SAURASHTRA UNIVERSITY
B.Sc. SEMESTER – V
CHEMISTRY [C-501] SYLLABUS
INORGANIC CHEMISTRY AND INDUSTRIAL CHEMISTRY
EFFECTIVE FROM JUNE-2018

UNIT-1

Wave mechanics: [12 hours]

- Outline of basic concepts of wave mechanics.
- Operator's algebra (Addition, Subtraction, multiplication), commutative property, linear operation, commutation operation, the operator $\nabla$and ∇^2, momentum operator, 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

Crystal field Theory: 1 [12 hours]

- Introduction
- Concept of crystal field theory
- Splitting of d-orbitals in octahedral and tetrahedral crystal filed with CFSE concept.
- Factor affecting splitting energy.
- Weak field and strong field ligands.
- High spin and low spin complexes with paring energy
- Magnetic behaviour of transition metal complexes
- Orbital angular momentum contribution to magnetic momentum of complexes
- Example based on CFSE, pairing energy and magnetic momentum

UNIT-3

1. **Transition metal complexes of π-acid ligands: [7 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 $Ni(CO)_4$, $Fe(CO)_5$, $Fe_2(CO)_9$, $Co_2(CO)_8$, $Fe_3(CO)_{12}$ and $Mn_2(CO)_{10}$
- Metal nitrosyl: Structure and bonding in complexes of NO^+, NO^- and NO.

2. Cement: [5 hours]

- Introduction and type of cement.
- Raw materials and manufacturing process (1) Dry process (2) Wet process.
- Setting of cement (1) Hydrolysis (2) Hydration.
- Properties of cement.
- Testing of cement and ISI specification of cement.
- Mortar, concrete, RCC
- Curing and decay of cement.
- Uses of cement.

UNIT-4

Fertilizers: [12 hours]

- Introduction to fertilizers, role of plant nutrients.
- Classification and properties of fertilizers.
- Nitrogenous fertilizers.
- Manufacturing process of (1) Ammonium nitrate (by prilling method), (2) Ammonium sulphate (sindri process), (3) Urea (from Ammonium carbonate), (4) Calcium cyanamide(by electro carbonate) and action of fertilizers(of all above).
- Phosphate fertilizer: (1) Normal super phosphate and its manufacturing process, (2) Triple super phosphate and its manufacturing process, (3) Manufacture of mono ammonium and diammonium phosphate.
- Potassium fertilizer: NPK fertilizers and nomenclature.

UNIT-5

Glass: [12-hours]

- Introduction
- Physical and chemical properties of glass
- Raw materials for glass manufacture
- Chemical reactions involved in glass manufacture
- Manufacture process: Formation of batch material, Melting, Shaping, Annealing, and Finishing.
- Special type of glass: Fused silica glass, High silica glass, optical glass, borosilicate glass, lead glass, glass wool, Pyrex glass, photochromic glass, insulating glass, rare earth glass, vitreosil glass, photosensitive glass.

SAURASHTRA UNIVERSITY
B.Sc. SEMESTER – V
CHEMISTRY [C-502] SYLLABUS
ORGANIC CHEMISTRY AND SPECTROSCOPY
EFFECTIVE FROM JUNE-2018

UNIT-I:

1. **Name reactions, Rearrangements and Reagent: [6 hours]**

Reactions

(a) Arndt Eistert reaction
(b) BischlerNapierski reaction
(c) Wolf-Kishner reaction

Rearrangements

(a) Beckmann rearrangement
(b) Curtius rearrangement
(c) Bayer-villiger oxidation

Reagent

(a) Lithium Aluminium hydride $LiAlH_4$
(b) Triphenyl phosphine
(c) Sodamide

2. **Alkaloids [6 hours]**

Introduction, Occurrence, classification, Isolation, General method of proving structure of alkaloids, Constitution, Properties and synthesis of

(a) Coniine
(b) Nicotine
(c) Papaverine

UNIT-II:

1. **Carbohydrates [9hours]**

Introduction, classification and nomenclature, general reaction of monosaccharides (with reference to Glucose and Fructose)

Inter-conversions:

(a) Conversion of Aldose to the corresponding ketose
(b) Conversion of Aldose to the next higher Ketose (wolform method)
(c) Conversion of Aldose to the Ketose having two more carbon atoms (Swoden method)
(d) Conversion of Ketose to the corresponding Aldose

Step-up reaction (Ascending in Aldose series)

(a) Kiliani reaction
(b) Swodennitromethane reaction

Step-down reaction (Descending in Aldose series – Aldohexose to Aldopentose) by Ruff's method

Configuration of monosaccharides

Ring structure of Aldoses

Determination of ring size of Glucose by

(a) Methylation method
(b) Periodic oxidation method

Mutarotation of D (+) glucose

2. Synthesis Drugs, Dyes and Sweetening Agents [3 hours]

Synthesis and applications of

Drug: Ibuprofen, Atenlol and Adrenaline

Dyes: Orange II, Crysodine G, Auramine O

Sweetening agent: Saccharin, p-anisylurea and dulcin

UNIT-III:

1. Synthesis of Heterocyclic Compounds containing Two Heteroatoms [6 hours]

Synthesis of

1. Pyrazole
2. Imidazole
3. Isoxazole
4. Thiazole
5. Pyrimidine
6. Pyridiazine
7. Oxazine
8. Thiazine
9. Dioxane

2. Ultraviolet and Visible Spectra [6 hours]

Instrumentation; types of transition in organic molecules; auxochrome; chromophore; explanation of bathochromic shift and hypsochromic shift; hyperchromic and hypochromic effects; calculation of λ_{max} of (i) dienes and conjugated dienes; (ii) enones and dienones(iii) aromatic carbonyl system; factor affecting of UV spectral bands; application of UV.

UNIT-IV:

1. Molecular Symmetry [12 hours]

Introduction; symmetry element and symmetry operations with illustrations; definition of properties of group; subgroup and classes; products of symmetry operation; symmetry point group [C_1, C_s, C_i, C_n, C_{nv}, D_n, D_{nh}, D_{nd}, C_v, $D_{\alpha h}$, Td, Oh]; multiplication tables for C_{2v}, C_{3v} and C_{2h} point groups.

UNIT-V:

1. Infrared Spectroscopy [12 hours]

Introduction; Range of IR , theory of IR; Modes of fundamental vibration; IR active, force constant; Vibration coupling; Fermi resonance; Finger print region; Instrumentation; Application of IR; determination of structure of organic molecules From IR; Interpretation of IR for given molecules and problems.

SAURASHTRA UNIVERSITY
B.Sc. SEMESTER – V
CHEMISTRY [C-503] SYLLABUS
PHYSICAL CHEMISTRY AND ANALYTICAL CHEMISTRY
EFFECTIVE FROM JUNE-2018

UNIT-I:

1. Second law of thermodynamics [12 hours]

- Limitations of first law of thermodynamics
- Spontaneous process
- Carnot cycle & theorem
- Statements of second law of thermodynamics
- Perpetual motion of second kind (briefly)
- Concept of entropy, Definition of entropy
- ΔS in reversible & irreversible (spontaneous) process
- ΔS in ideal gases
- ΔS of mixture of ideal gas
- ΔS in physical transformations
- Entropy and second law of thermodynamics
- Physical significance of entropy

UNIT-2

1. Electrochemistry-1 [8 hours]

- Introduction
- Types of cell
- Half-cell, standard half-cell, standard cell
- Standard electrode potential
- Conventional sign and representation of cell
- emf series
- Types of electrode such as active, Innert and gas electrode
- Types of reversible electrodes
- Galvanic cell
- Hydrogen electrode, calomel electrode, glass electrode
- Reversible cell and Irreversible cell
- Nernst equation for the calculation of single electrode potential
- Examples based on theory

2. Phase rule [4 hours]

- Three component system
- Method of graphical presentation
- Types of partially miscible three liquid systems:
    1. One partially miscible pair: Effect of adding third component,Nature of tie line, Plait point, Binodae curve, Characteristics ofdiagram, A is added to binary system, A is constant and B and Cvaried.
    2. Formation of two pairs of partially miscible liquid

3. Formation of three pairs of partially miscible liquid

- Application of ternary liquid diagram

UNIT-3

1. Free energy and chemical equilibrium [8 hours]

- Work function: its physical significance and variation with V and T
- ΔG for ideal gases, Gibbs Helmholtz equation and its applications
- Free Energy: its significance & variation with P and T
- Criteria for chemical equilibrium
- Vant Hoff reaction isotherm
- Law of active mass
- ClausiusClapeyron equation

2. Colourimetry [4 hours]

- Introduction
- Grotthuss Draper law, lambert's law, Beer's law, lambert's-beer's law and Derivation, application & deviation of lambert's law
- Spectrophotometric titration with graph and proper explanation
- Deficit of absorbance by product and titrant
- Deficit of absorbance by product and reagent
- Deficit of absorbance by reagent and titrant
- Deficit of absorbance by product only

UNIT-4

1. Conductometry [9 hours]

- Electric transport , Specific conductance in metals and in electrolyte solution, equivalent conductance
- Importance of conductivity electrodes and platinization of electrodes etc.
- Variation of specific conductance with dilution as well as area of cross section of dip type electrode and distance between two plates of electrodes etc.
- Kohlrausch law and its importance, cell constant and its importance.
- Conductometric Titration:
  (1)Strong acid - strong base
  (2)Strong acid - Weak base
  (3)Weak acid – Strong base
  (4)Mixture of strong acid + Weak acid - strong base
- Precipitation Titration :
  (1) $AgNO_3$ – NaCl (2) $BaCl_2$ – K_2SO_4 (3) $Ba(OH)_2$ – $MgSO_4$
- Replacement Titration:
  (1) Salt of weak acid – strong acid
  (2) Salt of weak base – strong base
- Degree or hydrolysis and Hydrolysis constant
- Determination of solubility and solubility product of sparingly soluble salt, for the measurement of conductivity
- Importance of conductivity water and temperature for the measurement of conductivity

2. **Introduction of complexometry titration [3 hours]**
   - Method of preparation of standard EDTA solution
   - Velcher's law explanation of Pm- $\rightarrow$ EDTA Vol., Graph with stability constant value.
   - Types of EDTA titration (i) Direct, (ii) Back titration, (iii) Substitution titration(iv) Alklimetry titration mixture with the help of masking and demasking agent.
   - Principle of metal ion indicator, use of EBT, calcon, muroxide with structure and characteristics.

UNIT-5

1. **Volumetric analysis with example of calculation based on pH, normality, molarity, Ksp etc. [12 hours]**
   - Ostwald's law- Regarding indicator – necessary derivation and formulaof indicator used in Neutralization, redox, precipitation titration.
   - Primary and secondary standard explanation

   Explanation of neutralization titration with graph
   - Strong acid - Strong base titration
   - Weak acid - Strong base titration
   - Strong acid – Weak base titration
   - Poly protic acid - Strong base titration

   Redox Titration
   - Principle of external and internal indicator in redox titration.e.g. Diphenyl amine, starch & $K_3[Fe(CN)_6]$
   - Redox Titration with graph and calculation
   - Iodometry and Iodimetry titration
   - Preparation of standard sodium thiosulphate solution

   Precipitation Titration
   - Argentometric Titration (I) Mohr's method (II) Fazan'smethod (III) Volhard's method with use of proper indicator, graph and its practical application
   - Examples of calculation based on pH, Normality,Molarity,Ksp etc...

Saurashtra University
B.Sc. SEMESTER – V
CHEMISTRY PRACTICALS [C-504] SYLLABUS
[Practical Exam. would be conducted for 1 ½ days]
[Total Marks: 105 marks]
EFFECTIVE FROM JUNE-2018

1. **Organic Separation (Mixture of two compounds) [30+5 marks]**
   [Minimum 12 mixtures should be done]
   Separation & Analysis of an organic mixture containing
   (a) Two solid components using water, $NaHCO_3$, NaOH and HCl for separation
   (b) Liquid + liquid component - separation by physical method.
   (c) Liquid + solid component - separation by physical method.
2. **Inorganic Volumetric Analysis [30 marks]**
   [Minimum 8 exercises should be done]
   For volumetric exercise all the standard solutions are to be prepared by the students.
   i. Iodometry and Iodimetry
   (a) Estimation of Cu^{+2} and $CuSO_4.5H_2O$ in the given $CuSO_4.5H_2O$ using 0.05N $Na_2S_2O_3.5H_2O$ solution.
   (b) Estimation of As^{+3} and As_2O_3 in the given As_2O_3 using 0.05N $Na_2S_2O_3.5H_2O$ solution.
   ii. Complexometric titration:
   1. Estimation of the amount of Ni^{+2} in the given $NiSO_4.7H_2O$ solution using 0.02 N EDTA solutions.
   2. Estimation of the amount of Mg^{+2} and Pb^{+2} in the given solution containing a mixture of Mg^{+2} and Pb^{+2} using 0.02 N EDTA solution
   3. Estimation of the amount of Ca^{+2} and Zn^{+2} in the given solution containing a mixture of Ca^{+2} and Zn^{+2} using 0.02 N EDTA solution
   4. Estimation of the amount of Fe^{+3} and Cr^{+3} in the given solution containing a mixture of Fe^{+3} and Cr^{+3} using 0.02 N/ 0.01 M $Pb(NO_3)_2$ and 0.02 N/ 0.01 M EDTA solution.
   iii. Redox titration
   1. Determination of the amount of NO_2^{-1} in the given $NaNO_2$ or KNO_2 solution by reduction method using 0.1 N $KMnO_4$ solutions.
   iv. Water Analysis
   1. To determine the amount of chloride in the given sample of water using 0.02 N $AgNO_3$
   v. To determine the purity of $NaHCO_3$ in the given sample
3. **Physicochemical Exercise [30 marks]**
   [Minimum 10 exercises should be done]
   1. Conductometry
   i. To determine normality and gms/lit of xNHCl and also determine specific conductance by conductometry.

ii. To determine normality and gms/lit of the mixture of HCl+CH_3COOH by conductometry.
iii. To determine the normality of weak acid by conductometry
iv. To determine the concentration of Ni+2 using 0.1M EDTA solution.
v. To determine the normality of x$NAgNO_3$ using 0.5N NaCl by Conductometry.

2. Thermodynamics:

i. Calculate entropy of vaporization (ΔS_v) of a given liquid by plotting a graph of log (1/time) vs (1/temperature)

3. Refractometer

i. To determine specific refractivity and molecular refractivity of given pure liquid A, B, C, D.
ii. To determine specific refractivity and molecular refractivity of glycerine (10%, 5%, 2.5%) and unknown glycerine solution.

4. Viscosity

i. To determine relative and absolute viscosity of pure liquid A, B, C, D by Ostwald's viscometer.
ii. Preparation three different 10%, 5%, 2.5% aqueous solution of glycerine, find viscosity of these three solutions as well as unknown concentration solution with the help Ostwald's viscometer.

5. Colourimetry

i. Find out the amount of Ni^{+2} in the given solution by colourimetry method.
ii. Find out the amount of Fe^{+3} in the given solution by colourimetry method.

6. Polarimeter

i. To determine specific rotation of three different concentration (10%, 5%, 2.5%) of dextrose solution. From graph find out the unknown.
ii. Study the inversion rate of sugar in presence of 1N HCl and determine the rate of reaction.

7. Viva. [5+5=10 marks]