(Bachelor of Science)(Undergraduate)
B. Sc. (UG) Semester -V

Course Code	**US05CCHE51**	Title of the Course	**Organic Chemistry**
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	To make students familiar with: 1. Organic Chemistry as a subject. 2. Advanced topics of organic chemistry. 3. Understanding of heterocyclic compounds, reaction mechanism, polynuclear aromatic compounds and terpenoids.

Course Content		
Unit	Description	Weightage* (%)
1.	**HETEROCYCLIC COMPOUNDS** Heterocyclic systems, Structure of Pyrole, furan and thiophene, Source of Pyrole, furan and thiophene, Electriphilic 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**.**	**25%**
2.	**REACTION MECHANISM** Baeyer Villiger oxidation, Hofmann rearrangement, Mannich reaction, Curtius–Schmidt rearrangement, Benzilic acid rearrangement, Sommlet rearrangement, Birch reduction, Favorskii rearrangement, Benzoin condensation, Beckmann rearrangement, Wittig reaction, Perkin reaction.	**25%**

3.	**POLYNUCLEAR AROMATIC COMPOUNDS** 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.	**25%**
4.	**TERPENOIDS** General introduction including nomenclature, General properties of terpenoids, Isolation, Isoprene rule, special Isoprene rule, Classification of terpenoids, General methods for the determination of structure of terpenoids. Introduction, isolation and constitution of Citral, α-terpineol, Camphor, β-carotene.	**25%**

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to learn	
1.	About basic concept of heterocyclic chemistry, reaction mechanism, polynuclear aromatic compounds and Terpenoids.
2.	Aplication in further studies and in industries.

Suggested References:	
Sr. No.	References
1.	Organic chemistry of natural products by Gurdeep Chatwal, Vol.II.
2.	Organic chemistry by Morrison and Boyd, 6th ed.
3.	Organic reaction mechanism by R. K. Bansal, 3rd ed.
4.	Organic chemistry by S. M. Mukherji, S. P. Singh and R. P. Kapoor. Vol. II.
5.	Synthetic organic chemistry by Gurdeep R. Chatwal
6.	Organic chemistry, Vol II, by I.L.Finar.
7.	Principles of Organic synthesis, by ROC Norman.
8.	Heterocyclic chemistry vol.II by R. R. Gupta, M. Kumar and V. Gupta

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester -V

Course Code	**US05CCHE52**	Title of the Course	**INORGANIC CHEMISTRY**
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	To make students familiar with: 1. Inorganic Chemistry as a subject. 2. Advanced topics of inorganic chemistry. 3. Understanding of symmetry, CFT, coordination chemistry and inorganic polymers.

Course Content

Unit	Description	Weightage* (%)
1.	**SYMMETRY** Introduction, Various types of symmetry elements, Point groups, Properties of point groups, To determine the point group of a molecule, Representations of groups, multiplication table for point groups C_{2V}, C_{3V} and C_{2h}. Rules of Group theory.	**25%**
2.	**[A] CRYSTAL FIELD THEORY** Importance of CFT, Grouping of 5d orbitals, CFT applied for octahedral complexes, Distribution of d^n electrons (strong field and weak field), Factor influencing magnitude of Δ_0, Spectrochemical series, Mean paring energy and calculations, Calculation based on CFSE, CFT for tetrahedral complexes, Distribution of d^n electrons, Limitation of CFT, Energy Level Diagram for $[CoF_6]^{3-}$ and $[Co(NH_3)_6]^{3+}$. **[B] TRANS EFFECT** Introduction of trans effect, uses of trans effect, theories of trans effect : electrostatic polarision theory and π (pi) -bonding theory.	**25%**
3.	**(A) THERMODYNAMIC AND KINETIC ASPECTS OF METAL COMPLEXES & STABILITY OF COMPLEXES IN AQUEOUS SOLUTION** Definition of stability, Stability of complex ions in solution, Stepwise formation constants and overall formation constants, Labile and inert octahedral complexes according to CFT, Factors affecting the stability of complexes, Experimental determination of stability constant and composition of a complex, Spectrophotometric method, Job's method of continuous variation. **(B) LIGAND SUBSTITUTION REACTIONS IN OCTAHEDRAL COMPLEXES**	**25%**

	Transition state or activated complex, Types of substitution reactions, Labile and inert complexes, Acid hydrolysis reactions of six-coordinated, Acid hydrolysis reactions of six-coordinated Co (III) ammine complexes, Base hydrolysis reactions of six-coordinated Co (III) ammine complexes.	
4.	**INORGANIC POLYMERS** 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.	**25%**

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic concept of symmetry, crystal field theory, geometry of the molecule, stability of metal complexes and inorganic polymers.
2.	Understand application in further studies and in industries.

Suggested References:	
Sr. No.	References
1.	Advanced Inorganic Chemistry Volume I- 18th Edition By SatyaPrakash, G. D. Tuli, S. K. Basu, R. D.Madan
2.	Basic Inorganic Chemistry -3rd Edition By F. Albert Cotton, Geoffrey, Wilkinson & Paul L. Gaus
3.	Selected Topic in Inorganic Chemistry, 8th Edition, By Wahid U. Malik, G. D. Tuli And R. D. Madan
4.	Introductory Quantum Chemistry- 4th Edition By A K Chandra
5.	Selected Topic in Inorganic Chemistry, 8th Edition, By Wahid U. Malik, G. D. Tuli And R. D. Madan

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester - V

Course Code	**US05CCHE53**	Title of the Course	**PHYSICAL CHEMISTRY**
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	To make students familiar about: 1. Physical Chemistry as a subject. 2. Advanced topics of physical chemistry. 3. Understanding of thermodynamics, electromotive force of electrochemical cells, photochemistry, and phase equillibria.

Course Content		
Unit	Description	Weightage* (%)
1.	**ENTROPY AND SECOND LAW OF THERMODYNAMICS** 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, Numerical. **Reference Books :** Physical Chemistry by Gordan M. Barrow, 5th Edition. Physical Chemistry, Ira Levine. Text book of physical chemistry by Samuel Glasstone	**25%**
2.	**ELECTROMOTIVE FORCE OF ELECTROCHEMICAL CELLS** 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 Books :-** Physical Chemistry by G. M. Barrow, 5th ed. Physical Chemistry, Ira Levine	**25%**

3.	**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, Fluroescence and Phosphorescence, Numerical. **Reference Book :** Advanced Physical Chemistry by Gurdeep Raj	**25%**
4.	**PHASE EQUILLIBRIA** Introduction to Phase rule, Phase component and degree of freedom, Phase reactions, condition for equilibrium between phase, derivation of phase rule, advantage and limitations of phase rule, one component system, water system, the sulfur system, experimental determination of transition point, two component system, types of two component system, simple eutectic system, lead silver system, KI-Water system, simple eutectic system having congruent melting point. Numericals. **Reference Book :** Principles of Physical Chemistry (44^{th} Edition) By Puri, Sharma, Pathania.	**25%**

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic concepts of entropy, thermodynamics and electromotive force of electrochemical cells. Also understands basics of photo chemistry and phase equillibria.
2.	Know the basics helpful in further studies and in industries.

Suggested References:	
Sr. No.	References
1.	Advanced Physical Chemistry by Gurdeep Raj.
2.	Text book of physical chemistry by Samuel Glasstone.
3.	Principles of Physical Chemistry by Puri, Sharma and Pathania. 38th Edition.
4.	Essential of physical chemistry by Bahl, Bahl and Tuli. 25th edition.
5.	Physical Chemistry by G. M. Barrow, 5th ed.
6.	Textbook of physical chemistry by P.L. Soni, O.P. Dharmarha, U. N. Dash
7.	University chemistry by Bruce H Mahan
8.	Principles of Physical chemistry, S H Marron, Karl F prutton
9.	Physical Chemistry, Ira Levine
10.	Physical Chemistry, Atkins

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester - V

Course Code	**US05CCHE54**	Title of the Course	**ANALYTICAL CHEMISTRY**
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	To make students familiar with: 1. Analytical Chemistry as a subject. 2. Advanced topics of analytical chemistry. 3. Understanding of traditional and instrumental methods of analysis, chromatography and solvent extraction methods.

Course Content		
Unit	Description	Weightage* (%)
1.	**pH metry -** Introduction, types of indicator electrodes and reference electrodes, types of titrations. **Potentiometry-** Introduction, types of titrations, graphical method for end point determination. **Conductometry-** Introduction, types of conductance, effect of dilution, conductivity cells, types of titration.	**25%**
2.	**CHROMATOGRAPHY – I** Introduction, classification, paper chromatography, thin layer chromatography, column chromatography, ion-exchange chromatography, experimental details for all the techniques.	**25%**
3.	**CHROMATOGRAPHY-II** **GAS CHROMATOGRAPHY** 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. **HIGH PERFORMANCE CHROMATOGRAPHY (HPLC)** 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.	**25%**

4.	**SOLVENT EXTRACTION METHODS** 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.	**25%**

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	From the study of this paper, student will learn about basic concept of instrumental techniques, chromatography and solvent extraction methods.
2.	This study will helpful them in further studies and in industries.

Suggested References:	
Sr. No.	References
1.	Instrumental methods of Chemical Analysis by B. K. Sharma
2.	Instrumental methods of Chemical Analysis by Gurdeep R Chatwal
3.	Quantitative Analysis by Skoog & West

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester -V

Course Code	**US05CCHE55**	Title of the Course	**CHEMISTRY PRACTICAL**
Total Credits of the Course	08	Hours per Week	16

Course Objectives:	To make students familiar with: 1. Practical chemistry as a subject 2. Practical aspects of physical, organic, inorganic and analytical chemistry. 3. Advanced practical aspects of different branches of chemistry.

Course Content	**Total Marks : 200**
Unit	Description
1.	**Title Of Subject : PRACTICAL –I : PHYSICAL CHEMISTRY PRACTICAL** **Applications of pH metry** 1. To **determine Molarity** of strong acid by titrating against 0.1 M NaOH solution. 2. To determine molarity and d**issociation Constant** of weak monobasic acids like HAC 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 acid by titrating against 0.1 M NaOH solution. 5. To determine molarity and d**issociation Constant** of weak monobasic acids like HAC titrating against 0.1 M NaOH solution. 6. To determine Molarity of each acid present in a **Mixture** of strong acid and weak acid. **Applications of Conductometry** 7. To determine Molarity of strong acid by titrating against 0.1 M NaOH solution. 8. To determine Molarity of weak acid by titrating against 0.1 M NaOH solution. 9. To determine Molarity of each acid present in a Mixture of strong acid and weak acid. 10. To determine the Concentration of $KMnO_4$ / $K_2Cr_2O_7$ by Colourimetry. **VIVA EXAMINATION**
2.	**Title Of Subject : PRACTICAL -II : ORGANIC CHEMISTRY PRACTICAL** **Organic Preparation** (i) Preparation of p-Bromo Acetanilide from Acetanilide (Bromination) (ii) Preparation of p-Nitro Acetanilide from Acetanilide (Nitration) (iii) Preparation of m-Dinitrobenzene from m-Nitroaniline (Reduction) (iv) Preparation of Benzaldehyde from Benzoic acid (Oxidation) (v) Preparation of Iodoform

	(vi) Preparation of Di-benzyl acetone from Benzaldehyde (vii) Preparation of Dyes- Modernt Yellow dye **VIVA EXAMINATION**
3.	**Title Of Subject : PRACTICAL –III : INORGANIC MIXTURES (MIN 10 MIX.)** **Semi-micro Inorganic Qualitative Analysis Of Mixture Containing Three Positive & Three Negative Radicals.** Cd^{+2}, Cu^{+2}, Bi^{+3}, Sb^{+3}, Pb^{+2}, Fe^{+2}, Fe^{+3}, Zn^{+2}, Al^{+3}, Co^{+2}, Ni^{+2}, Mn^{+2}, Ba^{+2}, Sr^{+2}, Ca^{+2}, Mg^{+2}, NH_4^+, K^+, Cl^-, Br^-, I^-, NO_3^-, CO_3^{-2}, S^{-2}, PO_4^{-3}, BO_3^{-3}, SO_4^{-2}, CrO_4^{-2}, $Cr_2O_7^{-2}$ etc. **VIVA EXAMINATION**
4	**Title Of Subject : PRACTICAL –IV : ANALYTICAL CHEMISTRY PRACTICAL** **Estimation of Functional Group** (i) Estimation of Carboxylic Acid (ii) Estimation of Ketone (iii) Estimation of Ester (iv) Estimation of amide (v) Estimation of aspirin (vi) Estimation of Saponification of Oil **VIVA EXAMINATION**

Teaching-Learning Methodology	Hands on training of Practicals and Instruments. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn performing chemical experiments under time constraint and appreciate the physical principles useful in chemical science. Separation and identification of six radicals inorganic mixture. Estimation and preparation of organic compounds.
2.	Apply in further studies and in industries.

Suggested References:	
Sr. No.	References
1.	Experimental Physical Chemistry by R. C. Das & B. Behera
2.	Advanced Physical Chemistry by J. B. Yadav
3.	Comprehensive practical organic chemistry Preparation and qualitative analysis by V. K. Ahuwalia and Renu Agarwal.
4.	Organic Preparation by A. I. Vogel
5.	Vogel's Text book of Quantitative Chemical Analysis, 5th Edition By G. H. Jeffery, J. Basset, J. Mendham, R. C. Denney.
6.	Vogel's Textbook Of Qualitative Inorganic Analysis By G. Svehla
7.	Practical Chemistry By O. P. Pandey, D. N. Bajpai & S. Giri
8.	An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra & Nad

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web

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