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

Course Code	**US06CCHE51**	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 chemistry of amino acids and proteins, alkaloids, Dyes, explosives, pesticides and Drugs.

Course Content		
Unit	Description	Weightage* (%)
1.	**(A) Amino Acids And Proteins** Proteins, Structure of amino acids, Amino acids as dipolar ions, Isoelectric point of amino acids, Preparation of amino acids, Peptides. Geometry of the peptide linkage, Determination of structure of peptide. Terminal residue analysis. Synthesis of peptides, Structure of proteins, Peptide chain, Side chain. Isoelectric point. Electrophoresis, Secondary structure of protein. **(B) Purine and Pyrimidines** Purines – Synthesis of Purines, Adenine and Guanine. Pyrimidines – Synthesis of Pyrimidine, Uracil, Thymine and Cytosine.	**25%**
2.	**ALKALOIDS** 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 Nicotine, Papaverine, Conine, Atropine.	**25%**
3.	**(A) SYNTHETIC DYES**: Classification of Dyes, Anionic and Cationic dyes, Mordant and Vat dyes, Reactive and Dispersed dyes, Synthesis of Alizarin, Malachite green, Indigo, Congo red, Eosin. **(B) EXPLOSIVES**: Preparation of RDX, PETN, Nitroglycerine, Tetryl. **(C) PESTICIDES**: Preparation of Aldrine, Malathion, Parathion, methoxychlor.	**25%**

4.	**DRUG** 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, Antimalerial, Antiseptic, Sulphanilamides, Mechanism of action of sulpha drug. Antitubercular and antileprosy drugs. Synthesis and uses of following drugs : (i) Nirvanol (ii) Phenobarbitone (iii) Novalgin (iv) Hetrazan (v) Atenelol (vi) Chloroquine (vii) Lidocaine (viii) Sulphafurazole (ix) PAS (x) Acedapsone (xi) Tolbutamide.	**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 know following points:

1.	From the study of this paper, student will learnt about basic concept of Amino Acids And Proteins, Purine and Pyrimidines, alkaloids, Synthetic Dyes, explosives, pesticides and Drugs.
2.	This study will be helpful in further studies and in industries.

Suggested References:	
Sr. No.	References
1.	Organic Chememistry, Vol II, by I. L. Finar.
2.	Organic chemistry by A. Bahal& B. S. Bahal, 16th Ed**.**
3.	Organic Reaction Mechanism by S. M. Mukerji.
4.	Organic Reaction Mechanism by R. K. Bansal.
5.	Organic Chemistry by R. O. C. Norman.
6.	Organic chemistry of natural products by Gurdeep R. Chatwal, Vol. I.
7.	Synthetic Drugs 6th ed. by Gurdeep R. Chatwal.
8.	Medicinal chemistry 3rd ed. by Ashutosh Kar.

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 -VI

Course Code	**US06CCHE52**	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 wave mechanics, organometallic chemistry, term symbol and mettalurgy.

Course Content		
Unit	Description	Weightage* (%)
1.	**WAVE MECHANICS** Wave equation, Interpretation of Ψ and Heisenberg's uncertainty principle, Properties of Ψ, Operators, Second postulate of quantum mechanics, Setting up 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	**25%**
2.	**[A] ORGANO METALLIC CHEMISTRY** Introduction, General methods of preparations, General properties, Organo metallic compounds of alkali metals, Organo metallic compounds of beryllium, Organo metallic compounds of magnesium, Organo metallic compounds of aluminum, Metal olefin (alkene) complexes. Cyclopentadienyl complexes, preparation of metallocenes and their derivatives, Some properties of ferrocene molecule, Strcture and bonding in ferrocene molecule, Ionic cyclopentadienyl compounds. **[B] BORON HYDRIDE** Introduction and nomenclature of boron hydride, preparation and general properties, preparation and properties of individual boron hydride: Diborane (B_2H_6), tetraboren (B_4H_{10}), pentaborane (B_5H_9) and (B_5H_{11}), hexaborane (B_6H_{10}) enneaborane (B_9H_{15}), decaborane ($B_{10}H_{14}$). Structure of diborane, types of bonds found in higher borane, structure and bonding in higher boranes.	**25%**

3.	**[A] TERM SYMBOL** Russel Saunders coupling and determination of Term symbols of the ground state. Calculation of number of microstates. Pigeon hole diagram of p^2 and d^2 configurations. Hund's rule. Hole formulation. **[B] ELECTRONIC SPECTRA OF METAL COMPLEXES** Electronic spectra of transition metal complexes, Laporte orbital and spin selection rules. Orgel energy level diagram of d^5 and combined diagrams of d^1- d^9, $d^2 - d^8$, $d^3 - d^7$, $d^4 - d^6$ and their spectra. Jahn-Teller distortion.	**25%**
4.	**PRINCIPLES OF METALLURGY AND CHEMISTRY OF Pb, Fe, Ni, Cu & Ag** Metals, Occurrence of metals, Mineral wealth of india, Metallurgy, Concentration and ore, Calcinations 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 ion, manufacture of cast 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.	**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 (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.	From the study of this paper, student will learnt about basic concept of wave mechanics, Organometallic compounds, Cyclopentadienyl complexes, Term symbol, Electronic spectra of metal complexes and principles of metallurgy.
2.	This study will helpful them in further studies and in industries.

Suggested References:	
Sr. No.	References
1.	Introductory Quantum Chemistry- 3rd Edition, By A. K. Chandra
2.	Textbook of Inorganic Chemistry -20th edition, Chapter-13 By P. L. Soni & Mohan Katyal
3.	Advanced Inorganic Chemistry Volume –II, By Satya Prakash, G. D. Tuli, S. K. Basu, R. D. Madan
4.	Concise Inorganic Chemistry : 5TH Edition BY: J. D. LEE
5.	Basic Inorganic Chemistry- 3rd Edition By F. Albert Cotton, Geoffery Wilkinson & Paul L. Gaus
6	Advanced Inorganic Chemistry, By Gurdeep Raj. Vol. I (26th revised edition, 2001)

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 -VI

Course Code	**US06CCHE53**	Title of the Course	**PHYSICAL CHEMISTRY**
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	To make students familiar with: 1. Physical Chemistry as a subject. 2. Advanced topics of physical chemistry. 3. Understanding of entropy, thermodynamics, chemical kinetics, polymer chemistry and colloidal state.

Course Content		
Unit	Description	Weightage* (%)
1.	**ENTROPY AND THIRD LAW OF THERMODYNAMICS** 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, Free energy and Pressure, Free energy and the equilibrium constant, Free energy and Temperature, Free energy function, Equilibria and Distributions, Numerical. **Reference Books :** Text book of physical chemistry by Samuel Glasstone. Physical Chemistry by G.M.Barrow, 5th ed	**25%**
2.	**CHEMICAL KINETICS** Third order reaction (a= b=c), 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, Activated Complex Theory (ACT) of Bimolecular reaction, Numerical. **Reference Book :** Principles of Physical Chemistry 44th Edition By Puri, Sharma, Pathania	**25%**

3.	**POLYMER CHEMISTRY** 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. **Reference Books :** Principles of polymers Science by P. Bahadur and N. V. Sastry (2nd Edition) Polymer Science by V. R. Gowariker, N. V. Vashwanathan and Jaydev Shreedhar.	**25%**
4.	**COLLOIDAL STATE** Types of Colloidal system, Classifications of Colloids, Lyophobic and Lyophilic Sols, Size range, Preparation and Properties of colloids solution, Dialysis, Electrodialysis, Ultrafiltration, Electrical Double Layer, Electrophoresis, Electrosmosis, Importance and Applications of Colloids, Numerical. **Reference Books :** Principles of physical chemistry by puri, sharma and pathania. 44th Edition	**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,	
1.	From the study of this paper, student will be able learn about basic principles of thermodynamics and chemical kinetics. Also understands basics of colloidal state and polymer chemistry.
2.	This study will helpful them 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 Ed.
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 - VI

Course Code	**US06CCHE54**	Title of the Course	**APPLIED CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make students familiar with: 1. Several topics related to applied chemistry. 2. Advanced topics of applied chemistry. 3. Understanding of IR spectroscopy, ^{1}H NMR, CMR spectroscopy, heavy chemicals and bioorganic chemistry.

Course Content		
Unit	Description	Weightage* (%)
1.	**INFRARED SPECTROSCOPY** Introduction, principle of IR spectroscopy, instrumentation, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies. Differentiate two compounds by the IR frequencies. Problems pertaining to the structure elucidation of organic compounds using IR.	**25%**
2.	**NMR - SPECTROSCOPY** The nuclear magnetic resonance (Proton 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. **^{13}Carbon 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.	**25%**
3.	**TITRATION TECHNIQUE** Titration curves, Feasibility, Indicators, Mohr, Volhard and Fajans' Methods, Factors affecting solubility. Introduction, Precipitation, Digestion, Filtration, Washing of the precipitate, Drying and/or incineration of the precipitate, Weighing, Specific and selective precipitation, Organic precipitants, Masking or sequestering agent, Problems involved in precipitation gravimetry.	**25%**

4.	**HEAVY CHEMICALS** **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.	**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,	
1.	From the study of this paper, student will learn about basic concepts of principles of IR spectroscopy, NMR Spectroscopy, Bioinorganic chemistry and Heavy chemicals.
2.	This study will be helpful in further studies and in industries.

Suggested References:	
Sr. No.	References
1.	Organic Chemistry by Morrison and Boyd, 6thed
2.	Organic Spectroscopy by P. S. Kalsi
3.	Organic Spectroscopy by J R Dyer.
4.	Elementary Spectroscopy by Y R Sharma
5.	Introduction to Spectroscopy**:** Donald L. Pavia, Gary M. Lampman, George S.Kriz Cengage Learning; 4th Edition.
6.	Applications of spectroscopic techniques in Organic Chemistry**:** P.S. Kalsi, New Age International; 6th Edition.
7.	Basic Inorganic Chemistry- 3rd Edition By F. Albert Cotton, Geoffery Wilkinson & Paul L. Gaus
8.	Textbook of Inorganic Chemistry - 20th by P. L. Soni & Mohan Katyal
9	Gary D. Christian, "Analytical Chemistry", John Wiely & Sons, INC, New York, 1994. (Fifth Edition)
10	Douglas A. Skoog, Donald M. West, F.James Holler, "Analytical Chemistry An Introduction", Saunders College Publishing, Harcourt Brace College Publishers, Philadelphia, 1994. (Sixth edition)
11	Industrial chemistry 9th Edition by B K Sharma

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 - VI

Course Code	**US06CCHE55**	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 and inorganic chemistry. 3. Advanced practical aspects of different branches of chemistry.

Course Content	**Total Marks : 200 (140 + 60 internal)**
Unit	Description
1.	**Title Of Subject : PRACTICAL –I : PHYSICAL CHEMISTRY PRACTICAL** 1. Chemical kinetics of a reaction between $K_2S_2O_8$ and KI in an aqueous system. (a=b) 2. Chemical kinetics of a reaction between $K_2S_2O_8$ and KI in an aqueous system. ($a \neq b$) 3. The study of rate of reaction between hydrogen peroxide and KI in an aqueous media. (a=b) 4. The study of rate of reaction between hydrogen peroxide and KI in an aqueous media. ($a \neq b$) 5. To determine the rate constant for the reaction between $KBrO_3$ and KI in an aqueous media. (a=b) 6. To determine the rate constant for the reaction between $KBrO_3$ and KI in an aqueous media. ($a \neq b$) 7. To determine the rate constant for the decomposition of hydrogen peroxide using catalyst and promoter. 8. The distribution coefficient of Benzoic acid distributed between water and kerosene. 9. To determine the Composition of a Binary liquid mixture by Refractrometry. **VIVA EXAMINATION**
2.	**Title Of Subject : PRACTICAL -II : ORGANIC CHEMISTRY PRACTICAL** Separation and Identification of two component organic mixture using chemical and physical methods (water soluble, insoluble & liquid + liquid) **Solid Acid**: Benzoic acid, salicylic acid, cinnamic acid, phthalic acid , succinic acid, oxalic acid. **Solid phenol**:- α- naphthol, β-naphthol, resorcinol. **Solid neutrals**:- p-dichlorobenzene, naphthalene, anthracene, benzamide, urea, thiourea, acetanilide, m-dinitrobenzene. **Solid Base**:- o-, m- & p-nitroaniline, p-toluidene, **Liqui d base**:- aniline, **Neutral liquid**:- ethyl acetate, methyl acetate, acetone, methyl alcohol, ethylalcohol, benzaldehyde, chlorbenzene, nitrobenzene, $CHCl_3$, acetohpenone **(Derivative of any one out of two compounds)** **VIVA EXAMINATION**

3.	**Title Of Subject : PRACTICAL -III : INORGANIC CHEMISTRY PRACTICAL** **Gravimetric Analysis (Mixture with interfering radicals like removal of Cu)** 1. Ba as $BaSO_4$ 2. Fe as Fe_2O_3 3. Al as Al_2O_3 4. Ni as $Ni(DMG)_2$ 5. Mn as $Mn_2P_2O_7$ 6. Zn as $Zn_2P_2O_7$ **VIVA EXAMINATION**
4.	**Title Of Subject : PRACTICAL -IV : Analytical Chemistry Practical** **Volumetric Analysis by self preparation of EDTA** 1. Estimation of Bi^{3+} by EDTA. 2. Estimation of Ni^{2+} by EDTA. 3. Estimation of Cu^{2+} by EDTA. 4. Estimation of Chloride by silver nitrate (Mohr's Method). 5. Estimation of Ca^{2+} and Mg^{2+} in mixture by EDTA Hardness 6. Estimation of Fe^{3+} by EDTA (Back Titration). **VIVA EXAMINATION**

Teaching-Learning Methodology	Hands on training of Practicals. 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,

1.	From the study of this paper student will learn about hands on training of instruments like pH metry, Potentiometry, Conductometry. Separation and identification of two component Organic mixture. Volumetric analysis.
2.	This study will be helpful 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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