

**COURSE STRUCTURE  
FOR  
T. Y. B. Sc. (SEMESTER – V) CHEMISTRY**

<b>SEMESTER – V</b>			
<b>Principal Subject</b>	<b>Course Code</b>	<b>Paper Title</b>	<b>Credits</b>
<b>CHEMISTRY</b>	US05CCHE01	ORGANIC CHEMISTRY	<b>3</b>
	US05CCHE02	ORGANIC CHEMISTRY	<b>3</b>
	US05CCHE03	INORGANIC CHEMISTRY	<b>3</b>
	US05CCHE04	INORGANIC CHEMISTRY	<b>3</b>
	US05CCHE05	PHYSICAL CHEMISTRY	<b>3</b>
	US05CCHE06	PHYSICAL CHEMISTRY	<b>3</b>
	US05CCHE07	PHYSICAL CHEMISTRY PRACTICAL	<b>3</b>
	US05CCHE08	ORGANIC CHEMISTRY PRACTICAL	<b>3</b>
	US05CCHE09	INORGANIC CHEMISTRY PRACTICAL	<b>3</b>

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

**Total 45 lectures**  
**[11 Hrs.]**

**UNIT: I HETEROCYCLIC COMPOUNDS**

Heterocyclic systems, Structure of Pyrole, furan and thiophene, Source of Pyrole, 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

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

**Total 45 lectures**

**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 sulpha drug. 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. Adrenocortical 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.

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

**Total 45 lectures**  
**[11 Hrs.]**

**UNIT: I SYMMETRY**

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, Geoffery 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

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**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**  
**[11 Hrs.]**

**UNIT: I**

**[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 Hydracids, 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 Its 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, Kneding, Jjollyng, 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

**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 lectures**  
**[11 Hrs.]**

**UNIT: I PHOTOCHEMISTRY**

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 Waals 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.



**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 lectures**  
**[11 Hrs.]**

**UNIT: I PHASE EQUILLIBRIA**

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, Apparatus, 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 its care, Removal of oxygen, Quantitative analysis, Numericals.

**Reference Book:** Instrumental methods of Chemical Analysis by B.K.Sharma

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**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

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**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

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**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