

ORIENTAL COLLEGE (AUTONOMOUS), TAKYEL, IMPHAL
DEPARTMENT OF CHEMISTRY

TEACHING PLAN

(Effective from 2020-21)

B.Sc. Chemistry (Honours)

Three Year Undergraduate Programme (Six Semester Course) under CBCS

PROGRAMME OUTCOMES (POS)

Upon completion of B.Sc. Chemistry Degree Programme, the graduates will be able to:	
PO -1	Apply the knowledge of Industrial Chemistry and its specializations to solve the complex scientific problems
PO - 2	Identify, formulate and analyze complex scientific problems reaching substantiated conclusions using principles of Industrial Chemistry
PO - 3	Define and solve various critical issues related with public health, safety, cultural, societal and environmental issues in the benefits of society and human beings
PO - 4	Use research based methods including design of experiments, analysis and interpretation of data and synthesis of chemical products
PO - 5	Creat, select, and apply appropriate techniques, resources and modern scientific and IT tools including predicting and modeling complex scientific activities
PO - 6	Apply the reasoning within the contextual knowledge of Industrial domain to serve the society in all horizon such as education ,medicines, environment and industry with their latest update of scientific and professional aspects

PROGRAMME SPECIFIC OUTCOMES (PSOS)

Upon completion of B.Sc. Chemistry the graduates will be able to:	
PSO - 1	have the knowledge of fundamental concepts of chemistry including organic, physical, inorganic, analytical and nanotechnology
PSO - 2	Use modern instrumentation and classical techniques to design experiments along with knowledge of the standard operating procedures and safety regulations for effective handling and use of chemicals
PSO - 3	Have additional knowledge on chemical engineering processes, IPR, TQM, and technology management , polymer and medicinal chemistry along with the work experience in industries also
PSO - 4	Design the new model of organic compounds and know about the green synthesis

SEMESTER - I (Year : 2020 -21 onwards)Core Course: **INORGANIC CHEMISTRY- I**Paper Code: **CHM-HC-1016**

No of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

This course aims at giving students theoretical understanding about the basic constituents of matter – atoms, ions and molecules in terms of their electronic structure and reactivity. Structure and bonding in/of these are to be dealt with basic quantum chemistry treatment. Reactivity of chemical species based on their electron transfer affinity is introduced. Further, periodic classification of elements in the periodic table and changes in properties along the periods and groups to be studied in detail. Accompanying laboratory course is designed for students to have hands-on experience of basic quantitative analytical techniques related to volumetric titrations.

Course Outcomes:

On successful completion, students would have clear understanding of the concepts related to atomic and molecular structure, chemical bonding, periodic properties and redox behaviour of chemical species. Students will also have hands on experience of standard solution preparation in different concentration units and learn volumetric estimation through acid-base and redox reactions.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment /Evaluation
Unit-1	1	Atomic structure	10	Students would have clear understanding of the concepts related to atomic and molecular structure which is the back bond of all natural science.	Lecture cum smart class and exercise	Quiz/Unit test/Seminar/ Group Discussion /Assignment
Unit-2	1	Periodicity of elements	12	Students would have clear understanding of elements' periodic in table; physical and chemical characteristics and periodicity.	Lecture cum smart class and demonstration	

Unit-3	1	Chemical Bonding	13	Students would have clear understanding about Chemical bonding	Lecture cum smart class and demonstration	Quiz/Unit test/Seminar/ Group Discussion /Assignment
Unit-4	1	Oxidation reduction	10	Students will also have hands on experience of standard solution preparation in different concentration units and learnt volumetric estimation through acid- base and redox reaction.	Lecture cum smart class and Practical	

N.B. The contact hours for tutorial classes will be 15 hours.

Reference Nooks.

1. Lee, J. D. Concise Inorganic Chemistry, 5th Ed., Oxford University Press, 2008.
2. Douglas, B.E. and Mc Daniel, D.H., Concepts and Models of Inorganic Chemistry, 3rd Ed. Wiley India, 2006.
3. Cotton, F.A., Wilkinson, G. and Gaus, P. L., Basic Inorganic Chemistry, 3rd Ed.,Wiley, 2007.
4. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. 6th Ed., Wiley-VCH,2007.
5. Atkins, P.W. & Paula, J. Physical Chemistry, 11th Ed., Oxford University Press, 2018.
6. Housecroft, C. E. and Sharpe, A. G. Inorganic Chemistry, 5th Ed., Pearson, 2018.
7. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, Literary Licensing, LLC,2012.

Course Teachers:

- 1.Rk. Meghachandra Singh
2. Dr. M. Phalguni Singh
3. Dr. N. Ranita Devi

HoD.....

SEMESTER - I (Year 2020-21 onwards)

Core Course: Physical Chemistry I

Paper Code: CHM-HC-1026

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

1. To introduce the students with various states of matter.
2. To acquaint the students the physical properties of each state of matter and laws related to describe the states.
3. To introduce the students with the elementary ideas of symmetry, symmetry elements and symmetry operations.
4. To make students understand the idea of electrolytes and electrolytic dissociation, salt hydrolysis and acid-base equilibria.

Course Outcomes:

Upon completion of this course the students will be able to

1. get acquainted with the states of matter, their properties and laws applicable to these systems.
2. learn the elementary ideas of symmetry, symmetry elements and symmetry operations.
3. understand the basic ideas of electrolytes and electrolytic dissociation, salt hydrolysis and acid-base equilibria and apply to various processes encountered in our daily life.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Gaseous state: Unit-1	1	Kinetic molecular model of a gas, postulates and derivation of the kinetic gas equation	6	The students will be able to understand the collision frequency; collision diameter; mean free path and viscosity of gases, relation between mean free path and coefficient of viscosity	Lecture/ Discussion/ PPT/	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
	2	Behaviour of real gases, Deviations from ideal gas behaviour	6	The students will have an idea of compressibility factor, causes of deviation from ideal behaviour. Van der Waals equation of state, virial equation of state.	Lecture/ Discussion/ PPT/	
Liquid State: Unit -2	1	Qualitative treatment of the structure of the liquid state; physical properties of liquids and their determination. Effect of addition of various solutes on surface tension and viscosity.	6	The students will get the knowledge of physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of temperature and addition of various solutes on surface tension and viscosity.	Lecture/ Discussion/ PPT/ Practical	

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Molecular and Crystal Symmetry : Unit-3	1	Elementary ideas of symmetry, symmetry elements and symmetry operations	4	Students will learn the elementary ideas of symmetry, symmetry elements and symmetry operations	Lecture/ Discussion/ PPT/	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
Solid State : Unit-4	1	Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, Bragg's law, Analysis of powder diffraction patterns	10	Students will learn the solid state, law of constancy of interfacial angles, rational indices, Miller indices; X-ray diffraction	Lecture/ Discussion/ PPT/	
Ionic Equilibria : Unit-5	1	Strong, moderate and weak electrolytes. Buffer solutions	7	The students will learn the degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect, derivation of Henderson equation, buffer capacity, buffer action and applications of buffers in analytical chemistry and biochemical processes	Lecture/ Discussion/ PPT/ Practical	
	2	Solubility and solubility product of sparingly soluble salts, qualitative treatment of acid – base titration curves. Theory of acid–base indicators	6	Students will learn applications of solubility product principle. Qualitative treatment of acid – base titration curves, selection of indicators and their limitations	Lecture/ Discussion/ PPT/ Practical	

N.B. The contact hours for tutorial classes will be 15 hours.

Reference Books:

1. Atkins, P.W.&Paula, J.deAtkin's Physical ChemistryEd., Oxford University Press (2006).
2. Ball, D.W. Physical Chemistry Thomson Press, India(2007).
3. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
4. Mortimer, R.G. Physical Chemistry 3rd Ed. Elsevier: NOIDA,UP(2009).
5. Puri, B.R.; Sharma, L.R.; Pathania, M. S. Principles of Physical Chemistry, Vishal Publishing Co.(2017)
6. Kapoor, K.L. A Text book of Physical Chemistry (Volume1) McGraw Hill Education; Sixth edition (2019)

Course Teachers:

- (i) Kh. Debendra Meetei
(ii) M. Lokendro Singh
(iii) Dr. K. Gayatri Sharma

HoD:**SEMESTER – II (Year 2020-21 onwards)****Core Course: Organic Chemistry-I****Paper Code: CHM-HC-2016**

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	04 (Theory)	60	75 (Theory)
4	02 (Practical)	30	25 (Practical)

Course Objectives:

- 1)Basic of organic molecules, structure, bonding, reactivity and reaction mechanism
- 2) Stereochemistry of organic molecules- conformation and configuration, asymmetric molecules
- 3) Aromatic compounds and aromaticity, mechanism of aromatic reactions
- 4) Understanding hybridization and geometry of atoms, identifying chiral centers

- 5) Reactivity, stability of organic molecules, structure, stereochemistry
- 6) Electrophiles, nucleophiles, free radicals, electronegativity, resonance and intermediates along the reaction pathways
- 7) Mechanism of organic reactions, substitution vs elimination

Course Outcomes:

Upon completion of this course the students will be able to

- 1) Design and synthesis of Organic molecules
- 2) Structure identification through IR, NMR and Mass spectroscopic data
- 3) Lab/Instrumentation techniques used for analyzing reaction mechanisms
- 4) Advanced soft-wares / Models used for predicting stereochemistry / study of energy minimization of organic molecules.

UNIT-1 : - BASICS OF ORGANIC CHEMISTRY

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Basics of Organic Chemistry (1)	1	Classification, nomenclature and hybridization of organic Compounds	3	The students will be exposed to the naming of organic compounds, hybridization	Lecture/ Discussion/ PPT/ Demonstration/ Practical	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
	2	Electronic Displacement	3	The students will understand the process of electronic movement and their applications	Lecture/ Discussion/ PPT/ Demonstration/ Practical	
	3	Types of organic reaction and their mechanism	3	The students get exposed to the different organic reactions and their mechanism	Lecture/ Discussion/ PPT/ Demonstration/ Practical	

	4	Electrophiles, nucleophiles, homolytic and heterolytic fission, types of reaction intermediate and their stabilities	3	The students will get knowledge about the breakdown of covalent bond and species of electron rich and deficient and reaction intermediate	Lecture/ Discussion/ PPT/ Demonstration/ Practical	
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UNIT-2 :- STEREOCHEMISTRY

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Stereochemistry (2)	1	Different projection formulae and their interconversion	3	The students will be exposed to the different Fischer, Newmann and sawhorse model formulae	Lecture/ Discussion/ PPT/ Demonstration	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
	2	Geometrical isomerism	3	The students will understand the process of different types of isomerism, their applications	Lecture/ Discussion/ PPT/ Demonstration	

3	Optical isomerism	3	The students will understand chirality, enantiomers absolute and relative configuration	
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UNIT-3 :- CHEMISTRY OF ALIPHATIC HYDROCARBON

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Chemistry of Aliphatic Hydrocarbon (3)	1	Chemistry of alkanes	3	The students will be exposed to the preparation of alkanes, reactions	Lecture/ Discussion/ PPT/ Demonstration/ Practical	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
	2	Chemistry of alkene	3	The students will understand the process of preparation, reactions of alkenes and their name reactions	Lecture/ Discussion/ PPT/ Demonstration/ Practical	
	3	Alkynes	3	The students get exposed to the different reactions of alkyne ,their acidity and type	Lecture/ Discussion/ PPT/ Demonstration/ Practical	

	4	Cycloalkanes and Conformation	6	The students will get knowledge about the Baeyer strain theory for stability of cycloalkane, energy diagram of cyclohexane	Lecture/ Discussion/ PPT/ Demonstration	
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UNIT-4 AROMATIC HYDROCARBON

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Aromatic Hydrocarbon (4)	1	Aromaticity	3	The students will be exposed to the characteristics of aromatic compounds	Lecture/ Discussion/ PPT/ Demonstration / Practical	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
	2	Electrophilic substitution reaction in benzene and mechanism	3	The students will understand the electrophilic reactions on benzene	Lecture/ Discussion/ PPT/ Demonstration / Practical	

3	Directing effects of group on benzene	3	The students will understand the ortho/para directing group and meta directing group	Lecture/ Discussion/ PPT/ Demonstration / Practical
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N.B. The contact hours for tutorial classes will be 15 hours.

Reference Books:

1. Morrison, R.N and Boyd, R.N *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education)
2. Finar, I.L *Organic Chemistry* (Volume 1) , Dorling Kindersley (India) Pvt. Ltd.(Pearson Education)
3. Nasipuri, D *Stereochemistry of Organic Compounds* ,Wiley London 1994
4. Kalsi, P.S *Stereochemistry Conformation and Mechanism*, New Age International ,2005
5. Sykes, P. *A guidebook to the mechanism in Organic Chemistry*, Pearson Education
6. Loudon, G M, *Organic Chemistry*, Oxford

Course Teachers :

1. Dr. Th. Brojendro Singh
2. Dr K. Inaomacha Singh
3. N. Surjit Singh

HOD

SEMESTER - II (Year 2020-21 onwards)

Core Course: Physical Chemistry II

Paper Code: CHM-HC-2026

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

1. To introduce the students with Laws of thermodynamics.
2. To give the students the concept of system, variables, heat and work.
3. To make students understand the concept of partial molar quantities and its attributes.
4. To make students understand the theories/thermodynamics of dilute solutions and colligative properties.

Course Outcomes:

Upon completion of this course the students will be able to

1. use thermo chemical equations for calculation of energy and related terms.
2. use of thermodynamics in explaining chemical behavior of solute/ solvent and reactions.
3. correlate the concepts of thermodynamics to our daily life.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Chemical Thermodynamics: Unit-1	1	Intensive and extensive variables; state and path functions; isolated, closed and open systems, Zeroth law and First law of thermodynamics.	8	The students will be able to understand the concept of heat, q , work, w , internal energy, U , enthalpy, H , calculations of q , w , U and H for reversible, irreversible and free expansion of gases	Lecture/ Discussion/ PPT	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
	2	Thermochemistry	6	The students will gain some idea of heats of reactions and its applications	Lecture/ Discussion/ PPT/ Practical	
	3	Second and third law of thermodynamics and free energy functions	8	The students will learn the concept of entropy, thermodynamic scale of temperature, concept of residual entropy, calculation of absolute entropy of molecules. Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.	Lecture/ Discussion/ PPT	

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Systems of Variable Composition:: Unit- 2	1	Partial molar quantities, Gibbs-Duhem equation,	7	Students will learn the dependence of thermodynamic parameters on composition, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.	Lecture/ Discussion /PPT	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
Chemical Equilibrium : Unit-3	1	Criteria of thermodynamic equilibrium, Equilibrium constants and their quantitative dependence on temperature, pressure and concentration	8	Students will learn the elementary ideas of chemical equilibrium in ideal gases, concept of fugacity, Le Chatelier principle	Lecture/ Discussion /PPT	
Solutions and Colligative Properties: Unit- 4	1	Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation of the four colligative properties using chemical potential	8	The students will be able to learn the thermodynamic derivation of the four colligative properties	Lecture/ Discussion / PPT/ Practical	

N.B. The contact hours for tutorial classes will be 15 hours.

Reference Books:

1. Peter, A. & Paula, J.de. *Physical Chemistry* 9th Ed., Oxford University Press(2011).
2. Castellan, G.W. *Physical Chemistry* 4th Ed., Narosa (2004).
3. Levine, I.N. *Physical Chemistry* 6thEd., Tata McGraw Hill (2010).
4. Kapoor, K. L. *A Textbook of Physical Chemistry (Volume 2)* McGraw Hill Education; Sixth edition (2019)

Course Teachers:

- (i) Kh. Debendra Meetei
- (i) M. Lokendro Singh
- (iii) Dr. K. Gayatri Sharma

HoD:

SEMESTER -III (Year 2021-22 onwards)
Core Course: **INORGANIC CHEMISTRY-II**
Paper Code: **CHM-HC-3016**

No. of Hours per Week	Credits	Total No. Of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

This course starts with the basic principles of metallurgy so as to acquaint the students with the application of the redox chemistry they have learnt in the earlier course on inorganic chemistry. Concepts of protonic and non-protonic acids and bases are introduced for students to appreciate different types of chemical reactions. Periodic behaviour of s and p block elements related to their electronic structure and their reactivity is included to acquaint students with the principles governing their reactivity. This course further intend to apprise students about the variety of compounds of the main group elements including oxides, hydrides, nitrides, inter halogens, noble gases and inorganic polymers. As part of the accompanying lab course, experiments involving iodo- and iodi-metric titrations are included for the students to explore other varieties of redox titration. Preparation of simple inorganic compounds is introduced to give hands-on experience of inorganic synthesis.

Course Outcomes:

On successful completion of this course students would be able to apply theoretical principles of redox chemistry in the understanding of metallurgical processes. Students will be able to identify the variety of s and p block compounds and comprehend their preparation, structure, bonding, properties and uses. Experiments in this course will boost their quantitative estimation skills and introduce the students to preparative methods in inorganic chemistry.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment /Evaluation
Unit-1	1	General Principles of Metallurgy	8	On successful completion of this course students would be able to apply Theoretical principles of redox chemistry in the understanding of metallurgical processes.	Lecture cum smart class and exercise	Quiz/Unit test/Seminar/ Group Discussion /Assignment
Unit-2	1	Acids and Bases	8	Students will have the knowledge of Bronsted-Lowry concept of acid-base reactions, Lewis acid-base concept, Hard and Soft Acids and Base (HSAB), application of HSAB principles.	Lecture cum smart class and Practical	
Unit-3	1	Chemistry of <i>s</i> and <i>p</i> Block Elements	12	Students will be able to identify the variety of <i>s</i> and <i>p</i> block compounds and comprehend their preparation, structure, bonding, properties and uses.	Lecture cum smart class and practical	
Unit-4	1	Noble Gases	10	Students would have clear knowledge about the specific properties of Noble gas elements	Lecture cum smart class and demonstration	
Unit-5	1	Inorganic Polymers	7	Students will learn the chemistry of inorganic polymers. They also learn the brief introduction of preparation, structure and properties of some industrially important and technologically promising polymers.	Lecture cum smart class and demonstration	

N.B. The contact hours for tutorial classes will be 15 hours.

Reference Nooks.

1. Lee, J. D., Concise Inorganic Chemistry, 5th Ed., Oxford University Press, 2008.
2. Douglas, B.E. and Mc Daniel, D.H., Concepts and Models of Inorganic Chemistry, 3rd Ed. Wiley India, 2006.
3. Greenwood, N.N. & Earnshaw, A., Chemistry of the Elements, 2nd Ed., Elsevier India, 2010.
4. Cotton, F.A., Wilkinson, G. and Gaus, P. L., Basic Inorganic Chemistry, 3rd Ed., Wiley, 2007.
5. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. 6th Ed., Wiley-VCH, 2007.
6. Miessler, G. L. & Tarr, D. A., Inorganic Chemistry 4th Ed., Pearson, 2010.
7. Weller, M., Armstrong, F., Rourke, J. & Overton, T., Inorganic Chemistry 6th Ed. 2015.

Course Teachers:

1. Rk. Meghachandra Singh
2. Dr. M. Phalguni Singh
3. Dr. N. Ranita Devi

HoD

SEMESTER-III (Year 2021-22 onwards)**Core Course : Organic Chemistry- II****Paper Code : CHM-HC-3026**

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

1. Familiarization about classes of organic compounds and their methods of preparation.
2. Basic uses of reaction mechanisms.
3. Name reactions, uses of various reagents and the mechanism of their action.
4. Preparation and uses of various classes of organic compounds.
5. Organometallic compounds and their uses.
6. Organic chemistry reactions and reaction mechanisms.
7. Use of reagents in various organic transformation reactions

Course Learning Outcomes:

1. Elucidating reaction mechanisms for organic reactions.
2. Organometallic compounds and their uses.
3. Use of active methylene groups inorganic mechanism and preparation of new organic compounds.

UNIT-1 : CHEMISTRY OF HALOGENATED HYDROCARBONS

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Chemistry of halogenated hydrocarbons (1)	1	Alkyl halide (preparation, reactions and their mechanism)	3	The Students will be able to know about the preparation and reaction mechanism of alkyl halide	Lecture, discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Aryl halide (preparation, reactions and their mechanism)	3	The Students will be able to know about the preparation and reaction mechanism of aryl halide	Lecture, discussion and practical	
	3	Organo metallic compounds	3	The Students get exposed to the preparation of organometallic compounds of Mg and Li and their applications	Lecture, discussion and practical	

UNIT-2 :- ALCOHOLS, PHENOLS, ETHERS AND EPOXIDES

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Alcohols, Phenols, Ethers and Epoxides (2)	1	Alcohols (preparation, reactions and their mechanism, types)	3	The Students will be able to know about the preparation and reaction mechanism of alcohol	Lecture, discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Phenol (preparation, reactions and their mechanism)	4	The Students will be able to know about the preparation and reaction mechanism and name reactions of phenol	Lecture, discussion and practical	
	3	Ethers and Epoxides	3	The Students get exposed to the preparation of ether and epoxide and their reactions	Lecture, discussion and practical	

UNIT-3 :- CARBONYL COMPOUNDS

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Carbonyl Compounds (3)	1	Aldehydes and Ketones (preparation, name reactions and their mechanisms)	5	The Students will understand the preparation of carbonyl compound and their name reactions and mechanism	Lecture , discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Unsaturated carbonyl compounds	2	The Students will be able to know about the preparation and reaction unsaturated carbonyl compounds	Lecture and discussion	
	3	Preparation and synthetic applications of diethyl malonate	3	The Students get exposed to the preparation	Lecture and discussion	

		and ethyl acetoacetate.		and application of diethyl malonate and ethyl acetoacetate		
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UNIT-4 :- CARBOXYLIC ACIDS AND THEIR DERIVATIVES

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Carboxylic acids and their derivatives (4)	1	Preparation, physical properties and reactions of monocarboxylic acids	4	The Students will understand the preparation of carboxylic acid and their name reactions and mechanism	Lecture , discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Dicarboxylic acids, hydroxy acids and unsaturated acids	3	The Students will be able to know about the preparation and reaction of unsaturated, hydroxy and di carboxylic acid	Lecture and discussion	
	3	Specific Name reactions of carboxylic acid	3	The Students get exposed to different name reactions of carboxylic acids	Lecture and discussion	

UNIT-5 :- Sulphur containing compounds

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Sulphur containing compounds (5)	1	Preparation of thiol, sulphonic acid and thioether	3	The Students will understand the preparation of sulphur containing compounds	Lecture , discussion	Quiz/Class test/Seminar/Assignment
	2	Chemical reactions of thiol, sulphonic acid and thioether	3	The Students will be able to know about the reaction of sulphur containing compounds	Lecture and discussion	

N.B.: The contact hours for tutorial classes will be 15 hours.

Recommended Books:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
4. Clayden, J., Greeves, N. & Warren, S. *Organic Chemistry*, Second edition, Oxford University Press, 2012.
5. Keeler, J., Wothers, P. *Chemical Structure and Reactivity – An Integrated approach*, Oxford University Press.
6. Smith, J. G. *Organic Chemistry*, Tata McGraw-Hill Publishing Company Limited.
7. Carey, F. A.; Sundberg, R. J. *Advanced Organic Chemistry: Reactions and Synthesis (Part B)*, Springer.

Course Teachers:

1. *Dr Th. Brojendro Singh*
2. *Dr. K. Inaomacha Singh*
3. *N. Surjit Singh*

HOD.**Semester – III (Year 2021-22 onwards)****Core Course: Physical Chemistry III****Paper Code: CHM-HC-3036**

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

1. To introduce the students with the idea of phase and phase equilibria.
2. To make the students understand the kinetics of chemical reactions and various associated theories chemical kinetics.
3. To introduce the students with the concept of catalysis.
4. Tho teach the students the adsorption process and the adsorption isotherms.

Course Outcomes:**Upon completion of this course the students will be able to**

1. learn phase rule and its application in some specific systems.
2. understand rate laws of chemical transformation, experimental methods of rate law determination, steady state approximation etc.
3. understand different types of surface adsorption processes and basics of catalysis including enzyme catalysis, acid base catalysis

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Phase Equilibria: Unit-1	1	Gibbs Phase Rule, Phase Diagram, Nernst Distribution law,	13	The students will be able to understand the concept of phase, component and degrees of freedom, phase diagram of one and two component systems, Nernst distribution law	Lecture/ Discussion/ PPT/ Practical	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
Chemical Kinetics: Unit-2	1	Order and molecularity, integrated rate equation, complex reactions, collision theory, Lindemann mechanism	12	The students will get some idea about kinetics of chemical reactions and various theories associated with chemical kinetics.	Lecture/ Discussion/ PPT/ Practical	

Catalysis: Unit-3	1	Catalysts, types of catalysis, enzyme catalysis and acid-base catalysis	10	The students will learn the types of catalysis, mechanism of catalysis, Michaelis - Menten mechanism	Lecture/ Discussion/ PPT/	
Surface chemistry: Unit-4	1	Adsorption, types of adsorption, adsorption isotherms	10	The students will get the knowledge of the process of adsorption, theories of adsorption and adsorption isotherms	Lecture/ Discussion/ PPT/ Practical	

N.B.: The contact hours for tutorial classes will be 15 hours.

Reference Books:

1. Peter Atkins & Julio De Paula, *Physical Chemistry 9th Ed.*, Oxford University Press(2010).
2. Castellan, G. W. *Physical Chemistry*, 4th Ed., Narosa (2004).
3. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.*, Prentice-Hall (2012).
4. Levine, I. N. *Physical Chemistry 6th Ed.*, Tata McGraw-Hill (2011).
5. Puri, B. R.; Sharma, L. R.; Pathania, M. S. Principles of Physical Chemistry, Vishal Publishing Co.; 47th Ed. (2017)
6. Kapoor, K. L. A Textbook of Physical Chemistry (Volume 5) McGraw Hill Education; 5th edition (2017)

Course Teacher: (i) **M. Lokendro Singh**
 (ii) **Dr. K. Gayatri Sharma**

HoD:

SEMESTER - III (Year 2021-22 onwards)
Skill Enhancement Course: Basic Analytical Chemistry
Paper Code: CHM-SE-3034

No. of Hours per Week	Credits	Total No. of Hours	Marks
4	3 (Theory)	45	75 (Theory)
2	1 (Practical)	15	25 (Practical)

Course Objectives:

1. To familiarize students with different micro and semi micro analytical techniques.
2. To help develop the ability to use modern instrumental methods for chemical analysis of food, soil, air and water.

Course Outcomes:

Upon completion of this course the students will be able to

1. explain the basic principles of chemical analysis, design/implement micro scale and semi micro experiments.
2. use modern instrumental methods for chemical analysis of food, soil, air and water and record, interpret and analyze data following scientific methodology.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Introduction	1	Introduction to Analytical Chemistry	5	The students will be able to understand the concept of sampling, importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.	Lecture/ Discussion/ PPT/	

Analysis of soil	1	Composition of soil, Concept of pH and pH measurement of soil sample	5	The students will learn determination of pH of soil samples, estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.	Lecture/ Discussion/ PPT/ Practical	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
Analysis of water	1	Sources responsible for contaminating water, water sampling methods, water purification methods.	4	The students will be able to know the determination of pH of a water sample, Determination of dissolved oxygen (DO) of a water sample.	Lecture/ Discussion/ PPT/ Practical	
Analysis of food products	1	Idea about food processing and food preservations and adulteration.	4	Students will learn identification of adulterants in some common food items like coffee powder, chilli powder, turmeric powder, coriander powder and pulses, etc.	Lecture/ Discussion/ PPT/	

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Chromatography	1	General introduction on principles of chromatography, paper chromatography, TLC etc.	4	Students will learn the paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}), compare paint samples by TLC method.	Lecture/ Discussion/ PPT/ Practical	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
Ion-exchange	1	Ion-exchange chromatography	4	The students will learn the basics of ion exchange chromatography, exchange capacity of ion exchanger	Lecture/ Discussion/ PPT/	

Analysis of cosmetics	1	Major and minor constituents of cosmetics and their functions	4	The students will be able to learn the analysis of deodorants and antiperspirants, determination of constituents of talcum powder	Lecture/ Discussion/ PPT/	
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N.B: The contact hours for tutorial classes will be 15 hours.

Reference Books:

1. Willard, H.H. *Instrumental Methods of Analysis*, CBS Publishers.
2. Skoog & Lerry. *Instrumental Methods of Analysis*, Saunders College Publications, New York.
3. Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry 6th Ed.*, Saunders College Publishing, Fort Worth(1992).
4. Dean, J.A. *Analytical Chemistry Notebook*, McGraw Hill.
5. Day, R.A. & Underwood, A.L. *Quantitative Analysis*, Prentice Hall of India.
6. Freifelder, D. *Physical Biochemistry 2nd Ed.*, W.H.Freeman and Co., N.Y.USA(1982).
7. Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA.16(1977).
8. Vogel, A.I. *Vogel's Qualitative Inorganic Analysis 7th Ed.*, Prentice Hall.
9. Vogel, A.I. *Vogel's Quantitative Chemical Analysis 6th Ed.*, Prentice Hall.
10. Robinson, J.W. *Undergraduate Instrumental Analysis 5th Ed.*, Marcel Dekker, Inc., New York (1995).

Course Teacher:

- (i) Dr. M. Phalguni Singh
- (ii) Dr. K. Inaomacha Singh
- (iii) Dr. N. Ranita Devi

HoD:

SEMESTER-IV (Year: 2021-22 onwards)Core Course: **INORGANIC CHEMISTRY-III**Paper Code: **CHM-HC-4016**

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

This course introduces students to coordination chemistry. Various aspects like nomenclature, structure, bonding, variety and reactivity of the coordination compounds are included for the students to appreciate. Bioinorganic chemistry is included in this course to acquaint students on the useful and harmful aspects of metals in biological systems. Through the accompanying lab course, experiments related to gravimetric analysis, synthesis of coordination compounds and separation of metal ions using chromatography is included. This will broaden the experimental skills of the students where students will learn about various aspects of experiment design depending upon the requirements like synthesis, estimation or separation.

Course Outcomes:

On successful completion, students will be able name coordination compounds according to IUPAC, explain bonding in this class of compounds, understand their various properties in terms of CFSE and predict reactivity. Students will be able to appreciate the general trends in the properties of transition elements in the periodic table and identify differences among the rows. Through the experiments students not only will be able to prepare, estimate or separate metal complexes/compounds but also will be able to design experiments independently which they should be able to apply if and when required.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment /Evaluation
Unit-1	1	Coordination Chemistry	10	On successful completion, students will be able to name coordination compounds according to IUPAC, explain bonding in this class of compounds, understand their various properties in terms of CFSE and predict reactivity.	Lecture cum smart class and exercise	

Unit-2	1	Transition Elements	14	Students will be able to appreciate the general trends in the properties of transition elements in the periodic table and identify differences among the rows.	Lecture cum smart class and demonstration	Quiz/Unit test/Seminar/ Group Discussion /Assignment
Unit-3	1	Lanthanoids and Actinoids	12	Students will have understanding of elements' periodic in table; physical and chemical characteristics and periodicity of lanthanoids and Actinoids.	Lecture cum smart class and demonstration	
Unit-4	1	Bioinorganic Chemistry	9	Students will have the knowledge of useful and harmful aspects of metals in biological systems.	Lecture cum smart class and demonstration	

N.B. The contact hours for tutorial classes will be 15 hours.

Reference Nooks.

1. Cotton, F.A., Wilkinson, G. and Gaus, P. L., Basic Inorganic Chemistry, 3rd Ed., Wiley, 2007.
2. Huheey, J. E., Keiter, E. A., Keiter, R. L., Medhi, O. K., Inorganic Chemistry: Principles of Structure and Reactivity, 4th Ed., Pearson Education India, 2006.
3. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry, Panima Publishing Company, 1994.
4. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. 6th Ed., Wiley-VCH, 2007.
5. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.
6. Greenwood, N.N. & Earnshaw, A., Chemistry of the Elements, 2nd Ed., Elsevier India, 2010.

Course Teachers:

1. Rk. Meghachandra Singh
2. Dr. M. Phalguni Singh
3. Dr. N. Ranita Devi

HoD.....

SEMESTER-IV (Year 2021-22 onwards)

Core Course : Organic Chemistry- III

Paper Code : CHM-HC-4026

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	45	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

1. Nitrogen containing functional groups and their reactions.
2. Familiarization with poly nuclear hydrocarbons and their reactions.
3. Heterocyclic compounds and their reactions.
4. Alkaloids and Terpenes
5. Understanding reactions and reaction mechanism of nitrogen containing functional groups.
6. Understanding the reactions and mechanisms of diazonium compounds.
7. Understanding the structure and their mechanism of reactions of selected polynuclear hydrocarbons.
8. Understanding the structure, mechanism of reactions of selected heterocyclic compounds.
9. Classification, structure, mechanism of reactions of few selected alkaloids and terpenes.

Course Learning Outcomes:

1. Use of benzene diazonium salt in organic synthesis.
2. Applications of heterocyclic compounds in pharmaceuticals/drugs and the mechanism of actions.
3. Pharmaceuticals / Biomedical applications of alkaloids and terpenes.
4. Nitrogen containing organic compounds / heterocyclic compounds in synthetic chemistry.

UNIT-1 : Nitrogen Containing Functional Groups

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Nitrogen Containing Functional Groups (1)	1	Nitro compound, nitrile and isonitrile	4	The Students will be able to know about the preparation and reaction mechanism of nitrogen containing functional groups	Lecture, discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Amines	4	The Students will be able to know about the preparation, properties, basicity and reaction of amines	Lecture, discussion and practical	
	3	Diazonium salt	4	The Students get exposed to the preparation of diazonium salt and its applications in conversion	Lecture and discussion	

UNIT-2 : Polynuclear Hydrocarbons

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Polynuclear Hydrocarbons (2)	1	Napthalene, its preparation and reactions	3	The Students will be able to know about the preparation, structure determination and reaction napthalene	Lecture and discussion	Quiz/Class test/Seminar/Assignment
	2	Anthracene and phenanthrene	3	The Students will be able to know about the preparation ,reactions and structures of anthracene and phenanthrene	Lecture and discussion	

UNIT-3 :- Heterocyclic Compounds

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Heterocyclic Compounds (3)	1	Classification and nomenclature of heterocyclic compounds	3	The Students will be able to know about the different types of heterocyclic compounds and their naming	Lecture and discussion	Quiz/Class test/Seminar/Assignment
	2	Synthesis and reactions of five membered heterocyclic compounds	4	The Students will be able to know about the preparation and reactions of furan, thiophene, pyrrol	Lecture and discussion	
	3	Synthesis and reactions of six membered heterocyclic compounds	3	The Students get exposed to the preparation and reaction of pyridine, pyrimidine	Lecture and discussion	
	4	Synthesis and reactions of fused ring system of heterocyclic compound	4	The Students get exposed to the preparation and reaction of Indole, Quinoline and isoquinoline	Lecture and discussion	

UNIT-4 : Alkaloids

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Alkaloids (4)	1	Natural occurrence, General structural features, Isolation and physiological action of alkaloids	3	The Students will be able to know about the occurrence, isolation and structures of alkaloids	Lecture, discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Structure elucidation and synthesis of Nicotine	2	The Students will be able to know about the synthesis of nicotine and its structure	Lecture and discussion	

	3	Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.	2	The Students get exposed to the medicinal importance of many alkaloids	Lecture and discussion	
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UNIT-5 : Terpenes

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Terpenes (5)	1	Occurrence, classification, isoprene rule of terpenes	3	The Students will be able to know about the occurrence, isolation and classification of terpenes	Lecture and discussion	Quiz/Class test/Seminar/Assignment
	2	structure and synthesis of Citral, Neral and α -terpineol.	3	The Students will be able to know about the synthesis of many terpenes	Lecture and discussion	

N.B. The contact hours for tutorial will be 15 hours.

Recommended Books:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
5. Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
6. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, Oxford University Press.
7. Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Parakashan (2010).

Course Teachers:

1. Dr. Th. Brojendro Singh
2. Dr. K. Inaomacha Singh
3. N. Surjit Singh

HOD.....

SEMESTER - IV (Year 2021-22 onwards)

Core Course: Physical Chemistry IV

Paper Code: CHM-HC-4036

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

1. To introduce the students with the concepts of conductance, strong and weak electrolytes.
2. To make the students understand the working of electro chemical cells, EMF measurement and their applications.
3. To study the electrical and magnetic properties of atoms and molecules

Course Outcomes:

Upon completion of this course the students will be able to

1. understand the basic principles of conductance and electrochemistry
2. understand some important topics such as solubility and solubility products, ionic products of water, conductometric titration etc.
3. apply EMF measurements in different fields of chemistry
4. gain basic theoretical idea of electrical & magnetic properties of atoms and molecules.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Conductance: Unit-1	1	Arrhenius theory of electrolytic dissociation. Conductivity, weak and strong electrolytes. Kohlrausch law of independent migration of ions	6	The students will be able to understand electrolytic dissociation. Equivalent and molar Conductance and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution.	Lecture/ Discussion/ PPT/ Practical	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
	2	Debye- Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules. Ionic velocities, mobilities and Transport number	6	The students will have an idea of ionic velocities and determination of transference numbers using Hittorf and Moving Boundary methods	Lecture/ Discussion/ PPT	
	3	Applications of conductance measurement	5	The students will be able to know the applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.	Lecture/ Discussion/ PPT/ Practical	

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Electrochemistry: Unit-2	1	Faraday's laws of electrolysis, Chemical cells. EMF of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells	10	Students will learn the reversible and irreversible cells. Electromotive force of a cell and its measurement, Nernst equation.	Lecture/ Discussion/ PPT/	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
	2	Application of EMF measurements. Concentration cells	8	The students will learn applications of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH also Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers.	Lecture/ Discussion/ PPT/ Practical	
Electrical & Magnetic Properties of Atoms and Molecules: Unit-3	1	Basic ideas of electrostatics, Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment and molecular polarizabilities	6	Students will learn electrostatics of dielectric media, dipole moment and molecular polarizabilities	Lecture/ Discussion/ PPT/ Practical	
	2	Diamagnetism, paramagnetism, magnetic susceptibility	4	Students will get some idea on diamagnetism, paramagnetism, magnetic susceptibility and its measurement, molecular interpretation	Lecture/ Discussion/ PPT/ Practical	

N.B.: The contact hours for tutorial classes will be 15 hours.

Reference Books:

1. Atkins, P.W & Paula, J.D. *Physical Chemistry*, 9th Ed., Oxford University Press
2. Castellan, G. W. *Physical Chemistry 4th Ed.*, Narosa (2004).
3. Mortimer, R. G. *Physical Chemistry 3rd Ed.*, Elsevier: NOIDA, UP (2009).
4. Barrow, G. M., *Physical Chemistry 5th Ed.*, Tata McGraw Hill: New Delhi (2006).
5. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.*, Prentice-Hall (2012).
6. Rogers, D. W. *Concise Physical Chemistry* Wiley (2010).
7. Silbey, R. J.; Alberty, R. A. & Bawendi, M. G. *Physical Chemistry 4th Ed.*, John Wiley & Sons, Inc. (2005).
8. Puri, B. R.; Sharma, L. R.; Pathania, M. S. *Principles of Physical Chemistry*, Vishal Publishing Co.; 47th Ed. (2017)
9. Kapoor, K. L. *A Textbook of Physical Chemistry (Volume 1)* McGraw Hill Education; Sixth edition (2019)

Course Teachers: (i) M. Lokendro Singh
(ii) Dr. K. Gayatri Sharma

HoD:

SEMESTER – IV (Year 2021-22 onwards)
Skill Enhancement Course: Pesticide Chemistry
Paper Code: CHM-SE-4054

No. of Hours per Week	Credits	Total No. of Hours	Marks
4	3 (Theory)	45	75 (Theory)
2	1 (Practical)	15	25 (Practical)

Course Objective: *This is a brief and introductory course on pesticides, through which the students will be introduced to various classes of pesticides, their synthesis, applications and possible hazards of their uses.*

Course Learning Outcome: *Students will be able to explain or describe and critically examine different types of pesticides, their activity/toxicity and their applications and the need for the search of an alternative based on natural products.*

PESTICIDES

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
PESTICIDES	1	Definition, classification and synthesis of different pesticides	10	The students will be able to know about the different types of pesticides	Lecture , discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Benefits and adverse effects of pesticides	6	The students will be able to know about the uses and harmful effects of pesticides	Lecture, discussion	
	3	Mode of action, toxicity and methods of pesticides residue analysis	6	The students will be able to know about the toxicity of pesticides	Lecture, discussion	
	4	Synthesis and technical manufacture and uses of pesticides	8	The students will be able to know about the synthesis of pesticides	Lecture, discussion and practical	

N.B. The contact hours for tutorial classes will be 15 hours.

Recommended Book:

1. R. Cremlyn: Pesticides, Preparation and Mode of Action, John Wiley & Sons, New York, 1978
2. RP Bateman, Pesticide Applications, AAB Press, 2004
3. Principles of Pesticide chemistry: S K Handa, Ed. by Agrobios (India), 2008
4. Pesticide Science & Biotechnology: R Greenhalgh and T R Robers, IUPAC, Blackwell Scientific Publications, 1987
5. The Chemical Process Industries: D N Shreve
6. Pesticide Chemistry : G Matolesy, M. Nadasy, V. Andriska, Elsevier Sc. Publisher, USA, 1988.

Course Teachers:

1. Dr N. Ranita Devi
2. N. Surjit Singh

HOD.....

SEMESTER-V (Year 2022-23 onwards)**Core Course : Organic Chemistry- IV****Paper Code : CHM-HC-5016**

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives: This course introduces students to nucleic acids, amino acids and pharmaceutical compounds. Students will be familiarized with the importance of nucleic acids, amino acids and develop basic understanding of enzymes, bioenergetics and pharmaceutical compounds.

Course Learning Outcomes: Students will be able to explain/describe the important features of nucleic acids, amino acids and enzymes and develop their ability to examine their properties and applications.

UNIT-1 : Nucleic Acid

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Nucleic acid (1)	1	Composition of nucleic acid ,types difference	4	The Students will be able to know about the nucleic acids	Lecture and discussion	Quiz/Class test/Seminar/Assignment
	2	Synthesis of many nitrogenous bases	4	The Students will be able to know about the synthesis of adenine, guanine, cytosine, uracil and thymine	Lecture and discussion	

UNIT-2 :- Amino Acids, Peptides and Proteins

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Amino Acids, Peptides and Proteins (2)	1	Amino acids	3	The Students will understand different types of amino acids and their synthesis and characteristics	Lecture , discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Peptides	3	The Students will be able to know about the synthesis of peptides	Lecture and discussion	
	3	Proteins	2	The Students get exposed to the preparation and application and types of protein	Lecture, discussion and practical	

UNIT-3 :- ENZYMES

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Enzymes (3)	1	classification and characteristics of enzymes	2	The Students will understand different types of enzymes and their characteristics	Lecture, discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Salient features of active site of enzymes. Mechanism of enzyme action, factors affecting enzyme action	3	The Students will be able to know about the mechanism of enzyme action	Lecture, discussion and practical	
	3	coenzymes and cofactors, enzyme inhibitors and their importance,	3	The Students get exposed to the functions of coenzymes, cofactors and enzyme inhibitors	Lecture and discussion	

UNIT-4 : Lipids

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Lipids (4)	1	oils and fats	2	The Students will be able to know about the difference between oil and fat	Lecture, discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Hydrogenation of fats and oils, saponification value, acid value, iodine number, rancidity.	3	The Students will be able to know about different terms used in lipid formation	Lecture, discussion and practical	

UNIT-5:- Concept of Energy in Biosystem

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Concept of Energy in Biosystem(5)	1	catabolism, anabolism	2	The Students will understand different metabolism of energy obtained	Lecture , discussion	Quiz/Class test/Seminar/Assignment
	2	glycolysis, fermentation, Krebs cycle.	3	The Students will be able to know about the mechanism of carbohydrate	Lecture and discussion	
	3	metabolic pathways of protein, fat and carbohydrate	3	The Students get exposed to the functions of protein, fat and carbohydrates	Lecture and discussion	

UNIT-6:- Pharmaceutical Compounds: Structure and Importance

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Pharmaceutical Compounds: Structure and Importance (6)	1	Antipyretic and analgesic drugs	3	The Students will understand different synthesis of drugs and their synthesis	Lecture , discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Anti malarial drugs and antibiotics	3	The Students will be able to know about the synthesis of chloroquine and chloramphenicol	Lecture and discussion	
	3	Medicinal values of curcumin (turmeric), azadirachtin (neem), vitamin C and antacid (ranitidine).	2	The Students get exposed to the functions of many drugs	Lecture and discussion	

N.B. The contact hours for tutorial classes will be 15 hours.

Recommended Books:

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VIth Edition. W.H. Freeman and Co.
2. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
3. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill.

Course Teachers:

1. Dr. Th. Brojendro Singh
2. Dr. K. Inaomacha Singh
3. N. Surjit Singh

HOD.....

SEMESTER - V (Year 2022-23 onwards)

Core Course: Physical Chemistry V

Paper Code: CHM-HC-5026

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

1. To introduce the students with three important areas of physical chemistry- quantum chemistry, molecular spectroscopy and photochemistry.
2. To make the students understand the applications of quantum mechanical ideas in some simple systems such as particle in a box, rigid rotor, simple harmonic oscillator etc.
3. To acquaint the students some important areas in spectroscopy viz. rotational, vibrational, Raman, electronic, spin resonance, and electronic spectroscopy.
4. To make the students understand the photochemical and photophysical processes.

Course Outcomes:

Upon completion of this course the students will be able to

1. Get acquainted with the application of quantum mechanics in some simple chemical systems such as hydrogen atom or hydrogen like ions.
2. Learn covalent bonding of some simple molecular systems.
3. Understand the basics of various kinds of spectroscopic techniques and photochemistry.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Quantum Chemistry: Unit-1	1	Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and particle in a box.	4	The students will be able to understand the quantization of energy levels, separation of variables, degeneracy.	Lecture/ Discussion/ PPT	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
	2	Simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution	4	The students will have an idea of vibrational energy of diatomic molecules and zero-point energy.	Lecture/ Discussion/ PPT	
	3	Angular momentum quantization of square of total angular momentum and z-component. Rigid rotator model of diatomic molecule.	4	The students will be able to know the transformation of Schrödinger equation to spherical polar coordinates and the solution.	Lecture/ Discussion/ PPT	
	4	Treatment of hydrogen atom and hydrogen-like ions. Variation theorem and application to simple systems.	4	Students will learn setting up of Schrödinger equation for one as well as many electron systems	Lecture/ Discussion/ PPT	
	5	Covalent bonding: valence bond and molecular orbital approaches. LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH).	4	Students will learn quantum mechanical treatment of covalent bonding.	Lecture/ Discussion/ PPT	

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Molecular Spectroscopy: Unit -2	1	Interaction of electromagnetic radiation with molecules. Rotation spectroscopy.	5	Students will learn the selection rules, determination of bond lengths of diatomic and linear triatomic molecules and effect of isotopic substitution.	Lecture/ Discussion/ PPT/ practical	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
	2	Vibrational spectroscopy	5	The students will learn dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom of polyatomic	Lecture/ Discussion/ PPT/ practical	
	3	Raman and Electronic spectroscopy:	5	The students will be able to learn the vibrational Raman spectra, Stokes and anti-Stokes lines; electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation	Lecture/ Discussion/ PPT/ Practical	
Photochemistry: Unit -3	1	Electromagnetic radiation, Lambert-Beer's law	5	Students will learn laws of photochemistry, quantum yield	Lecture/ Discussion/ PPT/ Practical	
	2	Kinetics of photochemical and photophysical processes	5	Students will get some idea on the role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.	Lecture/ Discussion/ PPT/ Practical	

N.B. The contact hours for tutorial classes will be 15 hours.

Reference Books:

1. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4thEd. Tata McGraw-Hill: New Delhi (2006).
2. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).
3. Kakkar, R. Atomic & Molecular Spectroscopy, Cambridge University Press(2015).
4. Kapoor, K. L. A Textbook of Physical Chemistry (Volume 4) McGraw Hill 5th edition (2017)
5. McQuarrie, D. A. Quantum Chemistry, Viva Books (2016)

Course Teacher: (i) M. Lokendro Singh
(ii) Dr. K. Gayatri Sharma

HoD:

SEMESTER-V (Year 2022-23 onwards)

DSE Course: **ANALYTICAL METHODS IN CHEMISTRY**

Paper Code: **CHM-HE-5026**

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

This is an elective course designed to complement the needs of students who wish to learn more about the qualitative/quantitative characterization and separation techniques. The content of this course aims to cover some of the widely used instrumental techniques for characterization of samples. Experiments included aim at giving students hands on experience using different instrumental techniques and chemical analysis.

Course Outcomes:

On successful completion students will be have theoretical understanding about choice of various analytical techniques used for qualitative and quantitative characterization of samples. At the same time through the experiments students will gain hands on experience of the discussed techniques. This will enable students to take judicious decisions while analyzing different samples.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment /Evaluation
Unit-1	1	Qualitative and quantitative aspects of analysis	9	The students will have knowledge of analytical data, errors, accuracy and precision	Lecture cum smart class and exercise	Quiz/Unit test/Seminar/ Group Discussion /Assignment
Unit-2	1	Optical methods of analysis	8	The students will understand about fundamental laws of spectroscopy, UV, IR and Flame atomic absorption and emission Spectroscopy	Lecture cum smart class and demonstration	
Unit-3	1	Thermal methods of analysis	12	The students will understand about the theory of TG, Instrumentation and techniques of quantitative estimation of Ca and Mg	Lecture cum smart class and demonstration	
Unit-4	1	Electro-analytical methods	8	The students will have knowledge of electro-analytical methods namely pH metric, Potentiometric and conductometric titrations and techniques for determination of pKa values	Lecture cum smart class and practical	
Unit-5	1	Separation techniques	8	The students will have knowledge of different solvent extraction techniques and its mechanisms, Classification of different chromatography techniques and its working principles	Lecture cum smart class and practical	

N.B. The contact hours for tutorial classes will be 15 hours.

Reference Nooks.

1. Mendham, J. et al.: Vogel's Text Book of Quantitative Chemical Analysis ; 6th Ed. Pearson Education, 2009.
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. CBS Publishers & Distributors, 2004.
3. Christian, Gary D: *Analytical Chemistry*, 6th Ed. Wiley India (P) Ltd., 2004.
4. Harris, Daniel C: *Exploring Chemical Analysis*, 4th Ed. W. H. Freeman, 2008.
5. Khopkar, S.M.: *Basic Concepts of Analytical Chemistry*, 3rd Ed. New Age, International Publisher, 2009.
6. Skoog, D.A. Holler F.J. and Nieman, T. A. *Principles of Instrumental Analysis*, 6th Ed. Thomson Asia Pvt. Ltd. Singapore.
7. Mikes, O. and Chalmes, R. A. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Ltd. London.1979
8. Ditts, R.V. *Analytical Chemistry: Methods of separation*. VanNostrand, New York, 1974.

Course Teachers:

1. Dr K. Inaomacha Singh
2. Dr. M. Phalguni Singh
3. Dr. N. Ranita Devi

HoD.....

SEMESTER - V (Year 2022-23 onwards)

DSE Course: Polymer Chemistry

Paper Code: CHM-HE-5056

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

1. To introduce the theory and applications of polymer chemistry to the students.
2. To make the students understand the applications of some polymeric materials for next generation devices.
3. To acquaint the students some industrially important polymers.

Course Outcomes:

Upon completion of this course the students will be able to

1. Learn the definition and classifications of polymers, kinetics of polymerization, molecular weight of polymers, glass transition temperature, and polymer solutions etc.
2. Learn the preparation, structure and properties of some industrially important and technologically promising polymers.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Introduction and history of polymeric materials: Unit-1	1	Different schemes of classification of polymers	5	The students will learn definitions, Polymer nomenclature, Molecular forces and chemical bonding in polymers.	Lecture/ Discussion/ PPT/	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
Functionality and its importance: Unit-2	1	Classification of polymerization processes	5	The students will learn the relationships between functionality, extent of reaction and degree of polymerization.	Lecture/ Discussion/ PPT/	
Kinetics of Polymerization: Unit-3	1	Mechanism and kinetics of polymerization.	5	The students will be able to know the step growth, radical chain growth, ionic chain polymerizations	Lecture/ Discussion/ PPT/ practical	
Crystallization and crystallinity: Unit-4	1	Determination of crystalline melting point and degree of crystallinity	5	Students will learn the morphology of crystalline polymers, factors affecting crystalline melting point.	Lecture/ Discussion/ PPT/ Practical	
Nature and structure of polymers: Unit -5	1	Structure and Property of polymers	5	Students will be able to learn the structure and property of polymers	Lecture/ Discussion/ PPT/	

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Determination of molecular weight of polymers: Unit-6	1	Viscometry, light scattering and osmotic pressure methods	5	The students will learn different techniques of molecular weight determination of polymer	Lecture/ Discussion/ PPT/ Practical	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
Glass transition temperature (T _g) and determination of T _g : Unit-7	1	Glass transition temperature (T _g) and determination of T _g	5	The students will learn the factors affecting glass transition temperature	Lecture/ Discussion/ PPT/	
Polymer Solution: Unit-8	1	Criteria for polymer solubility, Thermodynamics of polymer solutions	5	The students will be able to know the thermodynamics of polymer solutions	Lecture/ Discussion/ PPT/	
Properties of Polymers: Unit-9	1	Preparation, structure, properties and application of some industrially important polymers	5	Students will learn the preparation, structure, properties and application of some industrially important polymers	Lecture/ Discussion/ PPT/ Practical	

N.B. The contact hours for tutorial classes will be 15 hours.

Reference Books:

1. Seymour's Polymer Chemistry, Marcel Dekker, Inc.
2. G. Odian: Principles of Polymerization, John Wiley.
3. F.W. Billmeyer: Text Book of Polymer Science, John Wiley.
4. P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill.
5. R.W. Lenz: Organic Chemistry of Synthetic High Polymers.

Course Teacher: (i) **Dr K. Inaomacha Singh**
(ii) **Dr. M. Phalguni Singh**
(iii) **Dr. K. Gayatri Sharma**
(iv) **N. Surjit Singh**

HoD:

SEMESTER - VI (Year 2022-23 onwards)

Core Course: **INORGANIC CHEMISTRY-IV**

Paper Code: **CHM-HC-6016**

No of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

The unit on reaction mechanism is included for the students to get acquainted with the kinetic and thermodynamic factors governing the reaction path and stability of inorganic compounds. Organometallic compounds are introduced so as to apprise students about the importance of metal carbon bond to form complexes and their application as catalysts. Students are expected to learn factors leading to stability of organometallic compounds, their synthesis, reactivity and uses. Qualitative inorganic analysis is included to give students an idea and hands on experience of application of inorganic chemistry. Students should learn how differential reactivity under different conditions of pH can be used to identify variety of ions in a complex mixture. Experiments related to synthesis and characterization of coordination compounds are included to supplement their theoretical knowledge.

Course Outcomes:

By studying this course the students will be expected to learn about how ligand substitution and redox reactions take place in coordination complexes. Students will also learn about organometallic compounds, comprehend their bonding, stability, reactivity and uses. They will be familiar with the variety of catalysts based on transition metals and their application in industry. On successful completion, students in general will be able to appreciate the use of concepts like solubility product, common ion effect, pH etc. in analysis of ions and how a clever design of reactions, it is possible to identify the components in a mixture. With the experiments related to coordination compound synthesis, calculation of $10Dq$, controlling factors etc. will make the students appreciate the concepts of theory in experiments.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment /Evaluation
Unit-1	1	Mechanism of Inorganic Reactions	10	By studying this course the students will be expected to learn about how Ligand substitution and redox reactions take place in coordination complexes.	Lecture cum smart class and exercise	Quiz/Unit test/Seminar/ Group Discussion /Assignment
Unit-2	1	Organometallic Compounds	10	Students will also learn about organometallic compounds, comprehend their bonding, stability, reactivity and uses.	Lecture cum smart class and practical	
Unit-3	1	Transition Metals in Catalysis	15	The students will familiar with the variety of catalysts based on transition metals and their application in industry.	Lecture cum smart class and practical	
Unit-4	1	Theoretical Principles in Qualitative Inorganic Analysis (H ₂ S Scheme)	10	On successful completion, students in general will be able to appreciate the use of concepts like solubility product, common ion effect, pH etc. in analysis of ions and how a clever design of reactions, it is possible to identify the components in a mixture.	Lecture cum smart class and Practical	

N.B. The contact hours for tutorial classes will be 15 hours.

Reference Nooks.

1. Vogel, A.I. *Qualitative Inorganic Analysis*, Longman, 1972.
2. Svehla, G. & Sivasankar, B., *Vogel's Qualitative Inorganic Analysis*, 7th Ed., Prentice Hall, 2012.
3. Cotton, F.A., Wilkinson, G. and Gaus, P. L., *Basic Inorganic Chemistry*, 3rd Ed., Wiley, 2007.
4. Cotton, F.A. & Wilkinson, G, *Advanced Inorganic Chemistry*. 6th Ed., Wiley-VCH, 2007.
5. Huheey, J. E., Keiter, E. A., Keiter, R. L., Medhi, O. K., *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th Ed., Pearson Education India, 2006.
6. Sharpe, A.G. *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005
7. Douglas, B.E. and Mc Daniel, D.H., *Concepts and Models of Inorganic Chemistry*, 3rd Ed. Wiley India, 2006.
8. Greenwood, N.N. & Earnshaw, A., *Chemistry of the Elements*, 2nd Ed., Elsevier India, 2010.
9. Lee, J. D., *Concise Inorganic Chemistry*, 5th Ed., Oxford University Press, 2008.
10. Powell, P. *Principles of Organometallic Chemistry*, Chapman and Hall, 1988.
11. Shriver, D.D. & Atkins, P., *Inorganic Chemistry 2nd Ed.*, Oxford University Press.

Course Teachers:

1. Dr. M. Phalguni Singh
2. Dr. N. Ranita Devi

HOD.....

SEMESTER-VI (Year 2022-23 onwards)

Core Course : Organic Chemistry- V

Paper Code : CHM-HC-6026

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives: This is a basic course in organic spectroscopy and provides introduction to carbohydrate chemistry, dyes and polymers.

Students are expected to learn about the different spectroscopic techniques and their applications in organic chemistry. Students shall be apprised with carbohydrate chemistry, dyes and polymers and their structure, reactivity and chemical properties.

Learning Outcome: Students will be able to explain/describe basic principles of different spectroscopic techniques and their importance in chemical/organic analysis. Students shall be able to classify/identify/critically examine carbohydrates, polymers and dye materials.

UNIT-1 :- Spectroscopy

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Spectroscopy (1)	1	UV Spectroscopy	4	The Students will be able to know about bathochromic and hypsochromic shift and the application of Woodward Rules for calculation of λ_{max}	Lecture and discussion	Quiz/Class test/Seminar/Assignment
	2	IR Spectroscopy	4	The Students will be able to know about the application and structural determination by IR Spectroscopy	Lecture, discussion and practical	
	3	NMR Spectroscopy	4	The Students get exposed to the principles and application of NMR Spectroscopy	Lecture, discussion and practical	
	4	Electron Spin Resonance (ESR) spectroscopy	4	The Students get exposed to the principles and application of ESR Spectroscopy	Lecture, discussion	

UNIT-2 :- Carbohydrates

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Carbohydrates (2)	1	Occurrence, classification and biological importance of carbohydrates	3	The Students will be able to know about different types of carbohydrates and their biological importance	Lecture, discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose	4	The Students will be able to know about the mutarotation of glucose and absolute configuration of glucose	Lecture and discussion	
	3	Killiani- Fischer synthesis and Ruff degradation;	4	The Students get exposed to the inter conversion of aldoses and ketoses	Lecture, discussion and practical	
	4	Disaccharides Polysaccharide	3	The Students get exposed to the structures and of different types of disaccharide and polysaccharides	Lecture and discussion	

UNIT-3:- DYES

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Dyes (3)	1	Classification, Colour and constitution of dyes	2	The Students will understand different types of dyes	Lecture, discussion and practical	Quiz/Class test/Seminar/Assignment
	2	Synthesis and applications of different dyes	3	The Students will be able to know about the synthesis of many dyes like azo, phthalein	Lecture and discussion	
	3	Natural dyes Edible Dyes with examples.	2	The Students get exposed to the natural dyes and edible dyes with examples	Lecture and discussion	

UNIT-4:- POLYMERS

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Polymers (4)	1	Classification of polymers	2	The Students will understand different types of polymers	Lecture , discussion	Quiz/Class test/Seminar/Assignment
	2	Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index	3	The Students will be able to know about the determination of molecular mass of polymers	Lecture and discussion	
	3	Polymerisation reactions.	2	The Students get exposed to the synthesis of different types of polymers	Lecture discussion and practical	

N.B. The contact hours for tutorial classes will be 15 hours.

Recommended Books:

- Banwell, C. N. & Mc.Cash, E. M. *Fundamentals of Molecular Spectroscopy*, 4th Edition, McGraw Hill.
- Pavia, Lampman, Kriz & Vyvyan, *Introduction to Spectroscopy*, 5th Edition, CENGAGE Learning.
- Silverstein, R. M.; Webster, F. X.; Kiemle, D. J. & Bryce, D. L. *Spectrometric Identification of Organic Compounds*, 8th Edition, Wiley.
- Kemp, W. *Organic Spectroscopy*, Palgrave.
- Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
- Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.
- Finar, I. L. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
- Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, Oxford University Press.
- Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, PrajatiPrakashan (2010).

Course Teachers:

- Dr K. Inaomacha Singh
- N. Surjit Singh

HoD.....

SEMESTER - VI (Year 2022-23 onwards)
DSE Course: Industrial Chemicals & Environment
Paper Code: CHM-HE-6026

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

This course provides an introduction to the various industrial gases and inorganic chemicals, their manufacturing processes, applications, storage and the hazards of handling them. Contribution of these industrial chemicals towards air and water pollution and their effects on living organisms and the environment has also been covered. Students are also expected to learn about metallurgy, energy generation industry and the pollution threat they pose. This course also discusses about management of the different kinds of wastes, their safe disposal and the importance of practicing green chemistry in chemical industry.

Course Learning Outcomes:

After successful completion of the course, students would have learnt about the manufacture, applications and safe ways of storage and handling gaseous and inorganic industrial chemicals. Students will get to know about industrial metallurgy and the energy generation industry. Students will also learn about environmental pollution by various gaseous, liquid wastes and nuclear wastes and their effects on living beings. Finally, the students will learn about industrial waste management, their safe disposal and the importance of environment friendly “green chemistry” in chemical industry.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Industrial Gases & Inorganic Chemicals: Unit-1	1	Industrial Gases	5	Students will learn about the large scale production, uses, storage and hazards in handling of gases.	Lecture/ Discussion/ PPT/ Practical	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
	2	Inorganic Chemicals	5	Students will learn about the manufacture, applications and safe ways of storage and handling gaseous and inorganic industrial chemicals	Lecture/ Discussion/ PPT/ Practical	
Industrial Metallurgy: Unit-2	1	Industrial Metallurgy	5	Students will be able to know about industrial metallurgy and the energy generation industry.	Lecture/ Discussion/ PPT/ Practical	
Environment and its segments:Unit-3	1	Ecosystems, Biogeochemical cycles of carbon, nitrogen and sulphur. Air pollution	8	Students will learn about environmental pollution by various gaseous, effects of air pollution on living organisms and vegetation, control of particulates.	Lecture/ Discussion/ PPT/ Practical	
	2	Water pollution	8	Students will learn about hydrological cycle, water resources, aquatic ecosystems, techniques for measuring water pollution, impact of water pollution on hydrological and ecosystems, water purification methods,	Lecture/ Discussion/ PPT/ Practical	

	3	Industrial waste management	4	Students will get the knowledge of industrial waste management, incineration of waste, water treatment and purification.	Lecture/ Discussion/ PPT/ Practical	
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Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
Energy & Environment: Unit-4	1	Source of energy, Nuclear fusion/fission. Nuclear pollution.	10	Students will learn the energy sources, nuclear fusion/fission, solar energy, nuclear pollution, disposal of nuclear waste, nuclear disaster and its management.	Lecture/ Discussion/ PPT/	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
Biocatalysis: Unit-5	1	Biocatalysis, Importance in green chemistry and chemical industry.	5	The students will have the knowledge of biocatalysis, importance of green chemistry and chemical industry.	Lecture/ Discussion/ PPT/	

N.B. The contact hours for tutorial classes will be 15 hours.

Recommended Books:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
4. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
5. K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
6. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.
7. S.E. Manahan, *Environmental Chemistry*, CRC Press (2005).
8. G.T. Miller, *Environmental Science* 11th edition. Brooks/ Cole (2006).
9. A. Mishra, *Environmental Studies*. Selective and Scientific Books, New Delhi (2005).

Course Teachers:

- (i) Dr. Oinam Gobin Singh
- (ii) Dr K. Inaomacha Singh
- (iii) Dr M. Phalguni Singh
- (iv) Dr. N. Rania Devi
- (v) N. Surjit Singh

HoD:

SEMESTER - VI (Year 2022-23 onwards)
DSE Course: Inorganic Materials of Industrial Importance
Paper Code: CHM-HE-6036

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4 (Theory)	60	75 (Theory)
4	2 (Practical)	30	25 (Practical)

Course Objectives:

1. To learn the synthetic process, properties and the utility of the industrially important inorganic materials (such as silicates, ceramics, cements, fertilizers, paints, batteries, alloys and explosives).
2. To provide opportunity to learn some of the industrial process such as surface coating and catalysis relevant to industry where heterogeneous catalysis dominates.

Course Outcomes:

Upon completion of this course the students will be able to

1. establish the basic foundation of industrial inorganic chemistry among the students. This will be helpful for pursuing further studies of industrial
2. perform systematic qualitative and quantitative analysis of the inorganic materials which are used in our daily life.
3. have an insight of the industrial processes.

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Silicate Industries: Unit-1	1	Glass	3	The students will have an idea of composition and properties of some important types of	Lecture/ Discussion/ PPT/	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
	2	Ceramics and Cements	4	The students will be able to know the importance of ceramics, their types and manufacture. Classification of cements, ingredients and manufacture of cement	Lecture/ Discussion/ PPT/ practical	
Fertilizers: Unit-2	1	Types of fertilizers and. Manufacturing methods	6	Students will learn about some commonly used fertilizers	Lecture/ Discussion/ PPT/ Practical	
Surface Coatings: Unit-3	1	Objectives of coating surfaces, classification of surface coatings. Paints, Metallic Coatings	7	Students will learn the importance of surface coatings and also the methods of surface coatings.	Lecture/ Discussion/ PPT/ Practical	
Batteries: Unit-4	1	Primary and secondary batteries. Fuel cells, Solar cell and polymer cell.	6	Students will have some ideas of the types of batteries and also their working principles.	Lecture/ Discussion/ PPT	

Unit	Section	Topic	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
Alloys: Unit-5	1	Classification of alloys, Specific properties of elements in alloys. Manufacture of Steel, surface treatment, composition and properties of different types of steels.	7	Students will learn the specific role of elements in alloys and properties of different types of steels	Lecture/ Discussion/ PPT/ practical	Quiz/Class test / Seminar/ Group Discussion/ Q & A Session/ Assignment
Catalysis: Unit-6	1	Types of catalysis and their industrial applications	6	The students will learn the general principles and properties of catalysts and their industrial importance	Lecture/ Discussion/ PPT/	
Chemical explosives: Unit-7	1	Origin of explosive properties in organic compounds and their preparations	6	The students will get some basic knowledge of some important explosives	Lecture/ Discussion/ PPT/	

N.B. The contact hours for tutorial classes will be 15 hours.

Reference Books:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
4. Karl Heinz Büchel, Hans-Heinrich Moretto Peter, Woditsch; *Industrial Inorganic Chemistry*, Wiley-VCH.
5. J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
6. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.

Course Teachers:

- (i) Dr. Oinam Gobin Singh
- (ii) Dr N. Ranita Devi
- (ii) Dr. K. Gayatri Sharma

HoD: