outcomes:

- Student will able to determine cation & anion from inorganic mixtures by using qualitative analysis.
- Student will able to determine metal from ore & alloys.
- Students will be able to design & carry out scientific experiments as well as accurately record & analyze the results of experiments.
- Students will be able to handle colorimeter for estimation of metal ions.

1. **Inorganic Qualitative Analysis: (Any Five)**
   Binary mixtures containing common anions (Excluding phosphates and borates)
2. **Ore Analysis: (Any Two)**
   i) Heamatite ore - Estimation of Iron volumetrically
   ii) Pyrolusite ore- Estimation of Manganese volumetrically
   iii) Dolomite ore - Estimation of Calcium volumetrically
3. **Alloy Analysis: (Any Two)**
   i) Estimation of Zn from Brass alloy .
   ii) Estimation of Tin gravimetrically as SnO_2 from solder alloy.
   iii) Estimation of Copper iodometrically from nichrome alloy.
   iv) Determination of iron gravimetrically from stainless steel.
4. **Colourimetric analysis (any one)**
   i) Colourimetric titration of Cu(II) against EDTA method .
   ii) Estimation of Titanium using hydrogen peroxide.

IMPORTANT NOTE:

- For volumetric analysis pipette out solution should be 10 ml
- Preparation of stock solution or standard solution should be in **100/50ml volumetric flask** in order to avoid wastage of chemicals.

References

1. *A Text Book of Quantitative Inorganic Analysis, A. I. Vogel, 4th edition*
2. *Vogel's Qualitative Inorganic Analysis, A. I. Vogel.*
3. *Practical Chemistry, O. P. Pandey, D. N. Bajpai, S. Giri, S. Chand Publication, New Delhi.*
4. *Post Graduate Practical Chemistry, H. N. Patel, S. P. Turakhia, S. S. Kelker, S. **R.** Puniyani, Himalaya Publishing House.*
5. *College Practical Chemistry, H. N. Patel, S. P. Turakhia, S. S. Kelker, S.R. Puniyani, Himalaya Publishing House.*
6. *Practical Chemistry, K. K. Sharma, D. S. Sharma, Vikas Publication.*

T.Y.B.Sc. Chemistry

Semester -VI **Course No:- CH-608**

Subject: Inorganic Chemistry Practical

(Practical: Lectures = 60 hrs, Marks 60) **(Credits: 02)**

Course Objectives:

- To determine metal from gravimetric estimations.
- To determine amount of metal by volumetric analysis.
- To determine preparation /synthesis of co-ordination compound.
- To study separation techniques of metals.
- To use colorimetric analysis of metal.

Learning Outcomes:

- Students will be able to prepare co-ordination compounds.
- Students will be able to determine amount of metal by using quantitative analysis.
- Students will be able to calculate Rf value of metal.
- Students will be able to design & carry out scientific experiments as well as accurately record & analyze the results of experiments.
- Students will be able to explain why chemistry is an integral activity for addressing social, economic & environmental problems.

1. Gravimetric Estimations: (Any Two)

i) Fe as Fe_2O_3

ii) Zn as $Zn_2P_2O_7$

iii) Pb as lead chromate

iv) Al as Al_2O_3

2. Volumetric Analysis: (Any Two)

i) Manganese by Volhards method.

ii) Estimation of Nickel by EDTA method.

iii) Determination of strength of NaOH and Na_2CO_3 in a given solution.

iv) Estimation of ferrous and ferric by dichromate method.

3. **Inorganic Preparations: (Any Three)**
   i) Bis (ethylenediamine) copper (II) sulphate.
   ii) Potassium trioxalato chromate (III).
   iii) Tris (acetylacetonato) Iron (III).
   iv) Hexaaquonickel (II) chloride.
   v) Potassium tris oxalatoaluminate (III)trihydrate.
   vi) Synthesis of ZnO nanoparticles using Zinc acetate dihydrate

4. **Colourimetric Analysis: (Any One)**
   i) Estimation of iron using thiocynate method.
   ii) To determine the concentration of cobalt in the given solution using R-nitroso salt by colourimetry.

5. **Paper Chromatography: (Any Two mixtures)**
   Separation and identification of binary mixture of cations (Fe^{3+},Ni^{2+}, Cu^{2+},Co^{2+}, Mn^{2+},Zn^{2+})

IMPORTANT NOTE:

- For volumetric analysis pipette out solution should be 10 ml
- Preparation of stock solution or standard solution should be in **100/50 mL volumetric flask** in order to avoid wastage of chemicals.

References:

1. *A Text Book of Quantitative Inorganic Analysis, 4th edition, A. I. Vogel,*
2. *Vogel's Qualitative Inorganic Analysis, A. I. Vogel.*
3. *Practical Chemistry, O. P. Pandey, D. N. Bajpai, S. Giri, S. Chand Publication, New Delhi.*
4. *Post Graduate Practical Chemistry, H. N. Patel, S. P. Turakhia, S. S. Kelker, S. R. Puniyani, Himalaya Publishing House.*
5. *College Practical Chemistry, H. N. Patel, S. P. Turakhia, S. S. Kelker, S.R. Puniyani Himalaya Publishing House.*
6. *Practical Chemistry, K. K. Sharma, D. S. Sharma, Vikas Publications.*

STRUCTURE OF PRACTICAL EXAMINATION

Inorganic Chemistry Practical

CH-508, Semester-V

Internal Examination Pattern

Time Allowed: 3Hrs. **Max. Marks: 40**

Q 1. Inorganic Qualitative Analysis/Ore Analysis/ Alloy Analysis	**30 Marks**
Q 2. Oral	**10 Marks**
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	40 Marks

External Examination Pattern

Time Allowed: 3Hrs. **Max. Marks: 60**

Q 1. Inorganic Qualitative Analysis/Ore Analysis/ Alloy Analysis	**40 Marks**
Q 2. Oral	**10 Marks**
Q 3. Journal (completed and certified)	**10 Marks**
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	60 Marks

Inorganic Chemistry Practical

CH-608, Semester-VI

Internal Examination Pattern

Time Allowed: 3Hrs. **Max. Marks: 40**

Q 1. Gravimetric Estimations/Volumetric Analysis/colorimetric Analysis/ Inorganic Preparation and Paper Chromatography	**30 Marks**
Q 2. Oral	**10 Marks**
	40 Marks

External Examination Pattern

Time Allowed: 3Hrs. **Max. Marks: 60**

Q 1. Gravimetric Estimations/Volumetric Analysis/colorimetric Analysis/ Inorganic Preparation and Paper Chromatography	**40 Marks**
Q 2. Oral	**10 Marks**
Q 3. Journal (completed and certified)	**05 Marks**
Q 4. Industrial Tour Report	**05 Marks**
	60 Marks

T.Y.B.Sc. Chemistry

Semester -V **Course No: - CH-509**

Subject: Organic Chemistry Practical

(Practical: Lectures = 60 hrs, Marks 60) **(Credits: 02)**

Course Objectives

- To develop skills required in chemistry such as the appropriate handling of apparatus and chemicals.
- The student will learn the laboratory skills needed to design, safely conduct and interpret chemical research.
- To expose the students to an extent of experimental techniques using modern instrumentation.
- The student will develop the ability to effectively communicate scientific information and research results in written and oral formats.

Learning Outcomes

- Separate and analyze binary water insoluble mixture.
- Separate and analyze binary water soluble mixture.
- Estimate - Acetamide, Glucose and Glycine by volumetric method,
- Estimate basicity of various acids.
- Synthesis of various organic compounds through greener alternatives.
- Understand Thin Layer Chromatographic techniques and physical constant.
- Understand the purification technique use in organic chemistry.

I) Separation of Binary Mixtures and Qualitative Analysis (Any 6)

a) Solid-Solid (4 Mixtures) b) Solid-Liquid (1 Mixture) c) Liquid-Liquid (1 Mixture)

At least one mixture from each of the following should be given-Acid-Base, Acid-Phenol, Acid-Neutral, Phenol-Base, Phenol-Neutral, Base-Neutral and Neutral- Neutral. (Solid-solid mixtures must be insoluble in water)

Note:

- Students are expected to determine type of the mixture and to separate the mixture.
- Separation of the Mixture should be done by chemical method only.
- It is expected to perform preliminary tests, physical constants, detection of elements and determination of functional groups of separated compounds.
- On the basis of above tests, students are expected to determine structure of compounds.
- The separated compounds should be purified and then melting point of purified compound should be determined. The purified samples of the separated components should be submitted.
- Separation and qualitative analysis of the binary Mixtures should be carried out on micro scale using micro scale.

II) Organic Estimations (Any 2)

1. Estimation of acetamide
2. Estimation of basicity (Number of -COOH groups) of acid
3. Estimation of glycine
4. Saponification value of oil

III) Green Chemistry Preparation (Any 2)

1. Synthesis of acetanilide from aniline by using Zn dust / acetic acid.
2. Synthesis of dibenzalpropanone from benzaldehyde and acetone. using $LiOH.H_2O$/NaOH
3. Synthesis of p- bromo acetanilide from acetanilide by using KBr.
4. Synthesis of dihydropyrimidinone from ethyl ace to acetate, benzaldehyde and urea
5. Diels-Alder reaction between furan and maleic acid [4+2] Cycloaddition Reaction

T.Y.B.Sc. Chemistry

Semester -VI **Course No:- CH-609**

Subject: Organic Chemistry Practical

(Practical: Lectures = 60 hrs, Marks 60) **(Credits: 02)**

I) Organic preparations **(Any 6)**

1. Benzoquinone from Hydroquinone (Oxidation by $KBrO_3$ or $K_2Cr_2O_7$)
2. Preparation of Sudan-I (Diazocoupling)
3. p-nitroacetanilide from Acetanilide (Nitration)
4. 2-Naphthyl ether from 2-Naphthol (Methylation by DMS, NaOH)
5. Hippuric acid from Glycine (Benzoylation)
6. p-Iodonitrobenzene from p-Nitroaniline (Sandmeyer Reaction)
7. m- Nitro aniline from m-Dinitrobenzene (Reduction)
8. Benzoic acid from Ethyl benzoate (Ester hydrolysis)
9. Isolation of Starch from Potato
10. Adipic acid from Cyclohexanone (Oxidation by Con. HNO_3)

II) Preparation of derivatives **(Any 3)**

1. Oxime derivative of aldehydes or Ketones
2. Aryloxy acetic acid derivative of Phenol
3. 2, 4 DNP derivative of aldehydes or Ketones
4. Glucosazone derivative of Glucose
5. Anilide derivative of acid

III) Purification techniques **(Any 1)**

1. Solvent extraction using separating funnel
2. Preparative TLC
3. Steam distillation

Note:

- The Preparation or derivative should be carried out on small scale and the starting compound should not be given more than one gm.

- Purity of the sample in Preparation and derivative can be checked by thin layer Chromatography (TLC).
- If product is impure, it should be purified.
- The Head of the Department must see that the industrial tour will be arranged collectively by the Department staff members.

Reference Books

1. *Practical Organic Chemistry, A. I. Vogel, Pearson, 5th Edition, 2005.*
2. *Practical Organic Chemistry, O. P. Agarwal, Krishna Prakashan Media (P) Ltd, 2014.*
3. *University Practical Chemistry, P. C. Kamboj, Vishal Publishing Co.; 1st (Reprint) Edition, 2013.*
4. *Comprehensive Practical Organic Chemistry-Qualitative Analysis, V. K. Ahluwalia and Renu Aggarwal, Universities Press, 2016.*
5. *R.B. Woodward and H. Baer, J. Am. Chem. Soc. 1948, 70, 1161.*
6. *D. C. Rideout and R. Breslow, J. Am. Chem. Soc. 1980, 102, 7816.*
7. *Green Chemistry: Theory and Practice, Anastas, P.T and Warner, J.C. Oxford University Press (1998).*
8. *Monograph on Green Chemistry Laboratory Experiments, Green Chemistry Task Force Committee, DST*

STRUCTURE OF INTERNAL PRACTICAL EXAMINATION

Time allowed – 3 Hours **Marks – 40**

Q.1 Any One experiment from CH-509/609) **30 Marks**

Q.2 Oral **10 marks**

STRUCTURE OF EXTERNAL PRACTICAL EXAMINATION

Time allowed: 3 Hours **Marks: 60**

Semester V (CH-509)

Q.1 Separation of Binary Mixtures and Qualitative Analysis of any one Compound
OR Organic Estimation
OR Green Chemistry Experiment **40 Marks**

Q.2 Oral **10 Marks**

Q.3 Journal (completed and certified) **10 Marks**

Semester VI (CH-609)

Q.1 Organic Preparation / Derivative / Purification technique **40 Marks**

Q.2 Oral **10 Marks**

Q.3 Journal (completed and certified) **05 Marks**

Q.4 Industrial Tour Report **05 Marks**

Instructions

- In case of binary mixture experiment, examinee should identify type of mixture and should separate the mixture. After separation, examiner should ask the examinee to analyze any one compound from the mixture.
- In case of preparation of organic compounds and derivatives, product should be purified by recrystallization.
- Industrial tour is compulsory for each student.

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
T.Y.B.Sc Chemistry
(CBCS) Pattern equivalence

Equivalence in accordance with titles and contents of papers (for revised syllabus from June 2020) are as follows…

Sr. No.	Title of Old Paper		Title of New Paper	
	Semester-V			
1.	CH -351	Physical Chemistry	CH – 501	Principles of Physical Chemistry-I
2.	CH -352	Inorganic Chemistry	CH – 502	Inorganic Chemistry
3.	CH -353	Organic Chemistry	CH – 503	Organic Reaction Mechanism
4.	CH -354	Analytical Chemistry	CH – 504	Industrial Chemistry
5.	CH -355	Industrial Chemistry	CH – 505	Analytical Instrumentation
6.	CH -356 (A)	Bio Chemistry	CH – 506 (A)	Biochemistry
7.	CH -356 (B)	Environment Chemistry	CH – 506 (B)	Green Chemistry
8.	CH -357	Physical Chemistry Practical	CH – 507	Physical Chemistry Practical
9.	CH -358	Inorganic Chemistry Practical	CH – 508	Inorganic Chemistry Practical
10.	CH -359	Organic Chemistry Practical	CH – 509	Organic Chemistry Practical
11.	Non-Credit Audit Course **(Any One)**		AC-510	NSS
			AC-511	NCC
			AC-512	Sports
	Semester-VI			
1.	CH -361	Physical Chemistry	CH - 601	Principles of Physical Chemistry-II
2.	CH -362	Inorganic Chemistry	CH - 602	Novel Inorganic Solids
3.	CH -363	Organic Chemistry	CH - 603	Spectroscopic Methods of Structure Determination
4.	CH -364	Analytical Chemistry	CH - 604	Chemistry of Industrially Important Products
5.	CH -365	Industrial Chemistry	CH - 605	Analytical Technique
6.	CH -366 (C)	Polymer Chemistry	CH – 606 (A)	Polymer Chemistry
7.	CH -366 (D)	Chemistry In Every Day Life	CH – 606 (B)	Research Methodology for Chemistry
8.	CH -367	Physical Chemistry Practical	CH – 607	Physical Chemistry Practical
9.	CH -368	Inorganic Chemistry Practical	CH – 608	Inorganic Chemistry Practical
10.	CH -369	Organic Chemistry Practical	CH - 609	Organic Chemistry Practical
11.	Non-Credit Audit Course **(Any One)**		AC-610	Soft Skill
			AC-611	Yoga
			AC-612	Practicing Cleanliness