

**SARDAR PATEL UNIVERSITY**  
**B. Sc. [Semester-I]**  
**Syllabus of US01CCHE01 (GENERAL CHEMISTRY)**  
**[02 Credits]**  
**(Effective from June-2010)**  
**Total Marks: 100 [30+70]**

**UNIT 1 Analytical Chemistry (07 hrs)**

Introduction, Applications, Stages of analysis, Selecting the methods, Quantitative analysis, Limitations of analytical methods, classification of errors, accuracy, precision, how to reduce systematic errors, significant figures, mean and standard deviation, distribution of random errors, reliability of results.

**Reference Book:**

1. Vogel's textbook of quantitative chemical analysis, 6<sup>th</sup> Edition, J Mendham, R C Denney, J D Barnes, M J K Thomas

**UNIT 2 Ionic Equilibria in Aqueous Solution (08 hrs)**

Sparingly soluble salts, Common – ion effect, Selective precipitation, Arrhenius theory of Acids and Bases, The Lowry – Bronsted Concept, Strength of Acids and Bases, The Lewis concept, The pH Scale, Self Ionization of Water

**Reference Book :**

1. University Chemistry By Bruce H Mahan 4<sup>th</sup> edition, Narosa Publishing House

**UNIT 3 Alkanes, Alkenes and Alkynes (08 hrs)**

Introduction of Hydrocarbons, Physical properties of alkanes, Higher alkanes-The homologous series, Nomenclature, Alkyl groups, Common names of alkanes, IUPAC names of alkanes, Classes of carbon atom and H-atoms, Physical properties, Geometric Isomerism, Name of alkenes, Nomenclature, Qualitative and quantitative analysis of organic compounds  
Molecular formula: its fundamental importance, Quantitative elemental analysis, Quantitative elemental analysis: Carbon, Hydrogen and Halogen (Carius Method), Empirical Formula, Molecular weight: molecular formula, Quantitative elemental analysis (kjeldahl & Dumas methods)

**Reference Book:**

1. Organic Chemistry by Morrison & Boyd 6<sup>th</sup> Edition.

**UNIT 4 Basic Concepts of Coordination Chemistry (07 hrs)**

Definition of Some Terms, Classification of Ligands, Chelation, Classification of Chelates, Uses of Chelates, Co-ordination Number and Stereochemistry of Complexes, Nomenclature of Co-ordination Compounds.

**Reference Book:**

1. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D.Tuli, R.D.Madan.

**COURSE OUTCOME :** The paper provides basic opportunities to students to revive their knowledge and depth of understandings of basic general chemistry. The paper is niftily designed covering of fundamental aspects of all the major branches of chemistry viz. Analytical chemistry, Physical Chemistry, Organic Chemistry and

Inorganic chemistry. After completion of whole paper students would have cleared basic aspects of the chemistry as a subject and would have a profound pillar for upcoming syllabus.

**SARDAR PATEL UNIVERSITY**  
**B. Sc. [Semester-I]**  
**Syllabus of US01CCHE02 (INORGANIC CHEMISTRY)**  
**[02 Credits]**  
**(Effective from June-2010)**  
**Total Marks: 100 [30+70]**

**UNIT 1 Atomic Structure**

**(08 hrs)**

De Broglie's Concept of Dual Character of Matter, De Broglie's Wave Equation, Derivation of De Broglie's Equation, Heisenberg's Uncertainty Principle, Problems Based on De Broglie's Wave Equation and Heisenberg's Uncertainty Principle, Schrödinger Wave Equation, Derivation of Schrödinger Wave Equation, Other Forms of Schrödinger Wave Equation, To Convert Cartesian Coordinates into Polar Coordinates, Schrödinger Wave Equation for H Atom in Cartesian and Polar Coordinates, Significance of  $\Psi$  And  $\Psi^2$ , Electron Probability Function  $D$ , Plot of  $R_{n,l}$  against  $r$  and its Relation with The Electron Probability Density Around Point at a Distance of  $r$  from the Nucleus, Values of Angular Wave Function  $\theta_{l,m} \times \phi_m$  for s and p Orbitals and to their Shapes, Shielding Effect and Effective Nuclear Charge, Factors Affecting the Magnitude of  $\sigma$  and  $Z_{\text{eff}}$  and their Variation in the Periodic Table, Slater's Rule for Calculating  $\sigma$  and  $Z_{\text{eff}}$ , Problems.

**Reference Book:**

1. Advanced Inorganic Chemistry Volumel, Satyaprakash, GDTuli, SKBasu, RDMadan

**UNIT 2 Periodic Properties**

**(07 hrs)**

Brief Introduction of Periodic Table, Ionization Energy, Successive Ionization Energies, Factors Affecting Magnitude of Ionization Energy, Variation of IE Values in Main Group Elements, Variation of IE Values in Different Groups, Ionization Energies of Isoelectronic Species, To Find out the Order of Second IE Values of the Elements of Second Period, Difference Between Ionization Potential and Electrode Potential of a Metal.

Electron Affinity, Relation Between EA of  $X_{(g)}$  Atom and IE of  $X^{-}_{(g)}$  Ion,  $EA_2$  Represents Energy Required, Factors Affecting the Magnitude of Electron Affinity, Variation of Electron Affinity in Main Group Elements of the Periodic Table, Variation of Electron Affinity Values of Elements of Different Groups.

Electronegativity, Different Methods Used for Calculating Electronegativity, Factors Affecting the Magnitude of Electronegativity, Variation of Electronegativity in a Group

of s and p Block Elements, Variation of Electronegativity of The Elements of Different Group, Variation of Electronegativity in a Period of s and p Block Elements, Applications of Electronegativity

**Reference Book:**

1. Advanced Inorganic Chemistry Volume I, Satyaprakash, GDTuli, SKBasu, RDMadan

**UNIT 3 Chemical Bond 1**

**(07 hrs)**

The Lewis Theory, Sidgwick- Powell Theory, Valence Shell Electron Pair Repulsion (VSEPR) Theory, Effect of Lone Pairs, Effect of Electronegativity, Isoelectronic Principle, Some Example Using VSEPR Theory, Valence Bond Theory (VBT), Hybridization Involving s and p Orbitals ( $sp$ ,  $sp^2$ ,  $sp^3$ )

**Reference Book:**

1. Concise Inorganic Chemistry, 5<sup>th</sup> Edition, J D Lee

**UNIT 4 Chemical Bond 2**

**(08 hrs)**

Molecular Orbital Method, LCAO Method, s-s Combination of Orbitals, s-p Combination of Orbitals, p-p Combination of Orbitals, Rules for Linear Combination of Atomic Orbitals, Examples of Molecular Orbital Treatment for Homo Nuclear Diatomic Molecules  $H_2^+$ ,  $H_2$ ,  $He_2^+$ ,  $He_2$ ,  $Li_2$ ,  $Be_2$ ,  $B_2$ ,  $C_2$ ,  $N_2$ ,  $O_2$ ,  $O_2^-$ ,  $O_2^{2-}$  and  $F_2$ .

**Reference Book:**

2. Concise Inorganic Chemistry, 5<sup>th</sup> Edition, J D Lee

**COURSE OUTCOME** : This paper aims to provide students basic and fundamental knowledge related to inorganic chemistry. Students are expected to achieve and understand the modern periodic table which stand the backbone in understanding Chemistry and the periodic properties like Atomic and Ionic size Ionization Energy Electron Affinity Electro negativity and making student understand S Block elements in detail. This paper offers an ocean of basic chemistry knowledge as far as inorganic chemistry is concerned. After studying this course student will be able to learn succeeding semester's Inorganic chemistry subjects (US04CCHE01, US05CCHE03, US05CCHE04, US06CCHE03, US06CCHE04).

## SARDAR PATEL UNIVERSITY

### B. Sc. (Semester-I)

### Syllabus of US01CCHE03 (Chemistry Practical's)

[02 Credits]

(Effective from June-2010)

Total Marks: 100 [30+70]

#### [A] Volumetric

1. To determine amount of  $\text{Cu}^{+2}$  by using Fast sulphon Black – F indicator.
2. To determine amount of  $\text{Ni}^{+2}$  by EDTA using murexide indicator.
3. To determine amount of  $\text{Mg}^{+2}$  by EDTA using Eriochrom Black – T.

#### [B] Analysis of Inorganic substances

$\text{Pb}(\text{NO}_3)_2$ ,  $\text{CdCl}_2$ ,  $\text{Cu}_3(\text{PO}_4)_2$ ,  $\text{CaCO}_3$ ,  $\text{Al}_2(\text{SO}_4)_3$ ,  $\text{MnSO}_4$ ,  $\text{NiCO}_3$ ,  $\text{CuS}$ ,  $\text{ZnS}$ ,  $\text{BaCl}_2$ ,  $\text{Sr}(\text{NO}_3)_2$ ,  $\text{ZnCO}_3$ ,  $\text{MgSO}_4$ ,  $\text{AlPO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ,  $\text{KBr}$ ,  $\text{KCl}/\text{NH}_4\text{Cl}$ ,  $\text{KI}$ ,  $(\text{NH}_4)_3\text{PO}_4$ ,  $\text{ZnO}$ ,  $\text{MnO}_2$ .

#### Reference Book:

1. Vogel's textbook of quantitative chemical analysis, 6<sup>th</sup> Edition, J Mendham, R C Denney, J D Barnes, M J K Thomas
2. Practical Chemistry, OPPandey, DNBajpai, SGiri
3. An Advanced course in Practical Chemistry, Ghoshal, Mahapatra, Nad.

**COURSE OUTCOME** : Practical is an integral part of any chemistry branch. This paper offers volumetric and inorganic qualitative analysis part to students. Upon completion of this paper, students are able to employ critical thinking and scientific inquiry in the performance, design, interpretation and documentation of laboratory experiments, at a level suitable to succeed in future laboratory encounters.

**SARDAR PATEL UNIVERSITY**  
**B. Sc. [Semester-II]**  
**Syllabus of US02CCHE01 (ORGANIC CHEMISTRY)**  
**[02 Credits]**  
**(Effective from June-2010)**  
**Total Marks: 100 [30+70]**

**UNIT 1 ALKANES AND CYCLOALKANES** **[07 hrs]**

Introduction, Preparation of Alkanes, The Grignard reagent: An organometallic compound, Coupling of alkyl halides with organometallic compounds, Mechanism of halogenations, Orientation of halogenations, Stability of free-radicals, Nomenclature of selected bicyclic and tricyclic systems, Reactions, Reactions of small ring compounds, Baeyer strain theory, Heat of combustion & relative stabilities of cycloalkanes, Orbital picture of angle strain.

**UNIT 2 ALKENE AND ALKYNE** **[08hrs]**

Dehydrohalogenation of alkyl halide, The E2 mechanism, Evidence for the E2 mechanism Evidence for the E2 mechanism. Absence of hydrogen exchange, Evidence for the E2 mechanism. The element effect, The E1 mechanism, Evidence for the E1 mechanism, Heat of hydrogenation & Stability of alkene, Electrophilic addition; Mechanism Electrophilic addition; Orientation & reactivity, Mechanism of addition of halogen Halohydrin formation, Addition of alkene; Dimerization, Addition of alkane; Alkylation Oxymercuration-demercuration, Hydroboration-oxidation, Free-radical addition. Mechanism of peroxide-initiated addition of HBr, Orientation of Free-radical addition, Hydroxylation Ozonolysis, Preparation of alkynes, Hydration of alkynes. Tautomerism Acidity of alkynes, Reaction of metal acetylides, Analysis of alkynes.

**UNIT 3 ALKYL AND ARYL HALIDES** **[07 hrs]**

Homolytic and Heterolytic chemistry, Classification, Preparation, Reaction: Nucleophilic aliphatic substitution, S<sub>N</sub>2 Reaction: Mechanism & kinetics, S<sub>N</sub>2 Reaction: Reactivity & steric hindrance, S<sub>N</sub>1 Reaction: Mechanism & kinetics, Carbocation, Structure of carbocation, Relative stability of carbocations, Stability of carbocation: polar effect, Rearrangement of carbocation, S<sub>N</sub>2 Vs S<sub>N</sub>1, Reaction, Low reactivity of aryl and vinyl halides, Structure of aryl and vinyl halides, Nucleophilic aromatic substitution, Bimolecular displacement for nucleophilic aromatic substitution, Reactivity in nucleophilic aromatic substitution, Orientation in nucleophilic aromatic substitution, Electron withdrawal by resonance, Elimination-Addition mechanism, Benzyne, Problems.

**UNIT 4 BENZENE AND THEIR DERIVATIVES** **[08 hrs.]**

Aromatic character. The Huckel [4n+2] rule, Effect of substituent group, Determination of relative reactivity, Classification of substituent group, Mechanism of nitration, Mechanism of sulphonation, Mechanism of Friedel-Craft alkylation, Preparation of ketones by Friedel-Craft acylation, Mechanism of halogenations, Reactivity and Orientation, Theory of reactivity, Theory of orientation, Electron release via resonance, Effect of halogen on electrophilic substitution, Aromatic-Aliphatic hydrocarbon, Structure & Nomenclature of arenes & their derivatives,

Preparation of alkyl benzenes, Limitation of Friedal-Craft alkylation, Reaction of alkylbenzene, Oxidation of alkylbenzene, Halogenation of alkylbenzene: ring Vs side-chain, Side-chain halogenation of alkylbenzene, Preparation of alkenylbenzenes, Reactions of alkenylbenzenes.

**Reference Book:**

1. Organic Chemistry by Morrison & Boyd 6<sup>th</sup> Edition.
2. Organic Chemistry by Paule Yurkawis Bryce, Pearson Education Asia.

**COURSE OUTCOME** : This paper is completely basic organic chemistry. It contains basic concepts of organic chemistry so that Students become eligible to study the subject initially by understanding the basic things for chemical reactions i.e. Substrate and Reagents Types of reagents Electrophilic and Nucleophilic Homolytic and heterolytic fission, Electron mobility Inductive effect etc. After studying this course student will be able to learn succeeding semester's organic chemistry subject viz., US03CCHE01, US04CCHE02, US05CCHE01, US05CCHE02, US06CCHE01, US06CCHE02.

# SARDAR PATEL UNIVERSITY

## B. Sc. [Semester-II]

### Syllabus of US02CCHE02 (PHYSICAL CHEMISTRY)

[02 Credits]

(Effective from June-2010)

Total Marks: 100 [30+70]

#### Unit I Gaseous State

[8hrs.]

Kinetic Molecular Theory of Gases, Deviation of Real Gases from Ideal Behavior, Effect of Temperature and Explanation for the Deviations, Van der waal's Equation of State, Discussion of Van der waal's Equation, Boyle Temperature, Critical Constant of Gas, Determination of Critical Temperature, Pressure and Volume, Van der waal's Equation and the Critical States, Numerical Problems.

#### Unit II The liquid State

[7hrs.]

Vapour Pressure, Isoteniscopic method, Surface Tension and Surface Analysis, Effects of Temperature on Surface Tension, Capillary rise method and Double Capillary rise Method, Viscosity, The Ostwald's Viscometer Method, Effects of Temperature on Viscosity, Reynolds Number, Refractive Index and its Measurements

#### Unit III Chemical Thermodynamics

[8hrs.]

Terminology of Thermodynamics, Work and Heat, Internal Energy and First Law of Thermodynamics, Measurements of  $\Delta E$  and  $\Delta H$ , Hess's Law and its Applications, Heat Capacity and Temperature Dependence of  $\Delta H$ , Numerical Problems

#### Unit IV Chemical Kinetics

[7hrs.]

Differential Rate Laws, Integrated Rate Laws, Experimental Determination of Rate Laws, Reaction Mechanism and Elementary Process, Mechanism and Rate Laws, Reaction Rates and Equilibria, Temperature Effects, Numerical Problems

#### Reference Books

1. University Chemistry By Bruce H Mahan 4<sup>th</sup> edition, Narosa Publishing House
2. Principles of Physical Chemistry, Puri, Sharma and Pathania, 29<sup>th</sup> Edition S. Chand and Company.
3. Physical Chemistry By G. M. Barrow
4. Essential of Physical Chemistry by Bahl, Bahl and Tuli, 25<sup>th</sup> Edition, S. Chand and Company.

**COURSE OUTCOME** : This paper offers niftily designed concepts and theories regarding physical chemistry and its sub-parts like gaseous state, liquid state, thermodynamics, and chemical kinetics. The paper offers theoretical knowledge of the concepts and practical aspects of the same in terms of perfectly designed examples. After studying this course student will be able to learn succeeding semester's physical chemistry subjects viz., US03CCHE02, US05CCHE05, US05CCHE06, US06CCHE05, US06CCHE06.

## SARDAR PATEL UNIVERSITY

**B. Sc. (Semester-II)**  
**Syllabus of US02CCHE03 (Chemistry Practical's)**  
**[02 Credits]**  
**(Effective from June-2010)**  
**Total Marks: 100 [30+70]**

### **[A] Volumetric Analysis:**

1. To determine the amount of carbonates and bicarbonates in mixture.
2. To determine the molarity and gm / lit of NaOH and Na<sub>2</sub>CO<sub>3</sub> in mixture.
3. To determine amount of Fe<sup>+2</sup> by K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> using diphenyl amine as an internal indicator.

### **[B] Organic Spotting:**

Benzoic acid, Salicylic acid, β-Naphthol, p-nitroaniline/m-nitroaniline, Acetanilide, Urea, Naphthalene, p-dichlorobenzene, m-dinitrobenzene, Acetone, Benzaldehyde, CHCl<sub>3</sub>, CCl<sub>4</sub>, Methanol, Toluene, Ethylacetate, Aniline, Benzamide, Nitrobenzene.  
The above compounds must be characterized by M.P. / B.P.

### **Reference Book:**

1. Vogel's textbook of quantitative chemical analysis, 6<sup>th</sup> Edition, J Mendham, R C Denney, J D Barnes, M J K Thomas
2. Practical Chemistry, O P Pandey, D N Bajpai, S Giri
3. An Advanced course in Practical Chemistry, Ghoshal, Mahapatra, Nad.

**COURSE OUTCOME** : This In this paper students are required to perform qualitative analysis of organic substance. Students get knowledge about detection of elements, nature of organic compounds, functional group identification, and compound identification. It also offers students to jump in the world of chemistry laboratory where they need to follow GLP and have exposure to write up laboratory journals. After studying this course student will be able to learn practicals for succeeding semester's in the subject of organic chemistry and quantitative analysis.



**SARDAR PATEL UNIVERSITY**  
**B. Sc. [Semester-III]**  
**Syllabus of US03CCHE01 (ORGANIC CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**(Effective from June-2011)**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I STEREOCHEMISTRY**

**[11 Hrs.]**

Stereochemistry and stereoisomerism, Optical activity, Plane-polarized light, the polarimeter, Specific rotation, Production of Enantiomerism, Chirality, the chiral centre, enantiomers, the racemic modification, Configuration, Specification of configuration: R and S, Sequence rules, Diastereomers, Meso structures, Specification of configuration : More than one chiral center, Generation of a chiral center, Synthesis and optical activity, Reaction of chiral molecules: Bond-breaking, Reaction of chiral molecules: Generation of second chiral center, Reaction of chiral molecules with optically active reagent. Resolution, Reaction of chiral molecules: Mechanism of free radical chlorination.

Free rotation about C-C single bond. Conformation. Torsional strain

Conformation of n-butane Vander Waals repulsion, Factors affecting stability of conformation, Conformation of cycloalkanes, Equatorial and axial bond in cyclohexane, Stereoisomerism of cyclic compounds: Cis- and trans- isomers, Stereoisomerism of cyclic compounds. Conformational analysis.

**Reference Book:**

1. Organic chemistry by Morrison and Boyd, 6<sup>th</sup> ed.

**UNIT: II**

**[11 Hrs.]**

**[A] ALCOHOLS, ETHERS AND EPOXIDES**

Structure of alcohols, Classification of alcohols, Nomenclature of alcohols, Physical properties of alcohols, Addition of Grignard reagent, Product of the Grignard synthesis, planning a Grignard synthesis, Synthesis using alcohol, Limitation of Grignard synthesis, Reaction of alcohols, Alcohols as acids and bases, Oxidation of alcohols, Analysis of 1, 2-diols: Periodic acid oxidation.

**[B] POLYHYDRIC ALCOHOLS: ETHYLENE GLYCOL**

Preparation, Reaction and uses Pinacol rearrangement.

Method of preparation of glycerol: from Propene and other alternate methods, Chemical reactions: reaction with sodium,  $PCl_5$ , carboxylic acid, HCl,  $HNO_3$ , HI, Oxalic acids, acetyl chlorides, oxidation & uses.

**[C] ETHERS AND EPOXIDE**

Preparation of ethers. Williamson synthesis, Epoxide. Structure and preparation, Acid-catalyzed cleavage of epoxide, Based catalyzed cleavage of epoxide,

**Reference Books:**

1. A text book of organic chemistry by Arun Bahl and B. S. Bahl, 16<sup>th</sup> ed.
2. Organic chemistry by Morrison and Boyd, 6<sup>th</sup> ed.

### UNIT: III

#### [A] ALDEHYDES AND KETONES

[06 Hrs.]

Structure, Nomenclature, Preparation of ketones by use of organocopper compounds, Reaction. Nucleophilic addition, Oxidation, Reduction, Addition of cyanide, Addition of derivatives of ammonia, Addition of alcohols. Acetal formation, Iodoform test, Acidity of  $\alpha$ -hydrogens, Reactions involving carbanions, Base-promoted halogenation of ketones, Acid-catalyzed halogenation of ketones: Enolization, Aldol condensation, Dehydration of aldol products, Use of aldol condensation in synthesis, Crossed aldol condensation, Alkylation of carbonyl compounds via enamines, Claisen condensation: Formation of  $\beta$ -keto ester.

#### [B] AMINES

[06 Hrs.]

Structure, Classification, Nomenclature, Ammonolysis of halides, Reductive amination, Hofmann rearrangement: Migration to electron-deficient nitrogen, Reaction (alkylation), Structure and basicity, Effect of substitution on basicity of aromatic amines, Hoffmann elimination, Reactions of amines with nitrous acid, Synthesis of carboxylic acids, Synthesis using diazonium salt, Hinsberg test.

#### Reference Book:

1. Organic chemistry by Morrison and Boyd, 6<sup>th</sup> ed.

### UNIT: IV

#### [A] CARBOXYLIC ACIDS AND DERIVATIVES

[06 Hrs.]

Structure, Nomenclature, Physical properties, Grignard synthesis, Nitrile synthesis, Acidity of carboxylic acids, Effect of substituents on acidity, Conversion into acid chlorides, Conversion into esters, Conversion into amides, Halogenation of aliphatic acids. Substituted acids, Nucleophilic acyl substitution. Role of carbonyl group, Nucleophilic substitution. Alkyl Vs. Acyl, Alkaline hydrolysis of esters, Acidic hydrolysis of esters, Transesterification, Malonic ester synthesis of carboxylic acid, Aceto acetic ester synthesis of ketones, Reformatsky reaction: Preparation of  $\beta$ -hydroxy ester.

#### [B] PHENOLS

[05 Hrs.]

Structure and nomenclature, Physical properties, Industrial sources, Rearrangement of hydroperoxides, Rearrangement of hydroperoxides. Migratory aptitude, Acidity of phenols, Ester formation, Kolbe reaction. Synthesis of phenolic acids, Reimer-Tiemann reaction, Mechanism of Fries rearrangement, Gatterman synthesis.

#### Reference Books:

1. Organic chemistry by Morrison and Boyd, 6<sup>th</sup> ed.
2. Organic reaction mechanism by R.K.Bansal, 3<sup>rd</sup> ed.
3. Organic chemistry by S.M.Mukherji, S.P.Singh and R.P.Kapoor. Vol. II.

**COURSE OUTCOME** : This is the basic organic chemistry course designed to understand stereochemistry of organic compounds, chemistry of alcohol, phenol, ether, aldehyde, ketones, amines, carboxylic acid and their derivatives. After studying this course student will be able to learn succeeding semester's organic chemistry subject viz., US04CCHE02, US05CCHE01, US05CCHE02, US06CCHE01, US06CCHE02.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-III]**  
**US03CCHE02 (PHYSICAL CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I ENTROPY AND SECOND LAW OF THERMODYNAMICS [11 Hrs.]**

Limitation of first law, spontaneous or irreversible process, cyclic process, Carnot cycle, Carnot theorem, entropy the new state function, the concept of entropy, entropy change in isothermal expansion of an ideal gas, entropy change in reversible and irreversible change, the entropy change accompanying phase change, calculation of entropy of an ideal gas with change in P, V and T, entropy of mixing of an ideal gas, physical significance of entropy, work and free energy function, variation of free energy change with T and P.

**Reference Book:**

1. Principles of Physical Chemistry by Puri, Sharma and Pathania, 44<sup>th</sup> ed.

**UNIT: II COLLIGATIVE PROPERTIES OF DILUTE SOLUTIONS [12 Hrs.]**

Colligative properties, Vapour pressure lowering, Determination of molar mass of solute, Measurement of vapour pressure lowering  
Osmosis and osmotic pressure, Derivation of equation for calculating osmotic pressure, Determination of molar mass, Measurement of osmotic pressure,  
The boiling point elevation, Derivation of equation and measurement of boiling point elevation  
The Freezing point depression, Derivation of equation for molar mass, Measurement of freezing point depression, Numericals

**Reference Book:**

1. Principles of Physical Chemistry by Puri, Sharma and Pathania. 38<sup>th</sup> ed.

**UNIT: III ELECTROLYTES IN SOLUTION [11 Hrs.]**

Specific conductance, molar conductance, conductance and electrolytic dissociation, colligative properties and electrolytic dissociation, electrolysis transference numbers, ionic mobilities, applications, ionic strength, dissociation of weak electrolytes.

**Reference Book:**

1. Physical Chemistry by G.M.Barrow, 5<sup>th</sup> ed.

**UNIT: IV ELECTROMOTIVE FORCE OF ELECTROCHEMICAL CELLS [11 Hrs.]**

Electrodes, cell emf, emf and free energy, Standard electrode potentials, emf and activities, activity coefficients from emf's, equilibrium constant from emf's, electrode concentration cells, electrolyte concentration cells, thermodynamic properties from cell emf's

**Reference Book:**

1. Physical Chemistry by G.M.Barrow, 5<sup>th</sup> ed.

**COURSE OUTCOME** : This is the basic physical chemistry course designed to understand colligative properties of dilute solutions, electrolytes in solution, entropy, thermodynamics etc. After studying this course student will be able to learn

succeeding semester's physical chemistry subject viz., US05CCHE05, US05CCHE06, US06CCHE05, US06CCHE06.

# SARDAR PATEL UNIVERSITY

## BACHELOR OF SCIENCE INDUSTRIAL CHEMISTRY SEMESTER-III

PAPER NO.: US03EICH01 (2 CREDITS, 70 MARKS )  
(TRADITIONAL METHODS OF ANALYSIS)

Unit I : (A) Titrimetric Methods in Analysis [08 Hrs.]

Introduction, Definitions: Standard solutions, Equivalence Point, Indicators, End point, Titration General Aspects of: Primary standards, Desirable properties of standard solution. Volumetric calculations: Molarity, Normality, percentage concentration, parts per million.

(B) Neutralization Titration

Standard solution and acid-base indicators. Titration curve for strong acid-strong base Systematic equilibrium concentrations for SA-SB titration. Acid-Base indicators, colour change range of an indicator, Indicator error. Determination of Acetic acid in vinegar. Determination of Alkalinity of soda ash.

UNIT II : Complexometric Titration [07 Hrs.]

Introduction, terms involved in titration: complex, ligand, buffer solution, chelating agents, chelates, Some Chelating agents, Stability of complexes: stepwise formation constants. Complexometric titration curve. Equilibria involved in EDTA titration, Indicators for EDTA titrations. Hardness of water. Ca in Calcium Gluconate Sample. Numericals based on this titration.

UNIT III : Redox Titration [08 Hrs.]

Introduction, Terms involved: oxidation, reduction. Single electrode potential, formal potential, Nernst Equation, Titration curve for Iron(II) and cerium (IV). Types of redox indicators and their selection. Structural chemistry of redox indicators. Numericals: Calculation based on emf of electrode/cell, end point calculations, equation constants.

UNIT IV : Water pollutant Analysis [07 Hrs.]

Water pollution: Introduction. Classification of water pollutants, Sources of water pollution. Origin of waste water, Effect of water pollutants, Water analysis: colour, turbidity, total dissolved solids, conductivity, acidity, alkalinity, hardness, chlorides, sulphates, fluorides. Drinking water standards.

Reference Books :

1. Fundamentals of Analytical Chemistry, 7th Edition by Skoog, West, Holler.
2. Quantitative Analysis 6th Edition - R.A. Day, Jr., A.L. Underwood.
3. Analytical Chemistry –Dr. Alka Gupta, Pragati Prakashan.
4. Analytical Chemistry : Principles, 2<sup>Ed</sup> –John H. Kennedy.
5. Analytical Chemistry –VI<sup>th</sup> Ed. Gary D. Christian.

### COURSE OUTCOME:

- This course will give information of basics of analytical chemistry.
- It will be useful in chemistry practicals and in post graduation study.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-III]**  
**US03CCHE03 (PRACTICAL CHEMISTRY)**  
**[03 Credits]**  
**Total Marks: 100 [Internal 30 + External 70]**

**1. INORGANIC MIXTURE:** Four radicals. It may include two positive radicals and two negative radicals.

$\text{Cd}^{+2}$ ,  $\text{Cu}^{+2}$ ,  $\text{Bi}^{+3}$ ,  $\text{Fe}^{+2}$ ,  $\text{Zn}^{+2}$ ,  $\text{Al}^{+3}$ ,  $\text{Ni}^{+2}$ ,  $\text{Mn}^{+2}$ ,  $\text{Ba}^{+2}$ ,  $\text{Sr}^{+2}$ ,  $\text{Ca}^{+2}$ ,  $\text{Mg}^{+2}$ ,  $\text{NH}_4^+$ ,  $\text{K}^+$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$ ,  $\text{CO}_3^{-2}$ ,  $\text{S}^{-2}$ ,  $\text{PO}_4^{-3}$ ,  $\text{BO}_3^{-3}$ ,  $\text{SO}_4^{-2}$ ,  $\text{CrO}_4^{-2}$ ,  $\text{Cr}_2\text{O}_7^{-2}$  etc.

**2. VOLUMETRIC TITRATION** (By self preparation of solution of titrant):

1. Estimation of copper by iodometric method.
2. Determination of total hardness of water sample.
3. Determination of nickel by back titration.
4. Determination of nitrite by back titration.

**3. Preparation of standard solutions.**

**4. Paper chromatography.**

**Reference Books:**

1. Vogel's Testbook of Quantitative Chemical Analysis, 5<sup>th</sup> Edition By G.H.Jeffery, J.Basset, J.Mendham, R.C.Denney.
2. Vogel's Testbook Of Qualitative Inorganic Analysis By G. Svehla
3. Practical Chemistry By O. P. Pandey, D. N. Bajpai & S. Giri
4. An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra & Nad

**COURSE OUTCOME :** This course is designed to learn separation and identification of four component inorganic radicals, as well as semi-micro analysis of inorganic radicals. After studying this course student will be able to learn practical of semester V and VI viz. US05CCHE09 and US06CCHE09. Moreover student will learn about quantitative analysis.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-IV]**  
**US04CCHE01 (INORGANIC CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I CHEMISTRY OF d-BLOCK ELEMENTS** **[11 Hrs.]**

Introduction, Position of d-block elements in the periodic table, Electronic configurations and definition, Classifications of d-block elements in 3d, 4d, 5d and 6d series, Physicochemical properties: Atomic radii, Ionic radii, Metallic character and related properties, Atomic volumes and densities, Melting and boiling points, Ionization energies, Standard reduction potential values, Variable oxidation states, Colour of transition metal complex ions, Magnetic properties of transition metal ions and their complexes, Tendency of transition metals to form complex compounds, Formation of interstitial compounds, Catalytic activity, Alloy formation.

**Reference Book:**

1. Advanced Inorganic Chemistry (Volume-II) by Satya Prakash, G. D. Tuli, S. K. Basu & R D Madan

**UNIT: II COORDINATION CHEMISTRY AND ISOMERISM IN COORDINATION COMPOUNDS** **[11 Hrs.]**

**Postulates of** Werner's coordination theory, Explanation of the structure of Co(III) ammines and Pt(IV) complexes on the basis of Werner's coordination theory, Experimental evidences in favour of Werner's theory, Sidgwick's electronic concept of coordinate bond and its limitations, Sidgwick's effective atomic number rule, Structural isomerism: Conformation isomerism, Ionization isomerism, Hydrate isomerism, Coordination isomerism, Linkage isomerism, Coordination position isomerism, Ligand isomerism and Polymerization isomerism, Stereoisomerism: Geometrical isomerism, Geometrical isomerism in 4-coordinated complex compounds, Geometrical isomerism in 6-coordinated complex compounds, To distinguish between cis and trans isomers, Optical isomerism: Definitions, Conditions for a molecule to show optical isomerism, Optical isomerism in 4-coordinated complex compounds, Optical isomerism in 6-coordinated complex compounds.

**Reference Book:**

1. Advanced Inorganic Chemistry (Volume-II) by Satya Prakash, G. D. Tuli, S. K. Basu & R D Madan

**UNIT: III LANTHANIDES AND ACTINIDES** **[11 Hrs.]**

**(A) LANTHANIDES:** Definition, Position of lanthanides in periodic table, General properties- electronic configuration, oxidation state and oxidation potential, chemistry of +2, +3 and +4 state, chemistry of +2, +3 and +4 state, Atomic and ionic radii, lanthanide contraction, cause of lanthanide contraction, consequences of lanthanide contraction, Color and absorption spectra of  $\text{Ln}^{+3}$  ion, magnetic properties and complex formation, Extraction of lanthanides from monazite mineral, Separation of individual rare earth elements by modern methods- ion exchange method, solvent extraction method, uses of lanthanide compounds.

**(B) ACTINIDES:** Definition, Position of actinides in periodic table, General properties and their comparison with lanthanides like - electronic configuration, oxidation state and oxidation potential, chemistry of +2, +3, +4, +5, +6 and +7 oxidation state, Atomic and ionic radii, actinide contraction, color and absorption spectra, magnetic properties and complex formation, Separation of actinide elements by- ion exchange method and solvent extraction method.

**Reference Book :**

1. Selected Topics in Inorganic Chemistry by Wahid U. Malik, G. D. Tuli and R. D. Madan

**UNIT-IV CHEMISTRY OF METALLIC CARBONYLS AND NITROSYLS [12 Hrs.]**

**[A] METALLIC CARBONYLS:** General methods of preparation, general properties, Structure and nature of M-CO bonding in carbonyls, Effective atomic number (EAN) rule as applied to metallic carbonyls, 18-electron rule as applied to metallic carbonyls, Some carbonyls.

**[B] METALLIC NITROSYLS:** Some metallic nitrosyls, Effective atomic number (EAN) rule as applied to metallic nitrosyls.

**Reference Book:**

1. Selected Topics in Inorganic Chemistry by Wahid U. Malik, G. D. Tuli and R. D. Madan

**COURSE OUTCOME :** This inorganic chemistry course contains chemistry of *d*-, *p*-, *f* - block elements, chemistry of metal carbonyls and nitrosyls compounds, coordination compounds etc. After studying this course student will be able to learn inorganic chemistry subject viz., US05CCHE03, US05CCHE04, US06CCHE03, US06CCHE04.



**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-IV]**  
**US04CCHE02 (APPLIED CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I ELECTROMAGNETIC SPECTRUM: ABSORPTION SPECTRA [11 Hrs.]**

**Introduction of U. V. Absorption Spectroscopy**

Visible and UV spectroscopy Presentation (Sketching) of UV spectra of Benzene, 2,5-dimethyl-2,4-hexadiene and aniline.

Woodward-Fischer rules and application for calculating absorption maxima for the following molecules: 1. Myrcene, 2. 1,3-pentadiene, 3. Carvone, 4. Vitamin- A<sub>1</sub> 5. Crotonaldehyde, 6. 2,4-hexadiene

**I R Absorption spectroscopy**

Molecular Vibration, Application of I R Spectroscopy, (Absorption of common functional groups) to Aniline, Benzoic acid, nitrobenzene, benzamide, acetamide, acetone, benzaldehyde, phenyl acetylene, cynobenzene, acetone, styrene, phenol, ethanol, acetic acid and acrolein.

**Reference Books:**

1. Application of absorption spectroscopy of organic compounds by John R. Dyer.
2. Introduction to organic chemistry by Gurdeep R. Chatwal.

**UNIT: II VITAMINS [11 Hrs.]**

Introduction, history and nomenclature, classification, synthesis of vitamins by intestinal bacteria, Fat and water soluble vitamins.

Vitamin-A and its chemistry, absorption, transport and metabolization, colour vision, other biological functions and deficiency of Vitamin-A.

Vitamin-D: chemistry and biochemical functions of Vitamin-D, Vitamin-D is a hormone and not a vitamin, dietary sources and deficiency symptoms.

Vitamin-E: chemistry and biochemical functions of Vitamin-E, dietary sources and deficiency symptoms.

Vitamin-C: chemistry and biochemical functions of Vitamin-C, dietary sources and deficiency symptoms, biomedical/clinical concepts.

**Reference Books:**

1. Biochemistry by U. Satyanarayan and U. Chakrapani
2. Fundamentals of biochemistry by Dr. A.C. Deb.

**UNIT: III FERTILIZERS [11 Hrs.]**

Plant nutrients and their functions, Micronutrients, Types of Fertilizers, Need of Fertilizers, Essential, Requirements, Fertility of the Soil, pH Value of the Soil, Classification of Fertilizer, Direct and Mixed Fertilizers, Source of Fertilizers, Natural Organic Fertilizers, Granulations, Bulk Blending, Natural Inorganic Fertilizers, Artificial Fertilizers, Nomenclature in Fertilizer Industry, Nitrogenous Fertilizers, Ammonium Nitrate, Important Points, Ammonium Sulfate, Ammonium Sulfate from gypsum or anhydride, Action of Ammonium Sulfate as Fertilizer, Urea, Raw Materials, Manufacture, Condition for a Good Yield, Important Points, Action of Urea as Fertilizer, Calcium Cyanamide, Action of CaCN<sub>2</sub> as Fertilizer, Calcium Ammonium Nitrate, Sodium Nitrate, Ammonium Chloride, Organic

Materials, Controlled Release Nitrogen Solution, Phosphate Fertilizer, Phosphate Rock, Normal Super Phosphate, Modification in Manufacturing Equipment, Properties, Triple Super Phosphate, Important Points, Ammonium Phosphate. Phosphates, Potassium Fertilizer, NPK Fertilizer, Important Fertilizers.

#### **UNIT: IV CEMENT INDUSTRY**

**[12 Hrs.]**

Introduction and types of cement, High alumina cement, Slag cement, Acid resisting cement, Super sulphate cement, White and coloured cement, Sorel's cement, Roman cement, Pozzolan cement, Blended portland cement, Types of Portland cement, cementing materials, Raw materials, Cement rock beneficiation, Manufacture, Reactions in the kiln, Mixing of additives to the cement, Setting of cement, Function of compounds, Properties of cement, Indian standard institute specifications, Testing, Uses, Physicochemical processes occurring in thermal treatment of raw cement mixture, Heat requirement, Definitions, Rotary kilns for making cement clinker, Fuel burning devices, Clinker coolers, Factors affecting quality, economy in cement industry, Mortars and concrete, Curing and decay of concrete, Corrosion of concrete or cement stone, Gypsum, Plaster of Paris, Lime and its manufacture, Properties of lime, Setting and hardening of lime.

#### **Reference Books:**

1. Industrial Chemistry, (9<sup>th</sup> Edition), B.K.Sharma.
2. A Textbook of Engineering Chemistry by M. M. Uppal.

**COURSE OUTCOME** : This applied chemistry course contains chemistry of basic of spectroscopy viz UV and IR in addition to fertilizers and cement. This course is beneficial to student to understand the role of chemistry in Industries.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**INDUSTRIAL CHEMISTRY**  
**SEMESTER-IV**  
**COURSE NO.:US04EICH02 (2 CREDITS, 70 MARKS)**  
**TITLE: INSTRUMENTAL METHODS OF ANALYSIS**

Unit-1:

pH metry: Introduction and determination of pH, applications. Potentiometric titrations: Introduction, Types of titrations, Advantages of potentiometric titrations. Conductometric measurements: Introduction, Some important laws, Definition and relations, Effect of dilution, Applications of conductance measurements, Types of titrations, Advantages and disadvantages.

Unit-2:

Chromatography: Introduction, Classification and application

Paper chromatography: Experimental details for qualitative analysis, Experimental details for quantitative analysis. Thin layer chromatography: Superiority of TLC over the other techniques, Experimental techniques, Limitations, Scope.

Column chromatography: Introduction, Experimental details, Theory of development, factors affecting column efficiency.

Unit-3:

HPLC and GC: Introduction, Instruments involved, Sampling methods, Experimental details and applications.

Unit-4:

Visible spectrophotometry and Colorimetry: Introduction, Theory of spectrophotometry and colorimetry, Deviation from Beer's Law, Instrumentation, Applications. Ultra Violet Spectroscopy: Introduction, Origin and theory of ultraviolet spectra, Choice of solvent, instrumentation, Applications.

**REFERENCE BOOKS**

1. Instrumental methods of chemical analysis by Chatwal – Anand, Himalaya Publishing House.
2. Instrumental methods of chemical analysis by B.K. Sharma, Krishna Publication Media (P) Ltd., Meerut.
3. Organic spectroscopy by William Kemp, Macmillan Press Ltd., London.
4. Analytical chemistry by Gray D. Christian, 4<sup>th</sup> edition, Wiley & Sons, Inc.
5. Instrumental methods of analysis by Willard Merritt, Dean Settle, CBS Publishers & Distributors, New Delhi.
6. Principles of instrumental analysis by Skoog, Holler, Nieman, Thomson Asia Pvt. Ltd., Singapore.
7. Basic concept of analytical chemistry by S.M. Khopkar, New Age International Publishers.
8. Instrumental methods of chemical analysis by Galen W. Ewing, McGraw – Hill Book Company.

**COURSE OUTCOME:**

- This course will give information regarding basic principles of different instruments.
- It will help students in operation of instruments. This will also help them while working in laboratory of post graduate courses and in industry.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-IV]**  
**US04CCHE03 (PRACTICAL CHEMISTRY)**  
**[03 Credits]**  
**Total Marks: 100 [Internal 30 + External 70]**

**1. BINARY ORGANIC MIXTURE:** [Solid + Solid or Solid + liquid i.e. (acetone, methyl acetate, ethanol, benzene, CCl<sub>4</sub>)].

**2. VOLUMETRIC TITRATION (By self preparation of solution of titrant):**

(1) Determination of equivalent weight of carboxylic acid by alkali solution.

(2) Determination of glucose.

(3) Determination of formaldehyde by sodium hypoiodide.

**3. GRAVIMETRIC ANALYSIS**

(1) ZnCO<sub>3</sub>

(2) BaCl<sub>2</sub>.2 H<sub>2</sub>O

**4. PREPARATION OF STANDARD SOLUTIONS**

**Reference Books:**

1. Vogel's Testbook of Quantitative Chemical Analysis, 5<sup>th</sup> Edition By G.H.Jeffery, J.Basset, J.Mendham, R.C.Denney.
2. Vogel's Testbook Of Qualitative Inorganic Analysis By G.Svehla
3. Practical Chemistry By O.P.Pandey, D.N.Bajpai & S.Giri
4. An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra & Nad

**COURSE OUTCOME :** This course is designed to learn separation and identification of two component organic substances, as well as volumetric/quantitative analysis. After studying this course student will be able to learn practical of semester V and VI viz. US05CCHE08 and US06CCHE08.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-V]**  
**(Effective from June-2012)**  
**US05CCHE01 (ORGANIC CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I HETEROCYCLIC COMPOUNDS** **[11 Hrs.]**

Heterocyclic systems, Structure of Pyrrole, furan and thiophene, Source of Pyrrole, furan and thiophene, Electrophilic substitution in Pyrrole, furan and thiophene Reactivity and orientation, Saturated five – membered heterocycle, Structure of pyridine, Sources of pyridine compounds, Reactions of pyridine, Electrophilic substitution in pyridine, Nucleophilic substitution in pyridine, Basicity of pyridine, Reduction of pyridine, Quinoline. The Skraup synthesis, Isoquinoline. The Bischler–Napieralski synthesis. Knorr pyrrole synthesis, Vilsmeier-Haack reaction, Feist-Benary synthesis, Structure of furan, Reactivity and orientation effect, Directing effect of substitution, Protonation.

**Reference Books:**

1. Organic Chemistry by Morrison and Boyd, 6<sup>th</sup> ed.
2. Heterocyclic chemistry vol. II by R. R. Gupta, M. Kumar and V. Gupta.

**UNIT: II** **[11 Hrs.]**

**[A] SPECTROSCOPY**

The infrared spectrum, Infrared spectra of hydrocarbons, Infrared spectra of alcohols, Infrared spectra of ethers, the nuclear magnetic resonance (NMR) spectrum. Number of signals, NMR positions of signals. Chemical shift, NMR peak area and proton counting, NMR Splitting of signals. Spin-spin coupling, NMR coupling constant,

**[B] Carbon – 13 NMR (CMR) spectroscopy**

CMR Splitting, CMR Chemical shift, NMR and CMR spectra of hydrocarbons, NMR and CMR spectra of alkyl halides, NMR and CMR spectra of alcohols and ethers, Spectroscopic analysis of aldehydes and ketones, Spectroscopic analysis of Carboxylic acids, Spectroscopic analysis of amines and substituted amides, Spectroscopic analysis of Carboxylic acid derivatives, Problems based on above spectroscopic technique.

**Reference Book:**

1. Organic Chemistry by Morrison and Boyd, 6<sup>th</sup> ed.

**UNIT: III DIENES AND MACROMOLECULES** **[11 Hrs.]**

Dienes: Structure and properties, Stability of conjugated dienes, Resonance in conjugated dienes, Hyperconjugation, Ease of formation of conjugated dienes, Electrophilic addition to conjugated diene : 1,4- addition, 1,2 Vs 1,4-addition, Rate Vs equilibrium, Free-radical polymerization of diene, Polymer and polymerization, Free radical vinyl polymerization, Co-polymerization, Ionic polymerization, Coordination, polymerization, Step reaction, polymerization, Structure and properties of macromolecules. Distinguishing features of addition and condensation polymerization Copolymer,

classification of polymers, plastics and resins, Phase system for polymerization (like bulk, solution, emulsion and suspension polymerization).

**Reference Books:**

1. Organic Chemistry by Morrison and Boyd, 6<sup>th</sup> ed.
2. Synthetic organic chemistry by Gurdeep R. Chatwal.

**UNIT: IV**

[12 Hrs.]

**[A] SYNTHETIC DETERGENT**

Introduction, Comparison of soap and detergents, Principle of cleansing action of detergents, Classification of detergents. Detergents Builders and additives, Synthesis and applications of following dyes from cheapest raw materials.  
(i) Miranol C2 M (ii) Tinopol RBX (iii) Igepon-T (iv) Sodium lauryl benzene

**[B] INSECTICIDE AND PERFUMES**

**Insecticides:**

Introduction to Insecticides, Classification of Insecticides, advantage of organophosphorous compounds, Synthesis and applications of DDT, BHC, Baygon, Malathion, Ferbum, Heptachlor.

**Perfumes:**

Introduction to Perfumes, Vehicle or solvents, Fixatives.  
Synthesis and application of Musk xylene, Coumarin, Vanilline, Heliotropian, Linalon.

**Reference Book:**

1. Synthetic Organic Chemistry by Gurdeep R. Chatwal

**COURSE OUTCOME** : This organic chemistry course is designed to learn use of spectroscopy (IR & NMR) for the identification of organic compounds, which will helpful students in study of M. Sc., research and industry.

It also includes application of organic chemistry in day to day life that is chemistry of polymer, detergents, and perfumes. Basic of heterocyclic chemistry is also included in this course. The content of this paper would be equally helpful for students to prepare for chemistry competitive examinations.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-V]**  
**US05CCHE02 (ORGANIC CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I REACTION MECHANISM**

**[11 Hrs.]**

Baeyer Villiger oxidation, Hofmann – Loeffler reaction, Mannich reaction, Curtius–Schmidt rearrangement, Benzilic acid rearrangement, Sommet rearrangement, Birch reduction, Favorskii rearrangement, Benzoin condensation, Beckmann rearrangement, Wittig reaction, Perkin reaction.

**Reference Books:**

1. Reaction mechanism in Organic Chemistry by S. M. Mukherji.
2. Organic reaction mechanism by R.K. Bansal, 3<sup>rd</sup> ed.
3. Org. Chem., Vol II, by I.L. Finar.
4. Principles of Org. synthesis, by ROC Norman.
5. Reaction mechanism in Organic Chemistry S. M. Mukherji and S. P. Singh.

**UNIT: II DRUG**

**[12 Hrs.]**

Introduction, Classification of drugs. Introduction and classification of following selected class of drugs. Hypnotics, sedative and anticonvulsants, Histamine and antihistaminic agents, Hematological agents, Antipyretic and analgesics, Mode of action of antipyretic drug. Anthelmintics Antimalarial, Antiseptic, Sulphanilamides, Mechanism of action of sulphadiazine. Antitubercular and antileprosy drugs.

Synthesis and uses of following drugs (i) Nirvanol (ii) Thiobarbitone (iii) Phenobarbitone (iv) Dimenhydrinate (v) Chlorcyclizine hydrochloride (vi) Novalgin (vii) Phenylbutazone (viii) Hetrazan (ix) Miracil-D (x) Chloroquine (xi) Primaquine (xii) Vioform, (xiii) Sulphamethazine, (xiv) Sulphafurazole (xv) Marfanil (xvi) PAS (xvii) Acedapsone (xviii) Warfarin (xix) Chlorpheniramine Meleate.

**Reference Books:**

1. Synthetic Drugs 6<sup>th</sup> ed. by Gurdeep R. Chatwal.
2. Medicinal chemistry 3<sup>rd</sup> ed. by Ashutosh Kar.

**UNIT: III TERPENOIDS**

**[11 Hrs.]**

General introduction including nomenclature, General properties of terpenoids, Isolation, Isoprene rule, Classification of terpenoids, General methods for the determination of structure of terpenoids. Introduction, isolation and constitution of Citral,  $\alpha$ -terpineol, Geraniol, Nerol, Linalool.

**Reference Book:**

1. Organic chemistry of natural products by Gurdeep Chatwal, Vol. II.



**UNIT: IV****[11 Hrs.]****[A] HORMONES**

Introduction, including difference between Hormones and Vitamins, Sex hormones. Introduction, constitution and Hughes's *et al* synthesis of Oestrone, Introduction, constitution and synthesis of Testosterone. Adrenaocortical hormones.

**[B]  $\alpha$ ,  $\beta$ -UNSATURATED CARBONYL COMPOUNDS**

Structure and properties, Preparation, Interaction of functional group, Electrophilic addition, Nucleophilic addition, Comparison of nucleophilic and electrophilic addition Michael addition, Synthesis of acids and esters via 2-oxazolines.

**Reference Book:**

1. Organic chemistry of natural products by Gurdeep Chatwal, Vol. II. 5<sup>th</sup> Edition.

**COURSE OUTCOME** : This organic chemistry course is designed to learn use of reaction mechanism, which is an important part of organic chemistry for the research and Industry. Using reaction mechanism one can understand reaction rout and type of reaction.

It also includes application of organic chemistry in hormones, terpenoids and drugs.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-V]**  
**US05CCHE03 (INORGANIC CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I SYMMETRY**

**[11 Hrs.]**

Introduction, Various types of symmetry elements, Point groups, Properties of point groups, To determine the point group of a molecule, Representations of groups, The character, Some important theorems concerning the irreducible representations and their characters, Character table for point groups  $C_{2v}$  and  $C_{3v}$ .

**Reference Book:**

1. Introductory Quantum Chemistry- 4<sup>th</sup> Edition By A K Chandra

**UNIT: II INTRODUCTION TO THE TRANSITION ELEMENTS: LIGAND FIELD THEORY**

**[11 Hrs.]**

Introduction, Ligand field theory, The crystal field approach, The molecular orbital approach, Magnetic properties of transition metal complexes, Electronic absorption spectroscopy, Some generalizations concerning ligand field splitting and spectra, Structural and thermodynamic effects of d-orbital splitting.

**Reference Book:**

1. Basic Inorganic Chemistry- 3<sup>rd</sup> Edition By F. Albert Cotton, Geoffrey Wilkinson & Paul L. Gaus

**UNIT: III WAVE MECHANICS**

**[11 Hrs.]**

Wave equation, Interpretation of  $\Psi$  and Heisenberg's uncertainty principle, Properties of  $\Psi$ , Operators, Second postulate of quantum mechanics, Setting up of operators for different observable, Third postulate of quantum mechanics, Fourth postulate of quantum mechanics, One dimensional box, Normalization and orthogonality, Characteristics of the wave functions, Three-dimensional box, Electron in a ring.

**Reference Book:**

1. Introductory Quantum Chemistry- 4<sup>th</sup> Edition By A K Chandra

**UNIT: IV THERMODYNAMIC AND KINETIC ASPECTS OF METAL COMPLEXES**

**[12 Hrs.]**

**[A] STABILITY OF COMPLEXES IN AQUEOUS SOLUTION:**

Definition of stability, stepwise formation of complexes, Stepwise formation and overall formation constants, kinetic vs. thermodynamic stability, labile and inert octahedral complexes according to CFT, factors affecting on the stability of complexes, experimental determination of stability constant and composition of a complex (spectrophotometric method, Job's method of continuous variation, Potentiometric Bjerrum method).

**[B] LIGAND SUBSTITUTION REACTIONS IN OCTAHEDRAL COMPLEXES:**

Transition state or activated complex, Types of substitution reactions, Labile and inert complexes, Acid hydrolysis reactions, Base hydrolysis reactions of six-coordinated Co (III) ammine complexes, Anation reactions, Substitution reactions without breaking metal ligand bond.

**[C] LIGAND SUBSTITUTION REACTION IN SQUARE-PLANAR COMPLEXES:**

The trans effect, Theories of trans effect, mechanism of substitution reactions, Factors affecting the rates of substitution reaction in square planar complexes.

**Reference Book:**

1. Selected Topics in Inorganic Chemistry – 7<sup>th</sup> Edition, Wahid U Malik, G.D.Tuli, R.D.Madan

**COURSE OUTCOME** : This syllabus is helpful to the students to understand the quantum chemistry, bonding and hybridization of different compounds, geometry of

molecules and periodic properties like ionization energy, electron affinity and electronegativity of different elements.

It will be also helpful to the students in teaching, for the further study in higher studies as well as various chemical industries to carry out different kinds of titrations, separation techniques and inorganic synthesis.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-V]**  
**US05CCHE04 (INORGANIC CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I**

**[11 Hrs.]**

**[A] ACIDS & BASES**

Arrhenius Concept, Lowry-Bronsted Acid-Base Concept, Solvent System Concept, Usanovich Concept, Luxflood Concept, Lewis Acid-Base Concept, Classification of Lewis Acids and Bases, Pearson's Soft and Hard Acid-Base Principle (HSAB), Applications of HSAB Principle, Leveling Effect, Strength of Hydraacids, Strength of Inorganic Oxyacids.

**[B] NON-AQUEOUS SOLVENTS**

Classification of Solvents, General Properties of Ionizing Solvents, Liquid NH<sub>3</sub> as Nonaqueous Solvent, Cavity Model, Alkali Metals in Liquid NH<sub>3</sub>, Merits and Demerits of Liquid NH<sub>3</sub> as Solvent, Liquid SO<sub>2</sub> as a Solvent, Liquid Hydrogen Fluoride.

**Reference Book:**

1. Selected Topic in Inorganic Chemistry, Wahid U. Malik, G. D. Tuli and R. D. Madan

**UNIT: II**

**[11 Hrs.]**

**[A] CARBIDES OF MAIN GROUP ELEMENTS:**

General method of preparation, General properties, Ionic Carbides, Acetylides, Methanides, Allylides, Interstitial or metallic carbides, Borderline carbides, Covalent Carbides, Calcium carbide [CaC<sub>2</sub>], Boron Carbide [B<sub>4</sub>C], Aluminium Carbide [Al<sub>4</sub>C<sub>3</sub>], Silicon Carbide or Silicon Silicide [SiC].

**[B] WATER AND HYDROGEN PEROXIDE:**

Water and It's Properties, Hard and Soft Water, Potable Water, Heavy Water, Hydrogen Peroxide, Strength of Hydrogen Peroxide Solution, Properties of Hydrogen Peroxide, Uses, Tests, Estimation of H<sub>2</sub>O<sub>2</sub>, Constitution of Hydrogen Peroxide, H<sub>2</sub>O<sub>2</sub> as Propellant.

**Reference Books:**

1. Advanced Inorganic Chemistry Volume I- 18<sup>th</sup> By Satya Prakash, G.D.Tuli, S.K.Basu, R.D.Madan
2. Text Book of Inorganic Chemistry (20th Edition), P.L.Soni & Mohan Katyal.

**UNIT: III GLASS & CERAMIC INDUSTRY**

**[11 Hrs.]**

**[A] GLASS:** Introduction, physical properties of glass, Chemical properties of glass, characteristics of glass, Raw materials, Chemical reactions, Methods of manufacture, Formation of batch material, Melting, Chemical reactions in the furnace, Shaping or forming, Forcault process of shaping sheet or window glass, Shaping of plate glass, Annealing, Finishing, Classification of glass making furnaces, Methods of division of the tank and flame space, Devices for recovery of heat of waste gases, Electric and flame electric furnaces, Flame electric furnaces, Auxiliary furnaces, Some special glasses.

**[B] CERAMICS:** What are ceramics, Subdivision of ceramics, General properties of ceramics, Permeable and impermeable wares, Distinction between permeable and impermeable wares, Classification based on reduction in porosity, Basic raw materials, Other ingredients, Manufacturing process, Grinding of raw material, Mixing or preparation of bodies, Body preparation using clay in plastic form, Body preparation using dry clay, Body preparation using clay slip, Filtering, Kneading, Jollying, Slit casting, Pressing, Extrusion, turning, Drying, Types of driers, Firing, Glazing, Frits, Decoration, Application of colors to the pottery, Porcelain and china, Raw materials, Manufacture, Earthenware and stone wares, Important points.

**Reference Book:**

1. Industrial Chemistry- 9<sup>th</sup> by B. K. Sharma

**UNIT: IV INORGANIC POLYMERS**

**[12 Hrs.]**

Introduction, Classification of inorganic polymers, General properties of inorganic polymers, Polymers containing boron: Preparation properties and structure of borazine and substituted borazines, boron nitrites

**Polymers containing silicon:** Preparation properties and structure of silicones, silicone resins, silicon fluids or oils, silicon rubbers, silicon greases

**Polymers containing phosphorous:** Preparation properties and structure of polyphosphonitrilic chlorides, Vitreous polyphosphates

**Polymers containing sulfur:** Preparation properties and structure of nitrides of sulfur, thiazyl halides, imides of sulphur.

**Reference Book:**

1. Advanced Inorganic Chemistry Volume I- 18<sup>th</sup> By Satya Prakash, G.D.Tuli, S.K.Basu, R.D.Madan

**COURSE OUTCOME :** This syllabus is helpful to the students to understand the acid-base and non aqueous solvents, carbide of main group elements, water and hydrogen peroxide, glass & ceramics and inorganic polymers.

It will be also helpful to the students in teaching, for the further study in higher studies as well as various chemical industries to study solvent properties, glass and ceramics characteristics and thorough knowledge of inorganic polymers.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-VI]**  
**US05CCHE05 (PHYSICAL CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I PHOTOCHEMISTRY**

**[11 Hrs.]**

Introduction, Types of chemical reactions, Difference between Dark and Photochemical reaction, Absorption of light, Laws of photochemistry, Quantum yield ( or ) Quantum efficiency, Deviation in the law of photochemical, Equivalence, Reasons of high and low quantum yield, Factors affecting quantum yield, Luminescence, Fluorescence and Phosphorescence, Numericals.

**Reference Book:**

1. Advanced Physical Chemistry by Gurdeep Raj.

**UNIT: II X-Ray DIFFRACTION**

**[11 Hrs.]**

Crystal shapes and point groups, Lattice and Unit cells, Miller Indices, X-ray diffraction, Diffraction by crystal, Single Crystal Diffraction, Powder Crystal Method, X-ray diffraction and Unit cells, Dimensions and the contents of the unit cell, Ionic radii, Covalent radii, Van der Wall's radii, Lattice energies in ionic crystals, Numericals.

**Reference Books:**

1. Physical Chemistry by G.M.Barrow.
2. Solid state chemistry and its application by Anthony R.West.

**UNIT: III MACROMOLECULES-I**

**[11 Hrs.]**

Introduction, Classification of polymers, Nomenclature of polymers, Isomerism of polymers, **Chain growth polymerization** – Introduction, Mechanism of free-radical, Cationic and Anionic polymerization, Kinetics of free radical, Cationic and Anionic polymerization, Mechanism and Kinetics polycondensation, Numericals.

**UNIT: IV MACROMOLECULES-II**

**[12 Hrs.]**

Polymerization Techniques, Concept of Averages-Number average molecular weight, Weight average molecular weight, Viscosity average molecular weight, Molecular weight and Degree of polymerization, Poly dispersity and molecular weight distribution, Methods for determination of molecular weight, Membrane Osmometry, Vapour Phase Osmometry, Viscometry, Light Scattering, Numericals.

**Reference Books:**

1. Principles of polymers Science by P.Bahadur and N.V.Sastry. (Second Edition )
2. Polymer Science by V.R.Gowariker, N.V.Vashwanathan and Jaydev Shreedhar.

**COURSE OUTCOME :** This paper targets photochemistry, X-ray diffraction studies and Macromolecules. These topics have great importance in theoretical as well as practical chemistry. The topics covered in this paper are niftily designed so that students can achieve thorough knowledge and can compete in various examinations related to chemistry.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-V]**  
**US05CCHE06 (PHYSICAL CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I PHASE EQUILLIBRIA**

**[11 Hrs.]**

Phase, Component, Degree of freedom, The Gibb's phase rule, Derivation of phase rule, One component system, Water system, Sulfur system, Two component system, Simple eutectic system, Lead silver system, System in which two component forms a stable compound, Numericals.

**Reference Book:**

1. Principles of Physical Chemistry (44 Edition ) By Puri ,Sharma , Pathania

**UNIT: II SURFACE PHENOMENON AND ADSORPTION**

**[11 Hrs.]**

Introduction, Factor on which adsorption depend, Kind of adsorption, Characteristic of physical and chemical adsorption, Type of adsorption curves, Type of experimental physical adsorption isotherm, Freundlich equation of adsorption isotherm, Langmuir equation of adsorption, B.E.T. equation, Application of adsorption.

**Reference Book:**

1. Advance Physical Chemistry 2<sup>nd</sup> Edition By D.N.Bajpeyee

**UNIT: III GAS CHROMATOGRAPHY**

**[11 Hrs.]**

Introduction, Technique of Gas Liquid Chromatography, Apparatus of Gas Liquid Chromatography ( Carrier Gas, Injection Port, Columns, The solid inert support, The stationary liquid phase), Detectors, Thermal Conductivity Detectors, Flame Ionization Detectors, Electron Capture Detectors, Separation Procedure, Theory and principle of Gas Liquid Chromatography, Factors affecting Separation, Miscellaneous Applications.

**Reference Book:**

1. Instrumental methods of Chemical Analysis by B.K.Sharma

**UNIT: IV POLAROGRAPHY**

**[12 Hrs.]**

Introduction, Principle, Appratus, Working, Brief description of polarographic measurements, Current voltage relationship, Polarogram, Interpretation of polarographic wave, Equation for polarographic waves, Half wave potential, Reversible & Irreversible wave, Explanation of polarographic wave, Different kinds of current contribution of polarographic wave (The charging current, the migration current, the diffusion current), The DME advantage and disadvantage, The capillary and it's care, Removal of oxygen, Quantitative analysis, Numericals.

**Reference Book:**

1. Instrumental methods of Chemical Analysis by B.K.Sharma

**COURSE OUTCOME :** This paper targets phase equilibria, surface phenomenon, adsorption, GC and polarography. These topics have great importance in applied chemistry to understand physical properties of molecules or material. The topics covered in this paper are niftily perfectly designed so that they can achieve great

exposure about these topics. The paper will be helpful for them in industry as well as research.



**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-V]**  
**US05CCHE07**  
**(PHYSICAL CHEMISTRY PRACTICAL)**  
**[03 Credits]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Applications of pH metry**

1. To **determine Molarity** of strong / weak acid by titrating against 0.1 M NaOH solution.
2. The **Dissociation Constant** of weak monobasic acids like HAC, Formic acid, Benzoic acid by titrating against 0.1 M NaOH solution.
3. To **determine Molarity** of each acid present in a **Mixture** of strong acid and weak acid.

**Applications of Potentiometry**

4. To **determine Molarity** of strong / weak acid by titrating against 0.1 M NaOH solution.
5. The **Dissociation Constant** of weak monobasic acids like HAC, Formic acid, Benzoic acid by titrating against 0.1 M NaOH solution.
6. To **determine Molarity** of each acid present in a **Mixture** of strong acid and weak acid.
7. To **determine the concentration** of Silver Nitrate solution by titrating against 0.1 M NaCl / KCl solution.
8. To **determine Solubility and Solubility product** of sparingly soluble salt AgCl.

**Applications of Conductometry**

9. To **determine Molarity** of strong / weak acid by titrating against 0.1 M NaOH solution.
10. To **determine Molarity** of each acid present in a **Mixture** of strong acid and weak acid.
11. To **determine the concentration** of Silver Nitrate solution by titrating against 0.1 M NaCl / KCl solution.
12. To **determine Cell Constant** of a given conductivity cell and solubility and solubility product of sparingly soluble salt ( CaSO<sub>4</sub>, PbSO<sub>4</sub> )

**VIVA VOCE**

**Reference books:**

1. Experimental Physical Chemistry by R.C.Das & B.Behera
2. Advanced Practical Physical Chemistry by J.B.Yadav

**COURSE OUTCOME :** This practical course is designed to learn basic instrumental techniques like pH metry, potentiometry and conductometry. After completion of this paper they will be able to determine concentration of various solution using instruments. So this study will be helpful to them in masters and industries.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-V]**  
**US05CCHE08**  
**(ORGANIC CHEMISTRY PRACTICAL)**  
**[03 Credits]**  
**Total Marks: 100 [Internal 30 + External 70]**

**1. SEPARATION AND IDENTIFICATION OF THREE COMPONENT ORGANIC MIXTURE**

Benzoic acid, salicylic acid, cinnamic acid, phthalic acid,  $\alpha$ -naphthol,  $\beta$ -naphthol, Nitrobenzene, o-, m-, & p-nitroaniline, acetophenone, p-dichlorobenzene, naphthalene, anthracene, benzamide, acetanilide, m-dinitrobenzene, Methylethylketon, xylene, ethyl acetate, methyl acetate, acetone, aniline, methyl alcohol, ethyl alcohol, benzaldehyde, toluene, chloroform, chlorobenzene, N,N-dimethylaniline.

**2. VIVA VOCE**

**Reference books:**

1. Comprehensive practical organic chemistry  
Preparation and qualitative analysis by V.K.Ahuwalia and Renu Aggarwal.
2. Qualitative Analysis by Vogel

**COURSE OUTCOME :** This practical course is designed to learn separation and identification of three component organic substances. After studying this course student will be able to learn separation of product from the crude product. It will be beneficial in their higher studies M. Sc and Ph.D. as well as in R & D section of Industry.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-V]**  
**US05CCHE09**  
**(INORGANIC CHEMISTRY PRACTICAL)**  
**[03 Credits]**  
**Total Marks: 100 [Internal 30 + External 70]**

**GRAVIMETRIC ANALYSIS**

1. Al as  $\text{Al}_2\text{O}_3$
2. Fe as  $\text{Fe}_2\text{O}_3$
3. Ba as  $\text{BaSO}_4$
4. Ni as  $\text{Ni}(\text{DMG})_2$
5. Cr as  $\text{Cr}_2\text{O}_3$
6. Zn as  $\text{Zn}_2\text{P}_2\text{O}_7$
7. Mn as  $\text{Mn}_2\text{P}_2\text{O}_7$

**VOLUMETRIC ANALYSIS**

1.  $\text{Pb}^{+2}$  by EDTA
2.  $\text{Bi}^{+3}$  by EDTA
3.  $\text{Ca}^{+2}$  by EDTA

**VIVA VOCE**

**Reference Books:**

1. Vogel's Testbook of Quantitative Chemical Analysis, 5<sup>th</sup> Edition By G.H.Jeffery, J.Basset, J.Mendham, R.C.Denney.
2. Vogel's Testbook Of Qualitative Inorganic Analysis By G.Svehla
3. Practical Chemistry By O.P.Pandey, D.N.Bajpai & S.Giri
4. An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra & Nad

**COURSE OUTCOME :** This practical course is in conjunction with previous practical where they learned qualitative analysis whereas here they perform quantitative analysis using gravimetric and volumetric methods. It will be beneficial in their higher studies M. Sc and Ph.D.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-VI]**  
**US06CCHE01 (ORGANIC CHEMISTRY)**  
**[03 Credits] [Total Unit IV] (Effective from June-2012)**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I** **[11 Hrs.]**

**[A] CARBOHYDRATES-I**

Introduction of monosaccharides, Definition and Classification, (+)-Glucose: an aldohexose, (-)-Fructose: 2-ketohexose, Stereo isomers of (+)-glucose, Oxidation Effect of alkali, Osazone formation Epimers, Kiliani-Fischer synthesis, Ruff degradation, Conversion of an aldose into its epimers, The Fischer proof, Configuration of aldose, Optical families D and L-Tartaric acid, Families of aldose, Absolute configuration, Cyclic structure of D-(+)-glucose, Configuration about C-1, Methylation, Determination of ring size, Conformation.

**[B] CARBOHYDRATE-II DISACCHARIDES AND POLYSACCHARIDES**

Disaccharides, (+)-Maltose, (+)-Cellobiose, (+)-Lactose, (+)-Sucrose, Cyclodextrine, Structure of cellulose, Reaction of cellulose,

**Reference Book:**

1. Organic Chemistry by Morrison and Boyd, 6<sup>th</sup> ed.

**UNIT: II POLYNUCLEAR AROMATIC COMPOUNDS** **[11 Hrs.]**

Fused ring aromatic compounds, Nomenclature of naphthalene derivatives, Structure of naphthalene, Reactions of naphthalene, Oxidation of naphthalene, Reduction of naphthalene, Dehydrogenation of hydroaromatic compounds. Aromatization, Nitration and halogenation of naphthalene, Orientation of electrophilic substitution in naphthalene, Friedal-Craft acylation of naphthalene, Sulphonation of naphthalene, Naphthols, Orientation of electrophilic substitution in naphthalene derivatives, Synthesis of naphthalene derivatives by ring closure (Haworth method). Structure of Naphthalene, Nomenclature of anthracene and phenanthrene derivatives, Structure of anthracene and phenanthrene, Reactions of anthracene and phenanthrene, Preparation of anthracene derivative by ring closure. Anthraquinone, Preparation of phenanthrene derivative by ring closure, Carcinogenic hydrocarbon. Arene oxides,

**UNIT: III ORBITAL SYMMETRY AND PERICYCLIC REACTIONS** **[11 Hrs.]**

Introduction to pericyclic reaction, Characteristics of pericyclic reaction, Molecular orbitals, LCAO method, Bonding and anti-bonding orbitals, Electronic configuration of some molecules, Aromatic character. The Huckel (4n+2) rule, Orbital symmetry and the chemical reaction, Electrocyclic reaction, Cycloaddition reaction, Sigmatropic reaction, Cope rearrangement.

**UNIT: IV DYES AND PIGMENT** **[12 Hrs.]**

Introduction, Textile fiber or type of fiber, Dyeing, Fastness properties, Bathochromic and hypsochromic effect, Colour and constitutions, Relation between colour and constitutions

including (Witt's theory only), Modern theories of colour and constitution, Pigments, Fluorescent Brightening agents, Non-textile use of Dyestuff, Detail consideration about food colorants and medicinal Dyes. Synthesis and applications of following dyes from cheapest raw materials. Direct Yellow 12, Auramine O, New Magenta, Disperse Orange 13, Disperse Blue 1, Mercurochrome, Safranine T, Astrazon Pink FG, Caledon Jade Green, Tartrazine, Procion Brilliant M5B, Hansa Yellow, Ciba Blue 2B, Crystal Violet, C.I. Disperse Blue

**Reference Books:**

1. Reaction mechanism in Organic Chemistry by S. M. Mukherji.
2. Other topics from Organic reaction mechanism by R.K. Bansal, 3<sup>rd</sup> ed.

**Books Recommended for Further Reading:**

1. Hand book of synthetic Dyes and Pigments, Vol.I and II, Synthetic Dyes, By K. M. Shah).
2. A text book of organic chemistry by Arun Bahl and B. S. Bahl (16<sup>th</sup> ed.).
3. Reaction mechanism in organic chemistry by S.M.Mukherji and S.P.Singh
4. Organic chemistry by S.M.Mukherji, S.P.Singh and R.P.Kapoor., vol. II.
- 5.

**COURSE OUTCOME** : This course is designed to learn topics like carbohydrates, dyes and pigments, polynuclear hydrocarbons, orbital symmetry and pericyclic reactions. Study of such topic will be beneficial to the students in research and industry and in day to day life.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-VI]**  
**US06CCHE02 (ORGANIC CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I AMINO ACIDS AND PROTEINS**

**[11 Hrs.]**

Proteins, Structure of amino acids, Amino acids as dipolar ions, Isoelectric point of amino acids, Configuration of natural amino acids, Preparation of amino acids, Peptides. Geometry of the peptide linkage, Determination of structure of peptide. Terminal residue analysis. Partial hydrolysis. Synthesis of peptides, Proteins. Classification and function. Denaturation, Structure of proteins, Peptide chain, Side chain. Isoelectric point. Electrophoresis, Conjugated proteins. Prosthetic group. Enzyme (definition), Coenzymes, Secondary structure of protein, Mechanism of enzyme action. Chymotrypsin, Nucleoproteins and nucleic acids.

**Reference Book:**

1. Organic chemistry, 6<sup>th</sup> Ed., By Morrison and Boyd.

**UNIT: II PURINES AND NUCLEIC ACIDS**

**[11 Hrs.]**

Introduction, Uric acid, Purine derivatives, Xanthine bases, Nucleic acids, Structure of nucleosides, structure of nucleotides, Ribonucleic acids, Deoxyribonucleic acids, Chemical and enzyme synthesis of the polynucleotides.

**Reference Books:**

1. Org. Chem., Vol II, by I.L. Finar.
2. Organic chemistry by A. Bahal & B. S. Bahal, 16<sup>th</sup> Ed.

**UNIT: III ALKALOIDS**

**[11 Hrs.]**

Introduction, function, classification, isolation and properties of alkaloids. General methods employed for determining the structure of alkaloids. Introduction, isolation, physiological action, properties, extraction, constitution and synthesis of Adrenaline, Nicotine, Papaverine. Introduction, isolation and constitution of Quinine.

**Reference Book:**

1. Organic chemistry of natural products by Gurdeep R. Chatwal, Vol. I.

**UNIT: IV ORGANIC PHOTOCHEMISTRY**

**[12 Hrs.]**

Principles of photochemistry. Photochemical energy. Electronic excitation, excited states, modes of dissipation of energy (Jablonski diagram). Energy transfer and photosensitization. Photochemistry of carbonyl compounds. Photoreduction. Norrish type -I and -II reactions. Photochemical reactions of cyclic ketones. Paterno-Buchi reaction. Photochemistry of  $\alpha$ ,  $\beta$ -unsaturated ketones. Photochemistry of olefins. Cis-trans isomerification. Dimerization reactions. Photo-Fries rearrangement. Barton reaction.

**Reference Books:**

1. Organic Reaction Mechanism by S.M. Mukerji.
2. Organic Reaction Mechanism by R.K. Bansal.
3. Organic Chemistry by R.O.C. Norman.

**COURSE OUTCOME** : This organic chemistry course is designed to learn topics of bioorganic chemistry like amino acids and proteins, alkaloids, purins and nucleic acids. It also describes about organic photochemistry. Study of such topic will be beneficial to the students in research and industry.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-VI]**  
**US06CCHE03 (INORGANIC CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lectures**

**UNIT: I ORGANO METALLIC CHEMISTRY**

**[11 Hrs.]**

Introduction, General methods of preparations, General properties, Organo metallic compounds of alkali metals, Organo metallic compounds of beryllium, magnesium and aluminum, metal olefin complexes, Cyclopentadienyl complexes: metallocenes, Some properties of ferrocene, Structure and bonding in ferrocene molecule, Ionic cyclopentadienyl compounds.

**Reference Book:**

1. Advanced Inorganic Chemistry Volume II- 18<sup>th</sup> By Satya Prakash, G.D.Tuli, S.K.Basu, R.D.Madan

**UNIT: II BIOINORGANIC CHEMISTRY**

**[11 Hrs.]**

Introduction, The role of model systems, The alkali and alkaline earth metals, Metalloporphyrins, Iron-sulfur proteins, Hemerythrin, Oxygen supply and transport, The bioinorganic chemistry of cobalt: Vitamin B<sub>12</sub>, Metalloenzymes, Nitrogen fixation.

**Reference Book:**

1. Basic Inorganic Chemistry- 3<sup>rd</sup> Edition By F.Albert Cotton, Geoffery Wilkinson & Paul L. Gaus

**UNIT: III CATALYSIS**

**[11 Hrs.]**

General Principles, the language of catalysis, homogeneous and heterogeneous catalysis, Homogeneous catalysis: hydrogenation of alkenes, hydroformylation, methanol carbonylation, Wacker oxidation of alkenes, alkene metathesis, Palladium catalysed C-C bond forming reactions, asymmetric oxidations.

Heterogeneous catalysis: the nature of heterogeneous catalysis, hydrogenation of alkenes, ammonia synthesis, sulfur dioxide oxidation, interconversion of aromatics by zeolites, Fisher and Tropsh synthesis, alkene polymerization, electrocatalysis.

**Reference Book:**

1. Inorganic Chemistry, 4<sup>th</sup> Edition By Shriver & Atkins

**UNIT: IV PRINCIPLES OF METALLURGY AND CHEMISTRY OF Pb, Fe, Ni, Cu & Ag**

**[12 Hrs.]**

Metals, Occurrence of metals, Mineral wealth of India, Metallurgy, Concentration of ore, Calcination and roasting, Standard electrode potentials and metallurgy, thermodynamics of metallurgy, Reducing behavior of carbon, Reduction of mineral to metal, Refining of metals, Physical methods of refining, Chemical methods of refining, Types of furnaces used.

**Pb:** Occurrence & extraction, Properties & uses of lead, White lead.

**Fe:** Occurrence and commercial forms of iron, Manufacture of cast iron, wrought iron, steel.

**Ni:** Occurrence & extraction, Properties and uses of nickel.

**Cu:** Occurrence & extraction, Electrolytic refining of copper, Properties and uses of copper.

**Ag:** Occurrence & extraction, Properties and uses of silver, Preparation, properties and uses of silver nitrate, Silvering of mirrors.

**Reference Book:**

1. Textbook of Inorganic Chemistry- 20<sup>th</sup> Edition By P.L.Soni & Mohan Katyal



**COURSE OUTCOMES** : This syllabus contributes the different topics like Organometallic compounds, Bio-inorganic Chemistry, Catalysis and Metallurgy. Study of such topic will be helpful to the students for their further study in M.Sc. with chemistry subject. It is also helpful to the students in various industries to carry out analysis of different metals, synthesis of bio-inorganic compounds, catalysts used in different synthesis and chemical reactions and some extraction of metals from different ores.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-VI]**  
**US06CCHE04 (INORGANIC CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I PASSIVITY & CORROSION**

**[11 Hrs.]**

Introduction to passivity, Alternative definition of passivity, Theories of passivity, Is passivity universal phenomenon?, Applications of passivity, Electrochemical passivity, Mechanical passivity, Introduction to corrosion, Economic aspects of corrosion, Types of corrosion, Corrosion by gaseous environment, Immersed corrosion, Prevention from corrosion.

**Reference Book:**

1. Advanced Inorganic Chemistry Vol-1, 23<sup>rd</sup> By Gurdeep Raj

**UNIT: II ALLOY AND INTER-METALLIC COMPOUNDS**

**[11 Hrs.]**

Introduction, Effects of alloying, Properties of alloys, Preparation of alloys, Types of alloys: simple mixtures, solid solutions, substitutional alloys, intermetallic compounds, Super structures, electron compounds, Tamman's rule, Hume-Rothery rule, Succession of Hume-Rothery phases, Hume-Rothery's ratio rule, Rules for formation of alloys, Ferrous and non-ferrous alloys.

**Reference Book:**

1. Advanced Inorganic Chemistry Volume I- 18<sup>th</sup> By Gurudeep Raj

**UNIT: III INTER HALOGEN COMPOUNDS**

**[11 Hrs.]**

Inter halogen compounds, Introduction, Preparations, properties, structure, geometry and uses of Inter halogen compounds of type XY: iodine monochloride, chlorine monofluoride, iodine monobromide, Preparations, properties, structure and geometry of Inter halogen compounds of type XY<sub>3</sub>: chlorine trifluoride, iodine trichloride, bromine trifluoride, Preparations, properties, structure and geometry of Inter halogen compounds of type XY<sub>5</sub>: Chlorine pentafluoride, iodine pentafluoride, Preparations, properties, structure and geometry of Inter halogen compounds of type XY<sub>7</sub>: Iodine heptafluoride, Structure of interhalogen compounds, Polyhalide ions and Polyhalides.

**Reference Book:**

1. Advanced Inorganic Chemistry Volume I- 18<sup>th</sup> By Satya Prakash, G.D.Tuli, S.K.Basu, R.D.Madan

**UNIT: IV HEAVY CHEMICALS**

**[12 Hrs.]**

**Sodium hydroxide**

Manufacture: Causticising process, electrolytic process (Nelson cell, Castner-Kellner cell, Kellner-Solvay cell), Properties and uses NaOH.

**Nitric acid**

Preparation of nitric acid in laboratory, Manufacture of nitric acid from nitre, from air (Birkland and Eyde process), from ammonia (Ostwald's process), Concentration of nitric acid, Properties and uses of nitric acid.

**Sulphuric acid**

Manufacture: Lead chamber process, principal impurities present in the chamber acid and their removal, Concentration of chamber acid, Cascade process, Gaillard tower, Contact process, Properties and uses of sulphuric acid.

**Reference Book:**

1. Textbook of Inorganic Chemistry- 20<sup>th</sup> by P. L. Soni & Mohan Katyal

**COURSE OUTCOME :** This paper contains theoretical aspects of passivity and corrosion, alloys, inter halogen compounds and heavy metals. This paper helps them to build up their knowledge of materials and their properties that will be helpful to them in industrial encounters.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-V]**  
**US06CCHE05 (PHYSICAL CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I VIBRATIONAL AND ROTATIONAL SPECTROSCOPY [11 Hrs.]**

Introduction, Molecular spectra, Origin of Infra red spectra, Rotational (or) Microwave spectrum, Classification of molecules, Rigid rotor model, Selection Rule, Effect of isotopic substitution on the transition frequencies, Refractive intensities of spectral line, Vibrational rotational Spectra, Harmonic oscillator model, Force constant, Normal modes of vibrations of atoms in polyatomic molecules, Vibrational Coupling, Numericals.

**Reference Book:**

1. Instrumental Methods of chemical Analysis by B.K.Sharma. 26<sup>th</sup> Edition

**UNIT: II PHYSICAL PROPERTIES AND CHEMICAL CONSTITUTION [11 Hrs.]**

Introduction, Refractive Index, Optical Activity & Chemical constitution, Electrical properties elucidating the molecular structure, Dipole moments, Electrical polarization of molecules, Dipole moments and dielectric constant, Dielectric polarization and dielectric constant, Clausius-mosotti equation, Determination of dipolemoments, vapour-temperature method, Dilute solution method, Bond moments and molecular dipole moments, Dipole moments and structure of molecules, Numericals.

**Reference Book:**

1. Text book of physical Chemistry by P.L.Soni, O.P.Dharmarha, U.N. Dash.

**UNIT: III ENTROPY AND THIRD LAW OF THERMODYNAMICS [11 Hrs.]**

Third law of thermodynamics, Molecular basis of Entropy, Translational Entropy, Rotational Entropy, Vibrational Entropy, Molecular basis of the third law, Trouton's Rule, Free-Energy, Standard free energy of formation, Free energy and Pressure, Free energy and the equilibrium constant, Free energy and Temperature, Free energy function, Equilibria and Distributions, Fugacity, Numericals.

**Reference Book:**

1. Physical Chemistry by Gordan M. Barrow. 5<sup>th</sup> Edition.

**UNIT: IV COLLOIDAL STATE [12 Hrs.]**

Types of Colloidal system, Classifications of Colloids, Lyophobic and Lyophilic Sols, Size range, Preparation and Properties of colloids solution, Dialysis, Electrodialysis, Ultrafiltration, Ultramicroscope, Electrical Properties, Charge on colloidal particles, Zeta potential, Coagulation of Colloidal solution, Flocculation values, Electrophoresis, Electrosmosis, Importance and Applications of Colloids, Numericals.

**Reference Book:**

1. Principles of physical chemistry by puri, sharma and pathania. 44<sup>th</sup> Edition.

**COURSE OUTCOME** : This paper contains theoretical aspects of rotational and vibrational spectroscopy, physical properties and chemical composition, entropy and thermodynamics and colloidal state. This paper helps them to build up their knowledge of some very important topics of chemistry that will be helpful to them in further studies.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-VI]**  
**US06CCHE06 (PHYSICAL CHEMISTRY)**  
**[03 Credits] [Total Unit IV]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Total 45 lecturers**

**UNIT: I CHEMICAL KINETICS**

**[11 Hrs.]**

Mechanism of Complex reaction, The equilibrium approximation, Steady state approximation, Collision and Encounters, Effect of temperature on reaction rate, Effect of Catalyst, The Arrhenius Equation, The theories of reaction rate, The Lindemann theory of unimolecular reaction, Kinetics of Complex reaction, Opposing or reversible reaction, Consecutive reactions, Chain reaction and Branch Chain reaction, Activated Complex Theory (ACT) of Bimolecular reaction

**Reference Book:**

1. Principles of Physical Chemistry 44<sup>th</sup> Edition By Puri ,Sharma, Pathania

**UNIT: II ENERGY OF COLLECTION OF MOLECULES**

**[11 Hrs.]**

Thermal Energy, Distribution over states, Boltzmann Distribution, Derivation of Boltzmann Distribution, Partition Function, One dimensional Translational media, Three dimensional Translational media, Rotational Motions, Vibrational Motions, Gas-Heat capacities, Crystal and Liquid Heat capacities, Heat capacity of metals, Numerical

**Reference Book:**

1. Physical chemistry (5<sup>th</sup> edition) by G.M.Barrow

**UNIT: III HIGH PERFORMANCE CHROMATOGRAPHY (HPLC)**

**[11 Hrs.]**

Introduction, Principle and Apparatus of HPLC( Solvent delivery system , Pumps , Sample Injection System, Columns, Column Packing materials, Column packing ), Choice of supporting materials for separation, Detectors, Characteristics of Detectors, Some Detectors used in HPLC, Method, Identification of Solvent peaks, Materials, Advantages of HPLC.

**Reference Book:**

1. Instrumental methods of Chemical Analysis by B.K.Sharma

**UNIT: IV SOLVENT EXTRACTION METHODS**

**[12 Hrs.]**

The Distribution Law, Extraction process, Liquid liquid extraction, Factor affecting Extraction, Technique for Solvent Extraction, Quantitative treatment of solvent Extraction eqillibria, Classification of Solvent Extraction system, Types of extraction system, Advantage of Solvent Extraction system, Application of Liquid extraction, Solvent extraction methods in Metallurgy, Solid-Liquid Extraction.

**Reference Book:**

1. Instrumental methods of Chemical Analysis by B.K.Sharma

**COURSE OUTCOME :** This paper contains theoretical aspects of chemical kinetics, solvent extraction methods, HPLC and study of energy of molecules using various fundamental principles and theorems . This paper helps them to build up their

knowledge of physical chemistry that will be helpful to them in future studies like masters or doctoral.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-VI]**  
**US06CCHE07**  
**(PHYSICAL CHEMISTRY PRACTICAL)**  
**[03 Credits]**  
**Total Marks: 100 [Internal 30 + External 70]**

1. **Chemical kinetics** of a reaction between  $K_2S_2O_8$  and KI in an aqueous system.
2. The **study of Decomposition Rate** of hydrogen peroxide in presence of catalyst and catalyst with promoter.
3. The **study of Rate of Reaction** between hydrogen peroxide and KI in an aqueous media.
4. To **determine the Rate Constant** for the reaction between  $KBrO_3$  and KI in an aqueous media.
5. The **Distribution coefficient** of Benzoic acid distributed between water and kerosene.
6. To study the **Adsorption** of acid on Activated charcoal.
7. To **determine Molecular weight** of polymer by using **Ubbelhold Viscometer**.
8. To **determine the Composition** of Binary liquid mixture through the viscosity measurement.
9. To **determine the Molar and Specific Refraction** of pure liquids through the measurement of refractive index.
10. To **determine the Composition of a Binary liquid mixture** by Refractrometry.
11. To **determine the Concentration** of  $KMnO_4$  /  $K_2Cr_2O_7$  by Colourimetry.
12. To study the effect of addition of NaCl and Succinic acid on **Critical Solution Temperature (CST)** of phenol –Water system.

**VIVA VOCE**

**Reference Books:**

1. Experimental Physical Chemistry by R.C.Das & B.Behera
2. Advanced Physical Chemistry by J.B.Yadav

**COURSE OUTCOME** : This paper contains chemical kinetics, refractrometry, colourimetry, determination of adsorption co-efficient like exercises. This paper helps them to build up their knowledge of physical chemistry and to understand fundamentals of physical chemistry in practical aspects.



**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-VI]**  
**US06CCHE08**  
**(ORGANIC CHEMISTRY PRACTICAL)**  
**[03 Credits]**  
**Total Marks: 100 [Internal 30 + External 70]**

**PREPARATIONS**

1. Preparation of iodoform from acetone
2. Preparation of p-nitroacetanilide
3. Preparation of p-bromoacetanilide
4. Preparation of 2,4,6-tribromoaniline
5. Preparation of Methyl Orange
6. Preparation of Mordant yellow
7. Preparation of Lake red
8. Preparation of Benzoic acid
9. Preparation of m-nitroaniline from m-dinitrobenzene
10. Preparation of dibenzalacetone from benzaldehyde
11. Preparation of m-nitrophenol from m-nitroaniline

**ESTIMATION**

1. Estimation of - COOH group
2. Estimation of Aspirin
3. Estimation of Amine
4. Estimation of amide
5. Estimation of ketone
6. To determine the amount of unsaturation

**VIVA VOCE**

**Reference books:**

1. Comprehensive practical organic chemistry  
Preparation and qualitative analysis by V.K.Ahuwalia and Renu Aggarwal.
2. Qualitative Analysis by Vogel
3. Preparation and quantitative analysis by V.K.Ahuwalia and Renu Aggarwal.

**COURSE OUTCOME :** This paper contains estimation and preparation exercise. This paper helps them to build up their knowledge of materials and hands on training of reactions and reaction conditions. The work-up procedures they follow help them to build up knowledge of filtration and crystallization procedures.

**SARDAR PATEL UNIVERSITY**  
**SYLLABUS OF CHEMISTRY**  
**B. Sc. [Semester-VI]**  
**US06CCHE09**  
**(INORGANIC CHEMISTRY PRACTICAL)**  
**[03 Credits]**  
**Total Marks: 100 [Internal 30 + External 70]**

**Semi-micro Inorganic Qualitative Analysis Of Mixture Containing Three Positive & Three Negative Radicals.**

$\text{Cd}^{+2}$ ,  $\text{Cu}^{+2}$ ,  $\text{Bi}^{+3}$ ,  $\text{Sb}^{+3}$ ,  $\text{Pb}^{+2}$ ,  $\text{Fe}^{+2}$ ,  $\text{Fe}^{+3}$ ,  $\text{Zn}^{+2}$ ,  $\text{Al}^{+3}$ ,  $\text{Co}^{+2}$ ,  $\text{Ni}^{+2}$ ,  $\text{Mn}^{+2}$ ,  $\text{Ba}^{+2}$ ,  $\text{Sr}^{+2}$ ,  $\text{Ca}^{+2}$ ,  $\text{Mg}^{+2}$ ,  $\text{NH}_4^+$ ,  $\text{K}^+$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$ ,  $\text{CO}_3^{-2}$ ,  $\text{S}^{-2}$ ,  $\text{PO}_4^{-3}$ ,  $\text{BO}_3^{-3}$ ,  $\text{SO}_4^{-2}$ ,  $\text{CrO}_4^{-2}$ ,  $\text{Cr}_2\text{O}_7^{-2}$  etc.

**ALLOY ANALYSIS**

1. Brass Alloy
2. Bronze Alloy

**VIVA VOCE**

**Reference Books:**

1. Vogel's Testbook of Quantitative Chemical Analysis, 5th Edition By G.H.Jeffery, J.Basset, J.Mendham, R.C.Denney.
2. Vogel's Testbook Of Qualitative Inorganic Analysis By G.Svehla
3. Practical Chemistry By O.P.Pandey, D.N.Bajpai & S.Giri
4. An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra & Nad

**COURSE OUTCOME :** This course is designed to learn separation and identification of six component inorganic radicals, as well as semi-micro analysis of inorganic radicals. After studying this course student will be able to learn separation and identification of inorganic radicals from ore.