



B. Sc. (UG) Semester -VI

Course Code	US06MACHE01	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 pairing 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 polarisation 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.	25%





	(B) LIGAND SUBSTITUTION REACTIONS IN OCTAHEDRAL COMPLEXES 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.	(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. Spectrochemical series.	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).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage (%)
1.	Internal Continuous Assessment in the form of Class test/Internal Written test 15 Marks (30%), Quiz 15 Marks (30%) Active learning 05 Marks (10%), Home Assignments 05 Marks (10%), Class Assignments 05 Marks (10%), Attendance 05 Marks (10%), (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 50 Marks (100%)].	50
2.	Semester End Examination [Total 50 Marks (100%)].	50

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, electronic spectral details of metal complexes and term symbol.
2.	Understand application in further studies and in industries.

References Books:

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





B. Sc. (UG) Semester -VI

Course Code	US06MACHE02	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, Phase rule and electrochemistry.
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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. Numericals.	25%
2.	CHEMICAL KINETICS: Kinetics of Third order reaction ($a = b = c$), Mechanism of complex reaction. The equilibrium approximation, Steady state approximation, Effect of temperature on reaction rate, Effect of Catalyst, Activated Complex Theory (ACT) of Bimolecular reaction. The Arrhenius Equation, The theories of reaction rate: The Lindemann theory of unimolecular reaction, Eyring equation, Numerical.	25%
3.	PHASE EQUILLIBRIA: Introduction to Phase rule, Phase component and degree of freedom, Phase reactions, condition for equilibrium between phases, 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, simple eutectic system, lead silver system.	25%
4.	ELECTROMOTIVE FORCE OF ELECTROCHEMICAL CELLS: Electrodes, cell emf, emf and free energy. Types of reversible electrodes. Standard electrode potentials, reference electrode, Nernst's equation. Applications of emf measurement (equilibrium constant, Solubility product for sparingly soluble salts, activities, activity coefficients, pH measurement), electrode concentration cells, electrolyte concentration cells. Numericals.	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).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage (%)
1.	Internal Continuous Assessment in the form of Class test/Internal Written test 15 Marks (30%), Quiz 15 Marks (30%) Active learning 05 Marks (10%), Home Assignments 05 Marks (10%), Class Assignments 05 Marks (10%), Attendance 05 Marks (10%), (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 50 Marks (100%)].	50
2.	Semester End Examination [Total 50 Marks (100%)].	50

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 Phase equilibria rule and electro 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. 38 th Ed.





4.	Essential of physical chemistry by Bahl, Bahl and Tuli. 25 th Edition.
5.	Physical Chemistry by G. M. Barrow, 5 th 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





B. Sc. (UG) Semester -VI

Course Code	US06MACHE03	Title of the Course	CHEMISTRY PRACTICAL
Total Credits of the Course	04	Hours per Week	08

Course Objectives:	To make students familiar with: 1. Practical chemistry as a subject 2. Practical aspects of physical and inorganic chemistry. 3. Advanced practical aspects of Instrumentals techniques and separation of binary inorganic mixture.
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Course Content		Total Marks : 100
Unit	Description	
Practical –I	<u>Physical chemistry practical:</u> <u>Applications of pH metry</u> 1. To determine Molarity of strong acid by titrating against 0.1 M NaOH solution. 2. To determine molarity and dissociation 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. <u>Applications of Conductometry</u> 4. To determine Molarity of strong acid by titrating against 0.1 M NaOH solution. 5. To determine Molarity of weak 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. <u>Applications of Potentiometry:</u> 7. To determine Molarity of strong acid by titrating against 0.1 M NaOH solution. 8. To determine molarity and dissociation Constant of weak monobasic acids like HAC titrating against 0.1 M NaOH solution. 9. To determine Molarity of each acid present in a Mixture of strong acid and weak acid.	





Practical -II	Title Of Subject : INORGANIC MIXTURES (MIN 08 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} , $\text{Cr}_2\text{O}_7^{-2}$ etc. VIVA EXAMINATION
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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).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage (%)
1.	Internal Continuous Assessment in the form of Labwork assessment 20 Marks (40%), lab quiz/viva voce 20 Marks (40%) and attendance 10 Marks (20%). [Total 50 Marks (100%)].	50
2.	Semester End Examination Labwork assessment 40 Marks (80%), lab quiz/viva voce 10 Marks (20%) . [Total 50 Marks (100%)].	50

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





Suggested References Books:

Sr. No.	References Books:
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.	Vogel's Text book of Quantitative Chemical Analysis, 5 th Edition By G. H. Jeffery, J. Basset, J. Mendham, R. C. Denney.
5.	Vogel's Textbook Of Qualitative Inorganic Analysis By G. Svehla
6.	Practical Chemistry By O. P. Pandey, D. N. Bajpai & S. Giri
7.	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





B. Sc. (UG) Semester - VI

Course Code	US06MICHE01	Title of the Course	ORGANIC CHEMISTRY-II
Total Credits of the Course	02	Hours per Week	02

Course Objectives:	To make students familiar with: 1. Organic Chemistry as a subject. 2. Understanding chemistry of Amino Acids and Proteins, Purine and Pyrimidines, polynuclear aromatic compounds.
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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.	50%
2.	Polynuclear Aromatic Compounds Fused ring aromatic compounds: Naphthalene Synthesis of naphthalene and its derivatives by ring closure (Haworth method). Nomenclature of naphthalene derivatives, Structure of naphthalene, Reactions of naphthalene: Oxidation and reduction of naphthalene. Nitration and halogenation of naphthalene, Orientation of electrophilic substitution in naphthalene, Friedal–Craft acylation of naphthalene, Sulphonation of naphthalene. Naphthols (α & β), Orientation of electrophilic substitution in naphthalene derivatives, Anthracene and Phenanthrene: Structure and synthesis of anthracene and phenanthrene (Haworth method).	50%





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).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage (%)
1.	Continuous and compression evaluation : Class test/Internal written test 10 Marks (40%), Quiz 05 Marks (20%), Home Assignments 05 Marks (20%), Attendance 05 Marks (20%), (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 25 Marks (100%)].	50
2.	Semester End Examination [Total 25 Marks (100%)].	50

Course Outcomes: Having completed this course, the learner will be able to	
1.	From the study of this paper, student will learn about basic concepts of amino acids, proteins and polynuclear hydrocarbons.
2.	This study will helpful them in further higher studies and in industries.

Suggested References Books:	
Sr. No.	References Books:
1.	Organic chemistry of natural products by Gurdeep Chatwal, Vol.II.
2.	Organic chemistry by Morrison and Boyd, 6 th Ed.
3.	Organic reaction mechanism by R. K. Bansal, 3 rd 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

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





B. Sc. (UG) Semester - VI

Course Code	US06MICHE02	Title of the Course	ORGANIC CHEMISTRY PRACTICAL: Organic Preparation
Total Credits of the Course	02	Hours per Week	04

Course Objectives:	To make students familiar about: 1. Organic Chemistry practical as a subject. 2. Basic concepts and applications related to organic synthesis. 3. Practical aspects of chemistry. 4. Hands on training of laboratory practices.
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Practical	Description
	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-Nitro aniline. (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: Mordant Yellow dye. VIVA EXAMINATION

Teaching-Learning Methodology	Hands on training to Practical Courses are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage (%)
1.	Continuous and compression evaluation: Class test/Internal written test 10 Marks (40%), Quiz 05 Marks (20%), Home Assignments 05 Marks (20%), Attendance 05 Marks (20%), (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 25 Marks (100%)].	50
2.	Semester End Examination [Total 25 Marks (100%)].	50





Course Outcomes: Having completed this course, the learner will be able to

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| 1. | Learn about hands on training of organic synthesis. |
| 2. | Improve practical skills of students. |

Suggested References Books:

- | Sr. No. | References Books: |
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| 1. | Comprehensive practical organic chemistry Preparation and qualitative analysis by V. K. Ahuwalia and Renu Agarwal. |
| 2. | Organic Preparation by A. I. Vogel |

On-line resources to be used if available as reference material

On-line Resources: Google books, INFLIBNET, Google Web

