SAURASHTRA UNIVERSITY

B.Sc. SEMESTER – VI

CHEMISTRY [C-601] SYLLABUS

INORGANIC CHEMISTRY AND INDUSTRIAL CHEMISTRY

UNIT-1

Chapter-1: Wave Mechanics [12 hours]

- Concepts of wave mechanics.
- Operators:

  Algebra Operator (Addition, Subtraction, multiplication), commutative property, linear operation, commutation operation, the operator ∇ and ∇^2, momentum operator and Hamiltonian operator.
- Particle in one dimensional box; normalised wave equation and energy related to particle moving in one dimensional box, energy equation and its interpretation with energy levels, linear polyenes as one dimensional box model, examples based on one dimensional box model.
- Particle in three dimensional box; Derivation of normalised wave equation, energy related with it, energy levels and degeneracy example.
- Wave equation for hydrogen atom: To derive the relation between Cartesian and polar coordinates, Schrodinger equation in polar coordinates,
- Separation of variables to derive R(r), $\theta(\theta)$ and $\phi(\phi)$ equations.
- Energy of 1s orbital, normalisation condition and problems on it (in polar coordinates for three dimension)

UNIT-2:

Chapter- 2: Magneto Chemistry [12 Hours]

- Introduction (Magnetic field, Magnetic pole, Intensity of magnetization) Magnetic induction, Magnetic Permeability, intensity of magnetism, magnetic susceptibility, molar magnetic susceptibility
- Magnetic behaviour: Diamagnetism, Paramagnetism, Ferromagnetism and Antiferromagnetism
- Effect of temperature on magnetic behaviour of substances
- Derivation of equation for total angular magnetic momentum and diamagnetic Momentum

- Determination of magnetic susceptibility by Gouy method, NMR method and Faraday method.
- Examples on Magnetic induction, Magnetic Permeability, intensity of magnetism, magnetic susceptibility, molar magnetic susceptibility

UNIT-3

Chapter-3: Transition Metal Complexes of π-acid Ligands [6 hours]

- Metal carbonyls: Definition, preparation, physical and chemical properties, nature of M-CO linear bond based on MO theory with spectral support,
- classification of metal carbonyls, type of CO group and detection of CO group, using IR spectra
- Structure of $Fe(CO)_5$, $Fe_2(CO)_9$, $Co_2(CO)_8$, and $Mn_2(CO)_{10}$
- Metal Nitrosyls: Structure and bonding in complexes of NO^+, NO^- and NO.

Chapter-4: Oil and Fats [6 Hours]

- Introduction
- Distinction between oils and fats and their classification
- Properties of Oils and Fats
- Manufacturing of cotton seed oil by (i) Expression method and (ii)Solvent extraction method
- Refining of crude vegetable oil; Hydrogenation of oils, Optimum conditions for the
- process, Dry process, Wet process
- Analysis of oils and fats; Saponification value, Acid value, Iodine value, Reichert-
- Meissl-Wollny (RM) value.

UNIT-4

Chapter-5: Environmental Pollution [12 Hours]

- Environment: Definition and introduction
- Segments of environment: Atmosphere, Hydrosphere, Lithosphere, Biosphere
- Air Pollution: Introduction, Greenhouse effect, Major sources of air pollution, Photochemical smog and acid rain, CFC and ozone depletion, Sources and effects of NOX and SOX, Control of Air pollution
- Water pollution: Introduction and Classification of water pollution (Physical pollution, Chemical pollution, Biological pollution, Physiological pollution); Sources of water

pollution (Sewage and domestic waste, Industrial effluents, Agricultural discharges, Fertilizers, Toxic metals, Siltation, Thermal pollutions, Radioactive aterials); Water Pollution Control, Dissolved Oxygen (DO) determination, Chemical oxygen Demand (COD) determination, Biological Oxygen Demand (BOD) determination

UNIT-5

Chapter- 6: Soaps and Detergents [12 Hours]

- Introduction to soap, Types of soap (Toilet soap, Transparent soap, Shaving soap, Neem soap, Liquid soap)
- Manufacturing of soap (Batch process, Continuous process)
- Recovery of glycerine from spent lye.
- Introduction to detergents
- Principal group of synthetic detergents
- Biodegradability of surfactants
- Classification of surface active agents
- Anionic detergents (Manufacture of anionic detergents (i) Oxo Process (ii) Alfol Process (iii) Welsh Process)
- Cationic detergents (Manufacture process)
- Non Ionic detergents (Manufacture by batch process)
- Amphoteric detergents
- Manufacture of shampoo

CHEMISTRY [C-602] SYLLABUS
ORGANIC CHEMISTRY AND SPECTROSCOPY
EFFECTIVE FROM JUNE-2021

UNIT-I:

1. Heterocyclic Compounds containing One and Two Heteroatoms [12 hours]

Heterocyclic Compounds containing one hetero atom

Structure, Aromaticity, synthesis (any two methods) & chemical properties of

1. Furan
2. Thiophene
3. Pyrrole
4. Pyridine

Basicity of Pyridine

Relative Basicity of Pyridine, Pyrrole and Aliphatic amines

Heterocyclic Compounds containing two hetero atoms [Only Synthesis]

Synthesis of heterocyclic compounds containing two hetero atoms (Two method of each)

1. Pyrazole (from Acetylene & Diazomethane, from propiolaldehyde & hydrazine, from dicarbonyl compounds & hydrazine)
2. Isoxazole (from propiolaldehyde, from 1,3 – diketones, from α, β-unsaturated ketones)
3. Thiazole (from chloroacetaldehyde & thioformaldehyde, from 2-formyl amino thioacetamide)
4. Pyrimidine (from 1,3 -diamino propane & formaldehyde, from malonic esters & urea, from formylacetic acid and urea)
5. Oxazine (from diethanolamine, from β, β'- dichloro diethyl ether & NH_3, from β, β'- diamino diethyl ether)
6. Thiazine (from β, β'- diamino diethyl thioether, from β, β'- dichloro diethyl thioether, from 2-amino ethane thiol & ethylene glycol
7. Dioxane (from ethylene glycol, from β, β'- dibromo diethyl ether & NaOH, from ethylene glycol and 1,2 dihaloalkane)

UNIT-II:

1. Synthetic Explosive, Perfumes and Insecticides [3 Hours]

Synthesis and uses of: Explosives:

a) RDX (Research Department Explosive)

b) TNT (Trinitrotoluene)

c) PETN (Penta erythritol tetranitrate) Synthesis and uses of Perfumes:

a) Musk Xylene

b) Musk Ketone

c) Musk Ambrette

Synthesis and uses of Insecticides:

a) Baygon

b) Carbendazim

c) Parathion

2. Amino acids, Peptides and Proteins **[9 hours]**

Introduction, Classification of amino acids name and formula

Synthesis of amino acids by:

a) Amination of α-halogen acids

b) Gabriel pthalimide synthesis

c) Erlenmeyer azlactone synthesis

Physical properties of amino acids, Chemical properties of amino acids

Isoelectric point

Introduction to Polypeptides

Synthesis of Polypeptides by:

a) Bergmann Method (use of carbobenzyloxy group)

b) Sheehan's Method (use of Phthaloyl group)

c) Fischer's Method (use of p-toluene sulphonylchloride)

Introduction to proteins, Colour Reactions of Proteins

Constitution of Thyroxine, Synthesis of Thyroxine

UNIT-III:

1. Terpenoids: **[6 hours]**

Introduction

Occurrence & Isolation

Isoprene Rule

Constitution and Synthesis of:

a) Citral
b) α-Terpineol

2. Mass Spectrometry **[6 Hours]**

Introduction: Basic principle

Instrumentation: Components of Mass Spectrometer

Types of ions produced in a Mass Spectrometer

General fragmentation modes

Retro Diel's Alder

Fragmentation

Mc Lafferty Rearrangement

Important features for the mass spectra of alkanes

General Rules for interpretation of Mass Spectra

Applications of Mass Spectrometry

(No problems on Mass spectrometry)

UNIT-IV

1. Nuclear Magnetic Resonance Spectroscopy **[12 Hours]**

Introduction: Principle

Nuclear quantum number

Instrumentation: NMR Spectrophotometer

Interpretation of NMR Spectra:

a) Number of Signals: Equivalent and non-equivalent protons with illustrations, Enantiomeric and diasteroiomeric protons
b) Position on PMR signals: Chemical shift, Shielding and deshielding of protons, Measurement of chemical shift, TMS as the reference compound, Factors affecting Chemical shift: Inductive effect, Anisotropic effect, Hydrogen bonding
c) Relative intensity of signals
d) Spin- spin coupling and coupling constant

Applications of NMR Spectroscopy

Problems based on determination of structure of organic molecules from NMR spectral data Limitations of NMR Spectroscopy

UNIT-V

1. Problems based on UV, IR, NMR spectroscopy [12 Hours]

Reference Books

1. Organic Name reactions by Gautam Brahmachari
2. Organic Reaction Mechanisms by V.K. Ahluwalia
3. Reactions and Rearrangements by Gurdeep Chatwal
4. Name Reactions in Organic Synthesis by A.R. Parikh et. al
5. Chemistry of Organic Natural Products (Volume I & II) by O.P Agrawal.
6. Organic Chemistry of Natural Products by Gurudeep Chatwal
7. Pharmaceutical Chemistry by Axel Kleemann & Jugen Engel
8. Heterocyclic compounds by Gurdeep Chatwal
9. Chemical Application of group theory by F Albert Cotton
10. Symmetry in Chemistry by H.N. Jhaffe
11. Spectroscopy by Gurdeep R. Chatwal & Sham K. Anand
12. Spectroscopy by Pavia, Lampman, Kriz, Vyvyan
13. Spectrometric Identification of organic compounds by Silverstien, Bassler and Morril
14. Elementary organic spectroscopy by Y.R Sharma
15. Spectroscopy of organic compounds by John R Dyer
16. Spectroscopy of organic compounds by PS Kalsi

SAURASHTRA UNIVERSITY

B.Sc. SEMESTER-VI

CHEMISTRY [C-603] SYLLABUS

Physical Chemistry and Analytical Chemistry

UNIT-I

1. Activity of Electrolytes [8 Hours]

- Ionic Activity: Introduction
- Derivation of $a_2 = a_+^{\vartheta +} a_+^{\vartheta -}$ and $a_2 = a_+ a_-$ for 1-1 electrolyte.
- Mean activity and its relation with a_+ and a_-
- Relationship between a_2 and $a_\pm$ i.e. $a_2 = at$
- Mean ionic activity coefficient f_t and f_+, ionic strength :
- Definition, explanation, equation Debye Huckel limiting law (without derivation) Derivation of $- \log f_\pm = Az_+z_-\mu^{½}$
- Interpretation of equation
- Graph of $- \log f_\pm \rightarrow \mu 1/2$ and its explanation/discussion
- Empirical correction of Debye Huckel limiting law of (i) Size of ion and (ii) Orientation of solvent molecules, Methods to determine Activity coefficient
- Solubility method
- Emf method

Examples based on theory

2. Third Law of Thermodynamics [4 Hours]

- Nernst heat theorem
- Third law of thermodynamics
- Determination of absolute entropies of solids, liquids and gases
- Applications of third law of thermodynamics (ΔS^0, ΔG^0 and equilibrium constant of chemical reaction)
- Tests of third law of thermodynamics, Residual entropy.

UNIT II

1. Electrochemistry-2 [12 Hours]

- Concentration cells: Definition, (1) Electrode concentration cells (2)Electrolyte concentration cells

- Concentration cells without transference
- Concentration cells with transference
- Liquid junction potential, Elimination of liquid junction potential.
- Applications of emf measurements:

  Determination of

  - Solubility of sparingly soluble salts
  - Valency of metal ion
  - Dissociation constant of weak acid
  - Transport number of ion
  - Ionic product of water
  - Degree of hydrolysis
  - pH by different
- electrodes Example

UNIT III

1. Partial Molar Properties [4 Hours]

- Definition
- Concept of chemical potential, Gibbs-Duhem equation Variation of
- chemical potential with temperature and pressure Determination of
- Applications of chemical potential (Henry's law, Rault's law and Nernst's partial molar properties by method of intercept distribution law)

2. Error and statistics [8 Hours]

- Introduction, Explanation of errors & mistake
- Classification of errors, Determinate and indeterminate errors, Operational and personal error, Instrumental errors and reagent errors, additive and proportional error.
- Accuracy and precision, minimization of error
- Calibration of Instruments , blank measurement , independent method parallel method, Standard addition method
- Explanation of Significant figure and its laws with completeInterpretation
- Mean and standard deviation , variance and coefficient of variance
- Absolute error and relative error, mean value, deviation and relativeMean

deviation. Gausian curve and its explanation

- Importance of Q– test and T -test (Student T-test)
- Example on errors, significant figures, Q test & T-tests.

UNIT IV

1. Chromatography [12 Hours]

- Introduction of Chromatography

  Chromatography: Classification, principle and efficiency of the technique.

  Detail study of Mechanism of separation

  (a) Adsorption (Column) chromatography

  (b)Partition chromatography– paper and TLC.

  (c)Gas chromatography- GLC & GSC

  (d)Ion exchange chromatography

- Application such as main physical characteristic of chromatography: Solubility, adsorption value, volatility, Rf value, Rx value, nature of adsorption etc.

  Qualitative and quantitative aspects of various chromatographic methods of analysis

  a. Column chromatography: Principle, Method of separation of green leafpigment, mixture of inorganic salts, vitamins,colors of flowers etc. separation ofα,β,Υ carotene from carrot.

  b. Partition chromatography:

  - **Paper chromatography:**Principle of paper chromatography, Experimental methods like :Ascending and Descending method containing one dimensional and two dimensional method; circular method and its Rf value , Rx value; circular method, separation of amino acids and metal ions(Fe^{+} , Co^{+2}, $Ni^{+2)}$ mixture using spray reagent ninhydrine and aniline phthalate
  - **TLC:**Principle, Method of preparation of chromatoplate, Experimental techniques, superiority of TCL over other chromatographic Techniques, Application of TLC.

  c. Gas chromatography; Principle of GLC and GSC,

  - GLC: Instrumentation, Evaluation selection and characteristic of

carrier gas, Effect of temperature& pressure of gas, application

- GSC:Methods and its application.

d. Ion Exchange chromatography: Principle, Type of resins, Properties of ion exchange resins, Basic requirement of useful resins, Method of separation with illustration curve, Application of ion exchange resins

UNIT V

1. Basic principle of qualitative analysis [3 Hours]

Separation of the following in presence of each other

(i) Cl^{-1} , Br^{-1} , I^{-1} (ii) NO_2^{-1} ,NO_3^{-1} , Br^{-1}

(iii) S^{-2} , SO_3^{-2} , SO_4^{-2} (iv) PO_4^{-3} , AsO_3^{-3} , AsO_4^{-3}

(v) CO_3^{-2} , SO_3^{-2} , S^{-2} (vi) Cu^{+2} , Cd^{+2}

2. Electro analytical methods [9 Hours]

- Introduction & Classification of Electro analytical methods
- Basic principle of pH metric, potentiometric and conductometric titrations.
- Importance of indicator and reference electrode in the measurement of EMF and pH
- E.M.F. method:
  - (i) Study of acid-base Titration
  - (ii) Redox Titration
  - (iii) Argentometric titration includes mixture of Cl^-, Br^-, I^- with graph and proper explanation.
- pH metry:

  Definition, Interpretation of various methods of determining pH value like pH paper method, potentiometric method using only hydrogen electrode as indicator electrode and calomel electrode as reference electrode to determine pH value
- Techniques used for the determination of equivalence points.
- Techniques used for the determination of pK_a values of Weak acid-strong base

Reference Books for Physical Chemistry

1. Elements of Physical Chemistry by Samuel Glasstone and D lewis
2. Principles of Physical Chemistry by SH Maron and CF Prutton
3. Thermodynamics for Chemists by Samuel Glasstone
4. Elements of Physical Chemistry by BR Puri, LR Sharma, MS Pathania
5. Advanced Physical Chemistry by JN Gurtu
6. Physical Chemistry by N Kundu and SK Jain
7. Physical Chemistry by KL Kapoor
8. Physical Chemistry by BK Sharma
9. Thermodynamics by Gurudeeep Raj
10. Introduction to electrochemistry by S. Gladstone

Reference Books for Analytical Chemistry

1. Jeffery, G.H., Bassett, J., Mendham, J.• & Denney,
2. R.C. Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.
3. Willard, H.H., Merritt, L.L., Dean, J.• & Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
4. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley• & Sons, New York, 2004.
5. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.•
6. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International• Publisher, 2009. Skoog, D.A. Holler F.J.• & Nieman, T.A.
7. Principles of Instrumental Analysis, Cengage Learning India Ed. Mikes, O.
8. Laboratory Hand Book of Chromatographic• & Allied Methods,
9. Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
10. Ditts, R.V. Analytical Chemistry; Methods of Separation, van Nostrand, 1974
11. Fundamental of analytical chemistry by Skoog& West
12. Instrumental Method & Chemical Analysis by B.K. Sharma Analytical
13. Water Analysis and Water pollution by V.P. Kudesia
14. Instrumental Method & Chemical Analysis by ChatwalAnand
15. Thin layer chromatography by Egal Stall
16. Book for Water Analysis by R. K. Trivedi, V. P. Kudesia

17. Analytical Chemistry by Dick
18. Inorganic Qualitative analysis by Vogel and Gehani Parekh
19. Electrometric Methods of analysis by Browning
20. Principle of instrumental analysis by Skoog

SAURASHTRA UNIVERSITY

B.Sc. SEMESTER-VI

CHEMITRY PRACTICAL [C-604] SYLLABUS

[Practical Examination Would Be Conducted For 1 ½ Days]

[TOTAL MARKS: 105 MARKS]

EFFECTIVE FROM- JUNE-2021

1. Inorganic Qualitative Analysis (SIX radicals) [30 marks]

[**Minimum 12 inorganic mixtures** should be analyzed]

To analyze the given inorganic mixture containing six radicals

2. Organic Synthesis [30 marks]

(Percentage of yield, crystallization, melting point)

[**Minimum 8 syntheses** should be done]

i. Acetylation / Benzoylation

1. Acetylation of salicylic acid
2. Acelytation of aniline
3. Acelytation of phenol
4. Benzoylation of aniline
5. Benzoylation of phenol

ii. Aliphatic Electrophilic substitution

1. Preparation of iodoform from ethanol
2. Preparation of iodoform from acetone

iii. Aromatic Electrophilic Substitution

Nitration:

1. Preparation of m-dinitrobenzene,
2. Preparation of nitro acetanilide.

Halogenation:

1. Preparation of p-bromo acetanilide,
2. Preparation 2:4:6 -tribromo phenol

iv. Diazotization / Coupling

1. Preparation of methyl orange
2. Preparation of methyl red

v. Oxidation

Preparation of benzoic acid from benzaldehyde

3. Physicochemical Exercise [30 marks]

[**Minimum 10 exercises** should be done]

i. pH metry

1. To determine normality and gms/lit. of xNHCl by pH metry
2. To determine normality and dissociation constant of weak acid ($xNCH_3COOH$) by pH metry.
3. To determine normality and dissociation constant of dibasic acid (xN oxalic acid/malonic acid/maleic acid) using 0.1N NaOH solution.

ii. Potentiomentry

1. To determine normality and dissociation constant of benzoic acid used 0.1N NaOH.
2. To determine normality of given acid xNHCl using NaOH solution.
3. To determine concentration of xN FAS using $K_2Cr_2O_7$.
4. To determine normality of each halide in the mixture using 0.1N $AgNO_3$ solution.

iii. Surface tension:

1. Find the surface tension of the liquids A, B and C by using drop weight method. Find the value of parachor of liquid and CH_2 group.

iv. Chromatography

1. To determine Rf value of individual and mixture of amino acid by ascending paper chromatography.
2. To determine Rf value of individual and mixture of amino acid by circular paper chromatography.
3. To determine Rf value of individual and mixture of amino acid by thin layer chromatography (TLC).
4. To determine Rf value of individual and mixture of metal ions by ascending paper chromatography.
5. To determine Rf value of individual and mixture of metal ions by circular paper chromatography.

4.Viva-voce; **[15 marks]**

- Inorganic Qualitative Analysis: **5 marks**
- Organic Synthesis: **5 marks**
- Physicochemical Exercise: **5 mark**

SAURASHTRA UNIVERSITY

B.Sc. SEMESTER- VI

PAPER STYLE – THEORY

EFFECTIVE FROM- JUNE-2021

Instructions to paper setters

1. B. Sc. Chemistry Syllabus for Semester V & VI consists of **FIVE** units each
2. All the units carry equal weightage (14 Marks each)
3. There must be one question from each unit.
4. Each subtopic must be given due weightage in question paper
5. 70 Marks for Semester Examination & 30 marks for Internal Examinations.
6. Time duration: 2 ½Hours

Question 1: Answer the following (UNIT-I)

a. Four objective questions each of one Mark :1x4 = 4
b. Answer any one out two each of two Marks :1x2 = 2
c. Answer any one out two each of three Marks :1x3 = 3
d. Answer any one out two each of five Marks :1x5 = 5

Total Marks: 14

Question 2: Answer the following (UNIT-II)

a. Four objective questions each of one Mark :1x4 = 4
b. Answer any one out two each of two Marks :1x2 = 2
c. Answer any one out two each of three Marks :1x3 = 3
d. Answer any one out two each of five Marks :1x5 = 5

Total Marks: 14

Question 3: Answer the following (UNIT-III)

a. Four objective questions each of one Mark :1x4 = 4
b. Answer any one out two each of two Marks :1x2 = 2
c. Answer any one out two each of three Marks :1x3 = 3
d. Answer any one out two each of five Marks :1x5 = 5

Total Marks: 14

Question 4: Answer the following (UNIT-IV)

a. Four objective questions each of one Mark :1x4 = 4
b. Answer any one out two each of two Marks :1x2 = 2
c. Answer any one out two each of three Marks :1x3 = 3
d. Answer any one out two each of five Marks :1x5 = 5

Total Marks: 14

Question 5: Answer the following (UNIT-V)

a. Four objective questions each of one Mark :1x4 = 4
b. Answer any one out two each of two Marks :1x2 = 2
c. Answer **a**ny one out two each of three Marks :1x3 = 3
d. Answer any one out two each of five Marks :1x5 = 5

Total Marks: 14