

**SAURASHTRA UNIVERSITY**  
**B.Sc. SEMESTER-VI**  
**CHEMISTRY [C-601] SYLLABUS**  
**INORGANIC CHEMISTRY & INDUSTRIAL CHEMISTRY**  
**EFFECTIVE FROM JUNE-2018**

**UNIT-1**

**Multi electron system**

**[12 Hours]**

- Introduction
- Concept of spectral terms and term symbols
- s-s coupling, l-l coupling, l-s coupling, j-j coupling and L-S coupling with vector diagram.
- Derivation of spectral term symbol for  $P^1$ ,  $P^2$ ,  $P^3$ , &  $d^1$  to  $d^9$
- Micro states: Definition, calculation and derivation of microstates for  $p^1, p^2, d^1$  &  $d^2$  by pigeon hole diagram
- Hund's rule for the determination of ground state spectral term
- All type of examples including calculation of S.Ms, l ML, J, MJ and microstates

**UNIT-2**

**Crystal Field Theory-II**

**[12 Hours]**

- Jahn-Teller effect: Statement and explanation
- Tetragonal distortion with example
- Splitting of d-orbital in square planar complexes with examples
- Hole formalism
- Splitting of D and F ground terms using hole formalism
- Orgel Diagram of D and F states
- Selection rules for d-d transition
- Types of electronic transition in metal complexes
- Absorption spectrum of  $Ti^{+3}$ ,  $Cu^{+2}$  &  $Ni^{+2}$

**UNIT-3**

**1. Magneto Chemistry**

**[6 Hours]**

- Introduction (Magnetic field, Magnetic pole, Intensity of magnetization)
- Magnetic induction
- 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

**2. 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**

##### **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 NO<sub>x</sub> and SO<sub>x</sub>, 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 materials); Water Pollution Control, Dissolved Oxygen (DO) determination, Chemical Oxygen Demand (COD) determination, Biological Oxygen Demand (BOD) determination

#### **UNIT-5**

##### **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

## **List of Reference Books**

### **Inorganic Chemistry**

- 1) Quantum Chemistry-R.K. Prasad, New Age International Publishers.
- 2) Inorganic Chemistry-James E. Huheey (3<sup>rd</sup> Edition) HarperInternational SI Edition.
- 3) Coordination chemistry -GurdeepChatwal and M.S. Yadav, Himalaya publishing House.
- 4) Principles of Inorganic Chemistry -B.R.Puri, L.R. Sharma &K.C.Kalia; Vallabh Publications, Delhi
- 5) Modern aspects of Inorganic Chemitry- H.J. Emeleus and A.G.Sharpe; Routledge&Kegan Paul Ltd., 39 Store street, London WCIE7DD
- 6) Advance Inorganic Chemistry (3<sup>rd</sup> Edition)- F.A. Cotton and G.Wilkinson; Wiley Eastern Pvt. Ltd.

### **Industrial Chemistry**

- 1) Industrial Chemistry -B.K. Sharma
- 2) Outlines of Chemical Technology - Charles Dryden
- 3) Regiel's Handbook of Industrial Chemistry - James A. Kent
- 4) Engineering Chemistry- Jain & Jain
- 5) Environmental Chemistry -A.K. De
- 6) Environmental Chemistry -Sharma &Kaur
- 7) Environmental Solution of Analysis- S.M. Khopkar
- 8) Environment Pollution Control Engineering -Rao C.S.

**SAURASHTRA UNIVERSITY**  
**B.Sc. SEMESTER – VI**  
**CHEMISTRY [C-602] SYLLABUS**  
**ORGANIC CHEMISTRY AND SPECTROSCOPY**  
**EFFECTIVE FROM JUNE-2018**

**UNIT-I**

**1. Terpenoids: [7 Hours]**

Introduction, Occurrence, Isolation, General characteristics of Terpenoids, Isoprene Rule, Constitution and Synthesis of:

- a. Citral
- b.  $\alpha$ -Terpineol

**2. Synthetic Explosive, Perfumes and Insecticides [5 Hours]**

Synthesis and uses of: Explosives:

- a. RDX (Research Department Explosive)
- b. TNT (Trinitrotoluene)
- c. PETN (Pentaerythritoltetranitrate)

Perfumes:

- a. Musk Xylene
- b. Musk Ketone
- c. Musk Ambrette

Insecticides:

- a. Baygon
- b. Carbendazim
- c. Parathion

**UNIT-II**

**1. Amino acids, Peptides and Proteins [12 Hours]**

Introduction, Classification of amino acids name and formula

Synthesis of amino acids by:

- a. Amination of  $\alpha$ -halogen acids
- b. Gabriel phthalimide synthesis
- c. Erlenmeyer azlactone synthesis
- d. Hydantoin method

Physical properties of amino acids, Chemical properties of amino acids, Isoelectric point

Introduction to Polypeptides, Synthesis of Polypeptides by:

- a. Bergmann Method
- b. Sneehan's Method (use of Phthaloyl group)
- c. Fischer's Method (use of p-toluenesulphonylchloride)

Introduction and classification of proteins,

Constitution of Thyroxine, Synthesis of Thyroxine

**UNIT-III**

**1. Polynuclear Aromatic Hydrocarbons [5 Hours]**

Introduction, Classification of Polynuclear hydrocarbon, Synthesis and chemical properties:

- a. Biphenyl
- b. Diphenyl methane
- c. Naphthalene
- d. Anthracene

- 2. Conformational Isomerism** [3 Hours]  
Conformation of cyclic system: Cyclohexane  
Conformational analysis of cyclohexane: Boat form and Chair form  
Conformation of mono-substituted and di-substituted cyclohexane
- 3. Mass spectrometry** [4 Hours]  
Introduction, Basic principle; instrumentation; General fragmentation modes, important features for the mass spectra of alkanes (No problems)

#### **UNIT-IV**

- 1 Nuclear Magnetic Resonance Spectroscopy** [12 Hours]  
Introduction; Principle; nuclear quantum number; equivalent and non-equivalent protons with illustrations; enantiometric and diastereometric protons; shielding and deshielding of protons; chemical shift; paramagnetic anisotropic effect; relative intensity of signals; spin-spin coupling and coupling constant; Deuterium labeling; applications of NMR; problems based on determination of structure of organic molecules from NMR spectral data

#### **UNIT-V**

- 1. Problems based on UV, IR, NMR spectroscopy** [12 Hours]  
[Molecular Formula should be given]

#### **Reference Books**

1. Synthetic Organic Natural Products (Volume I & II) by O.P Agrawal.
2. Organic Chemistry of Natural Products by GurudeepChatwal
3. A Text Book of Organic Chemistry by Raj K. Bansal
4. Organic Chemistry by Clayden
5. Medicinal Chemistry by Ashutoshkar
6. Pharmaceutical Chemistry by Axel Kleemann&Jugen Engel
7. Organic Name reactions by GautamBrahmachari
8. Organic Reaction Mechanisms by V.K. Ahluwalia
9. Reactions and Rearrangements by GurdeepChatwal
10. Name Reactions in Organic Synthesis by Dr. A.R.Parikhet. al
11. Chemical application of group theory by F Albert Cotton
12. Symmetry in chemistry by H.N. Jhaffe
13. Spectrometric identification of organic compounds by Silverstien, Bassler and Morrill
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
17. Molecular Spectroscopy by B.K.Sharma
18. Organic Spectroscopy by B.K.Sharma

**SAURASHTRA UNIVERSITY**  
**B.Sc. SEMESTER – VI**  
**CHEMISTRY [C-603] SYLLABUS**  
**Physical Chemistry and Analytical Chemistry**  
**EFFECTIVE FROM JUNE-2018**

**UNIT-I**

**1. Activity of Electrolytes [8 Hours]**

- Ionic Activity: Introduction
- Derivation of  $a_2 = a_+^{\theta} a_-^{\theta}$  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.  $a_2 = a_{\pm}^2$
- Mean ionic activity coefficient  $f_{\pm}$  and  $f_{\pm}$ , ionic strength : Definition, explanation, equation Debye Huckel limiting law (without derivation)
- Derivation of  $-\log f_{\pm} = A z_+ z_- \mu^{1/2}$
- 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
  - chemical cell with transference
  - concentration cell without transference
- 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 ( $\Delta S^0$ ,  $\Delta G^0$  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
  - 1) Solubility of sparingly soluble salts
  - 2) Valency of metal ion
  - 3) Dissociation constant of weak acid
  - 4) Transport number of ion

- 5) Ionic product of water
- 6) Degree of hydrolysis
- 7) 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 partial molar properties by method of intercept
- Applications of chemical potential (Henry's law, Raoult's law and Nernst's 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 complete Interpretation
- Mean and standard deviation, variance and coefficient of variance
- Absolute error and relative error, mean value, deviation and relative Mean deviation. Gaussian 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,
- Classification of chromatography - types of chromatography
- Detail study of
  - (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, R<sub>f</sub> value, R<sub>x</sub> value, nature of adsorption etc.
  - a. **Column chromatography:** Principle, Method of separation of green leaf pigment, mixture of inorganic salts, vitamins, colors of flowers etc. separation of  $\alpha, \beta, \gamma$  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( $\text{Fe}^+$  ,  $\text{Co}^{+2}$  ,  $\text{Ni}^{+2}$ ) 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) $\text{Cl}^{-1}$ , $\text{Br}^{-1}$ , $\text{I}^{-1}$       | (ii) $\text{NO}_2^{-1}$ , $\text{NO}_3^{-1}$ , $\text{Br}^{-1}$     |
| (iii) $\text{S}^{-2}$ , $\text{SO}_3^{-2}$ , $\text{SO}_4^{-2}$ | (iv) $\text{PO}_4^{-3}$ , $\text{AsO}_3^{-3}$ , $\text{AsO}_4^{-3}$ |
| (v) $\text{CO}_3^{-2}$ , $\text{SO}_3^{-2}$ , $\text{S}^{-2}$   | (vi) $\text{Cu}^{+2}$ , $\text{Cd}^{+2}$                            |

### 2. Potentiometry and pH metry: [9 Hours]

- Introduction and interpretation of pH metry and potentiometry.
- 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 include mixture of  $\text{Cl}^{-}$  ,  $\text{Br}^{-}$  ,  $\text{I}^{-}$  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
- Weak acid-strong base titration with curve and determination of dissociation constant (Ka) of weak acid.



### **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 Gurudeep Raj
10. Introduction to electrochemistry by S. Gladstone

### **Reference Books for Analytical Chemistry**

1. Fundamental of analytical chemistry by Skoog & West
2. Instrumental Method & Chemical Analysis by B.K. Sharma Analytical
3. Water Analysis and Water pollution by V.P. Kudesia
4. Instrumental Method & Chemical Analysis by Chatwal Anand
5. Thin layer chromatography by Egal Stall
6. Book for Water Analysis by R. K. Trivedi, V. P. Kudesia
7. Analytical Chemistry by Dick
8. Inorganic Qualitative analysis by Vogel and Gehani Parekh
9. Electrometric Methods of analysis by Browning
10. Principle of instrumental analysis by Skoog

**SAURASHTRA UNIVERSITY**  
**B.Sc. SEMESTER-VI**  
**CHEMISTRY PRACTICAL [C-604] SYLLABUS**  
**[PRACTICAL EXAMINATION WOULD BE CONDUCTED FOR 1 ½ DAYS]**  
**[TOTAL MARKS: 105 MARKS]**  
**EFFECTIVE FROM- JUNE-2018**

- 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 [35 marks]**  
(Percentage of yield, crystallization, melting point)  
[Minimum 8 syntheses should be done]
- i. Acetylation / Benzoylation**
1. Acetylation of salicylic acid
  2. Acetylation of aniline
  3. Acetylation 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<sub>3</sub>COOH) 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. Potentiometry**

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

**4. Viva (5+5)**

**[10 Marks]**

**SAURASHTRA UNIVERSITY**  
**B.Sc. SEMESTER-V and VI**  
**PAPER STYLE – THEORY**  
**EFFECTIVE FROM- JUNE-2018**

**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 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