DEPARTMENT OF CHEMISTRY

For UG CBCS syllabus of Chemistry in the University of North Bengal click link below:

http://42.104.73.51:91//nbuweb/doc/acr/syllabus/UG_Chemistry.pdf

PROGRAMME OUTCOMES

Sl No	PROGRAMME OUTCOMES
1	Disciplinary Knowledge and Skill
2	Critical Thinker and Problem Solver
3	Analytical Skill
4	Team Worker
5	Awareness and handling of Sophisticated Equipments/Instruments
6	Environmental Awareness
7	Develop Laboratory and Research Skill
8	Additional Academic Knowledge
9	develop job potency for research and development institutes/industries

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COURSE OUTCOMES

CORE COURSES

SEMESTER – I

CHEMCC1 : INORGANIC CHEMISTRY – 1

On completion of this course the students will be able to understand:

1. Atomic theory and its evolution.

2. Scientific theory of atoms, concept of wave function.

3. Elements in periodic table; physical and chemical characteristics, periodicity.

4. To predict the atomic structure, chemical bonding, and molecular geometry based on accepted models.

5. Atomic theory of matter, composition of atom.

6. Identity of given element, relative size, charges of proton, neutron and electrons, and their assembly to form different atoms.

7. How to define isotope, isobar and isotone.

8. Physical and chemical characteristics of elements in various groups and periods according to ionic size, charge, etc. and position in periodic table.

9. Characterize bonding between atoms, molecules, interaction and energies of hybridization and shapes of atomic, molecular orbital, bond parameters, bond distances and energies.

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10. Oxidation-Reductions and their use.

Practical:

After the course students will be able to do the following

1. Calibration and use of apparatus
2. Preparation of solutions of different Molarity / Normality
3. Acid-Base Titrations

CHEMCC2 : PHYSICAL CHEMISTRY – 1

Unit 1 : Gaseous State

Students can learn that why there required various corrected form of equation of state viz. van der Waals equation, virial equation, etc. They will get introduce with the concept of critical point and compressibility factor. From this unit they will be self-sufficient for understanding the Maxwell distribution law. Student can surely able to clarify the concept of collision frequency and mean free path. Moreover, various types of gaseous speed and Barometric distribution law will also be clarified. Further, they will able to calculate the theoretical C_p and C_v value of any given molecule. The basic concept of viscosity especially its origin will be appeared in its crystal-clear form. Both mathematical and physical aspect of temperature and pressure dependence on viscosity will be on its forecast.

Unit 2 : Liquid State

Students can learn about Newtonian fluid (laminar flow).They can learn the detail theory for the experimental determination of viscosity by Ostwald's viscometer and stokes falling sphere method. They will know about phenomenon of capillary action for both wetting and non-wetting

liquid. They learn about for the experimental determination of surface tension of the liquid by capillary rise method, drop count method and drop count method. Finally, they can learn that the effect of temperature on the viscosity and surface tension.

Unit 3 : Solid State

They know about various basic laws of crystallography and its implication. They learn about the classification of crystal on the basis of symmetry. They can explain treatment both qualitative and quantitative about the symmetry, crystal parameter, imperfection of cubic crystal. They can learn about Braggs law and its implication. Further they can get a brief account on powder diffraction analysis.

Unit 4 : Ionic Equilibria

Students get introduce with Ostwald dilution law for weak electrolyte. They can get a detail idea about pH scale and can learn how to calculate pH for both weak and strong acid/ base, and also for various salt hydrolysis. They will learn the importance and mechanistic action of buffer solution and a detailed theory how to prepare a buffer of given any pH. Student will acquire knowledge on the theory of titration especially acid-base titration, and will surely learn how the choice of indicator play a key role during the titration.

Practical:

Students will able to handle the Ostwald viscometer and can measure the coefficient of viscosity of any liquid. Students will able to handle the Stalagmometer and can measure the surface tension of any liquid.

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SEMESTER – II

CHEMCC3 : ORGANIC CHEMISTRY – 1

Unit 1 : Basics of Organic Chemistry

Organic Compounds: Students will learn about the hybridization and the three-dimensional structure of organic molecules.

Electronic Displacements: Students will understand about the various electronic effects like polarization, inductive effect, resonance (resonance energy) and also learn about the acid-base nature of various organic compounds. They will also able to identify the aromatic, non-aromatic, anti-aromatic and homo-aromatic compounds after adopting the concept of aromaticity.

UNIT 2 : Stereochemistry

1. After studying basic stereochemistry, students will get the concept of 3D structure of molecule; the way of representation by knowing the different projection formulae, isomerism (enantiomerism and diastereomerism) and nomenclature of stereoisomers.

2. They will also learn the concept of optical activity, specific rotation of organic compounds, chirality, elements of symmetry.

UNIT 3 : Chemistry of Aliphatic Hydrocarbons

Carbon-Carbon sigma bonds:

After studying this topic, students will able to know the different methods of synthesis of alkanes, various reactions of alkanes specially the halogenation reactions in terms of reactivity and selectivity.

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Carbon-Carbon pi bonds:

1. Student will able to get the detail idea on elimination reaction along with mechanisms (E1, E2, E1CB) and also acquire knowledge on Saytzeff and Hofmann elimination reactions.
2. Students will learn about the important electrophilic addition reactions of alkenes, alkynes with mechanism (oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, syn and antihydroxylation, 1,2-and 1,4-addition reactions in conjugated dienes etc.) and nucleophilic additions of alkynes.

Cycloalkanes and Conformational Analysis: After studying this module, students will able to gain the knowledge on

1. three dimensional structures of alicyclic compounds and on the concept of conformation.
2. Baeyer strain theory for predicting stability of ring compounds.
3. different types of strains in conformations of Cycloalkanes.
4. energy profile diagrams for various conformations of cyclohexane.
5. preferred configuration of substituted cyclohexanes.
6. dynamic stereochemistry of cyclic and acyclic systems.
7. varied reaction rate with respect to different stereochemistry of reactants and reaction intermediates.

UNIT 4 : Aromatic Hydrocarbons

Students will get some basic idea on electrophilic aromatic substitution reactions with their mechanisms like halogenation, nitration, sulphonation and Friedel-Craft's alkylation/ acylation.

Practical:

After the course students will be able to do the following

1. Student will learn the proper protocol for using chemistry laboratory, handling various

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equipments, disposal techniques of chemicals and also learn to present laboratory work as a scientific report.

2. How to purify an organic compound by filtration, crystallization and determination of melting point.
3. How to identify pure solid and liquid organic compounds by different chemical analysis.

CHEMCC4 : PHYSICAL CHEMISTRY – 2

UNIT 1: Chemical Thermodynamics

Students will learn various mathematical tools for chemist *viz.* partial derivative, cyclic rule, exact differentials, cross-derivative rule, and ideas on state and path function, extensive and intensive variable of the system. They will get a detail idea about various thermodynamic process *viz.* isothermal, isobaric, isochoric, adiabatic, reversible and irreversible process.

First law: They will learn on a detail about internal energy, heat content and work. They can also learn about Joule experiment and Joule-Thomson experiment and hence inversion temperature. *Thermochemistry:* They will get a detailed qualitative idea on exothermic and endothermic reaction. They will learn about the calculation of the enthalpy of any reaction from simple addition subtraction method. They will also learn about various types of heat of reaction. *Second Law:* They will learn about entropy and thequalitative idea on the spontaneity of any process. Further they will learn about Carnot cycle and will know about the principle behind the operation of heat engine, refrigerator, heat pump and can calculate the efficiency of the same.

Free Energy Functions: They will introduce with the two important energy function G and A and will understand its physical significance. They will come know about the Maxwellrelations and

the thermodynamic equation of state. Moreover, they will learn Gibbs-Helmoholtz equation and its physical significance.

UNIT 2 : Systems of Variable Composition

Students will know the concept of partial molar quantity and chemical potential. Further they will learn the brief mathematical manipulation during mixing of ideal gases especially change in entropy and free energy during the mixing. They can know about the relation between chemical potential and partial pressure of the gases and hence know about the modification required for the real system. Moreover, they will understand about activity and activity coefficient for real system.

UNIT 3 : Chemical Equilibrium

Students will know about various from of equilibrium constant Kp, Kc, Ka, KN and Kf and their inter relation with one another. They will learn both qualitative and quantitative about the influence of various external parameters on the equilibrium. They will learn about reaction isotherm and its importance regarding spontaneity of the reaction. They will also learn a detail about vant Hoff reaction isotherm and isochore. They will further know how equilibrium constant is effect by temperature both separately for exothermic and endothermic reaction. They further learn on qualitative treatment on Le-chatelier principle. They can express the degree of dissociation in terms of equilibrium constant for various type of reaction. They will also introduce with the concept of exoergic and endoergic reaction.

UNIT 4 : Solutions and Colligative Properties

They will learn about the thermodynamics of ideal solution (dilute solution). They know a details on Raoults law and Henry law, including its applicability and limitations for ideal solution. They will also understand a detail about four colligative properties*viz.* lowering of vapour pressure,

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elevation of bp, depression of fp and osmotic pressure. They will learn on the molecular origin of the colligative property. They can compute the detail derivation and mathematical manipulation of the associated problems of colligative properties. They will be self-sufficient to compute the molecular weight of any solute form the above two principle with the help of ebullocrospic and crysoscopic constant. They will also get a qualitative and a quantitative discussion on osmosis, reverse osmosis is given and also its parallelism with ideal gas. Further they will understand about vant Hoff factor for electrolyte solution and learn that the colligative property is also depend on the degree of dissociation. Finally, they will know about Trouton's rule.

Practical:

Students will be able to handle mechanical shaker. They will know about various calorimetric experiment by calorimeter and can calculate enthalpy of various chemical transformation/ neutralisation/ solution/ etc. They can perform the experiment of partition coefficient and equilibrium constant.

SEMESTER – III

CHEMCC5 : INORGANIC CHEMISTRY – 2

After completion of the course, the learner shall be able to understand:

1. General principles of metallurgy and their application in different metal extraction from their ores.
2. Chemistry of s and p-block elements.
3. Chemistry of noble gases.

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4. Inorganic polymers and their use.

5. Redox reactions in hydrometallurgy processes.

6. Structure, bonding of s and p block materials and their oxides/compounds.

7. Chemistry of boron compounds and their structures.

8. Chemistry of noble gases and their compounds; application of VSEPR theory in explaining structure and bonding.

9. Chemistry of inorganic polymers, their structures and uses.

Practical:

Students will be able to do Iodo / Iodimetric Titrations, Quantitative Estimation of metal ions.

CHEMCC6 : ORGANIC CHEMISTRY – 2

UNIT 1 : Chemistry of Halogenated Hydrocarbons

1. After studying this topic student will get a brief idea on different mechanistic approach with stereochemical aspects on nucleophilic substation reaction (SN1, SN2, SNi) of alkyl halides.
2. They will get idea on nucleophilic aromatic substitution (SNAr) and Benzyne mechanism.

UNIT 2 : Alcohols, Phenols, Ethers and Epoxides

1. Student will able to understand the difference between alcohols and phenols; importance and reactions of ethers and epoxides.

2. They will also learn some important reactions with mechanism like Bouvaelt-Blanc Reduction, Pinacol-Pinacolone rearrangement, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements etc.

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UNIT 3 : Carbonyl Compounds

Students will able to

1. explain the relative reactivity of carbonyl compounds toward nucleophilic addition.
2. write the mechanism for nucleophilic addition and nucleophilic addition-elimination reactions of aldehydes, ketones and α, β-unsaturated carbonyl compounds.
3. predict the products of such reactions.

4. describe mechanism and predict the products of different rearrangement reactions.

UNIT 4 : Carboxylic Acids and their Derivatives

1. Students will get a brief idea on preparation, physical properties, reactions and reactivity order of monocarboxylic acids and their derivatives.

2. They will also learn the different mechanistic approach of ester hydrolysis along with some rearrangement and name reactions *e.g*. Claisen condensation, Reformatsky reactions, Hofmannbromamide degradation and Curtius rearrangement.

UNIT 5 : Sulphur containing compounds

They will get the concept on preparation and reactions of thiols, thioethers & sulphonic acids.

Practical:

After the course student will be able to do the following

1. How to set or perform any reaction at laboratory using different glass apparatus, reagents and substrates under room temperature and also at refluxing condition.
2. The workup procedure for the reactions like acetylation, bromination, nitrartion, reduction,

hydrolysis, aldol condensation, Benzil-Benzilic acid rearrangement etc.

3. How to purify an organic compound by filtration, crystallization and determination of melting point.

4. Purity level of the prepared compounds can be checked by TLC.

CHEMCC7 : PHYSICAL CHEMISTRY – 3

UNIT 1 : Phase Equilibria

They can learn about phase diagram of one component system, two component system involving solid-liquid, liquid-liquid equilibria, and its application including the calculation of degree of freedoms in the various point of graph. They will underhand about critical solution temperature, triple point, eutectic and thermal analysis.

Further they can be familiar with a brief idea of three component system. They can learn about the principle of fractional distillation and steam distillation. They further come to know about the non-ideal system *viz.* aeolotropism. They also learn about the principle and process of solvent extraction.

UNIT 2 : Chemical Kinetics

The module covers all most all ground level aspect of the kinetics of any chemical reaction. This includes a details treatment of zero/ first/ second/ nth order reaction. This further extended to opposing, consecutive and parallel reaction. They can also learn about the steady state approximation. They can compute various problems on order of reaction, rate constant, etc. they further learn on the temperature effect on rate constant and its implication. They come to know about details on activation energy and its key role on the reaction mechanism. Next, they come to

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know about various quantitative theory including transition state theory, collision theory etc. Further they come to know about ionic reaction and its associated outcomes.

UNIT 3 : Catalysis

Students will learn about the Physical concept of catalyst and itsinfluences on reaction rate. They come to know about its distinction from inhibitor. They learn on the detail kinetics on enzyme catalysed reaction, acidbase catalysed reaction and reaction on solid surface.

UNIT IV 4 : Surface chemistry

They learn about the adsorption and how it influences by external parameter like temp. and pressure. They learn on various adsorption isotherm. This module extends by Gibbs's adsorption isotherm. They further learn about surfactant antsurface excess.They will also know about the concept of micelle and its chemistry. They also learn on the various type of colloid including sol and emulsion. They also learn on Hardy-Schulze rule, flocculation value, zeta potential and electrical double layer.

Practical:

Students will be able to perform the experiment of the kinetics of ester hydrolysis and its equivalent with details theoretical treatment.
Students will be able to perform the experiment on Freundlich adsorption isotherm.

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SEMESTER – IV

CHEMCC8 : INORGANIC CHEMISTRY – 3

After completion of the course, the learner shall be able to understand:

1. Coordination compounds – its nomenclature, theories, d-orbital splitting in complexes, chelate.
2. Transition metals, its stability, color, oxidation states and complexes.
3. Lanthanides, Actinides – separation, color, spectra and magnetic behavior
4. Bioinorganic chemistry – metal ions in biological system, its toxicity; hemoglobin.
5. The nomenclature of coordination compounds/complexes, Molecular orbital theory, d-orbital splitting in tetrahedral, octahedral, square planar complexes, chelate effects.
6. The transition metals stability in reactions, origin of colour and magnetic properties.
7. The separation of Lanthanoids and Actinoids, its color, spectra and magnetic behavior.
8. The bioinorganic chemistry of metals in biological systems.
9. Hemoglobin and its importance in biological systems.

Practical:

Students will be able to do the estimation of nickel, copper, iron and preparation of complex salts.

CHEMCC9 : ORGANIC CHEMISTRY – 3

UNIT 1 : Nitrogen Containing Functional Groups

Students will acquire the knowledge on

1. Preparation and important reactions of nitro, nitriles and isonitriles compounds.
2. Basicity of different amines and their methods of preparation.

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3. Separation procedures of mixture of different amines (primary, secondary and tertiary) and rearrangement reactions.

UNIT 2 : Polynuclear Hydrocarbons

After studying this topic, students will get the concept on structure elucidation, preparation and various reactions of naphthalene, phenanthrene and anthracene.

UNIT 3 : Heterocyclic Compounds

1. After studying this topic, the students will gain essential theoretical understanding of heterocyclic chemistry.

2. They will also able to learn the general methods for heterocyclic ring synthesis (furan, pyrrole, thiophene, indole etc.) and application of such methods for the preparation of specific groups of heterocyclic systems.

3. The student will also get familiarized with the properties and reactions for the most important heterocycles like furan, pyrrole, thiophene, indole.

UNIT 4 : Alkaloids

After studying this topic, the students will gain essential theoretical understanding of their occurrence, structural features, isolation and physiological action. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

UNIT 5 : Terpenes

After studying this topic, the students will gain essential theoretical understanding of their occurrence and classification. Students will also understand the elucidation of stucture and synthesis of Citral, Neral and α-terpineol.

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Practical:

Students will be able to detect extra elements in organic compounds and to perform functional group tests.

CHEMCC10 : PHYSICAL CHEMISTRY – 4

UNIT 1 : Conductance

Students can learn the details concept of specific conductance, molar conductance. They can learn the variation of molar conductivity upon dilution for both strong and weak electrolyte. With the help of Kohlrausch law they will be expert on calculating the equivalent conductance at infinite dilution for strong and weak electrolyte. They also understand about transport number and its experimental determination by moving boundary and Hittrof method. They will learn on a detail on Faradays' law of electrolysis and its application. Most interesting portion they learnis conductometric titration, its principle and advantages over ordinary titration. With the conductometric measurement they can calculate ionic product of water, solubility product, hydrolysis constant, etc.

UNIT 2 : Electrochemistry

Students will learn about electrochemical cell and electrolytic cell. They will know about half cell, electrode, electrolysis and electrolyte. They will know the concept of oxidation and reduction with the connection of cathode and anode and hence cell representation. They come to know about Nernst equation and it application in electrochemistry. Further they learn about reference electrode, calomel electrode and SHE. They learn about various kind of electrode including quinhydrone electrode, pH electrode and glass electrode. They also learn on concentration cell with and without transference number. Finally, they further introduce another type of titration viz. potentiometric titration, its principle and advantages.

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UNIT 3 : Electrical & Magnetic Properties of Atoms and Molecules

They can acquire a very basic knowledge on electrostatic. Know about the concept of orientation polarization. They learn about various equation expressing the polarity of molecule. They will get a qualitative idea on para, dia and ferro magnetic molecule. Further they will learn about Curie equation and molecular susceptibility.

Practical:

Students will be able to handle conductivity meter and its associated kit.
They can perform the conductometric titration of any pair.
They can also perform experiment based on conductance measurement.

SEMESTER – V

CHEMCC11 : ORGANIC CHEMISTRY – 4

UNIT 1 : Nucleic Acids

Upon successful completion of the course, the student will be able to draw or describe the structure of enzymes, lipids, and nucleic acids. They will able to explain the function of the above listed bio-molecules.

UNIT 2 : Amino Acids, Peptides and Proteins

Upon successful completion of this unit, the student will be able to draw or describe the structure of amino acids, peptides and proteins. They will gain knowledge on chemical as well as bio-synthesis of amino acids and peptides. Student will also know the C-terminal or N-terminal residue analysis method of the peptide/protein molecule.

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UNIT 3 : Enzymes

Upon successful completion of this unit the students will be able to know the mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action.

UNIT 4 : Lipids

Upon successful completion of this unit the students will be able to know about the oils and fats; common fatty acids present in oils and fats, Hydrogenntion of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

UNIT 5 : Concept of Energy in Biosystems

Upon successful completion of this unit the students will be able to know about metabolism, ATP, Conversion of food to energy, Caloric value of food, standard caloric content of food types.

Practical:

After the course students will be able to do the following

1. Students will gain the knowledge on quantitative estimation methods of organic molecules like glycine, proteins etc. and will able to determine the saponification value of oil/ester or fat.
2. Student will acquire knowledge on extraction procedure of natural products from natural resources.

CHEMCC12 : PHYSICAL CHEMISTRY – 5

UNIT 1 : Quantum Chemistry

Students will learn about the background for the development of quantum theory. They will understand the elementary concept about basic mathematics for quantum, like operators, eigen

function, eigen values, etc. They will come to know about the concept of wavefunction, nodal plane, normalization, orthogonality, etc. They will learn about Schrodinger equation and its application. They will understand the ideas of particle in 1d, 2d and 3d box and its associated application. They will also learn on degeneracy and zero-point energy. Further they will also learn on wave particle duality and uncertainty principle. They can also solve the energy computation of vibrational and rotational energy. They will learn about polar co-ordinateand can solving the problem of H and H-like atoms using polar co-ordinate. Further they will get a brief ideal of variation method and perturbation theory, and problems on many electrons system. They can also be expert on setting up Schrodinger equation and its computation.

UNIT 2 : Molecular Spectroscopy

They will learn about Born-Oppenheimer approximation and its accountability on molecular spectroscopy.They will understand on very details about rotational spectroscopy and vibrational spectroscopy,including selection rule, essential condition and applications. Students will further learn on vibrational-rotational spectrum and the P, Q, R branches. They will also learn about Morse potential, hot band and group frequencies. They will be able to calculate fundamental modes of vibration for polyatomic molecules. Next, they will come to introduce with Raman spectroscopy and its quantum mechanical explanation. They will learn about stokes anti-stokes and Raileigh lines. They also learn on various modes of vibration and its activity towards IR and Raman spectroscopy. They also learn on mutual exclusion principle. They learn about electronic spectra and its application in molecular system. They can acquire details knowledge on Jablonski's diagram, fluorescence and phosphorescence, and several associated phenomena in electronic spectrum. They will alsolearnvery brief on NMR and EPR spectroscopy

UNIT 3 : Photochemistry

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They will learn very details on Lambert-Beers law and its application in solution Chemistry. They learn on molar extinction coefficient and its physical significance. They learn on various laws of photochemistry and quantum yield. They will able to compute the kinetics of photochemical reaction. They will learn the concept of chemical actinometer. They will further know the concept of photo stationary states and its application.

Practical:

Students will be able to handle calorimeter and *UV-Vis* spectrophotometer. They can perform the experiment of verification of lambert-beers law and determination of unknown concentration from OD value measurement.

SEMESTER – VI

CHEMCC13 : INORGANIC CHEMISTRY – 4

After completion of the course, the learner shall be able to understand

1. Definition and classification organometallic compounds.
2. Structural features of Metal carbonyls and their preparations.
3. VBT and MO theory in connection with structures of different metal carbonyls.
4. Structure of metal alkyls, their preparation and applications.
5. Inorganic reaction mechanism and reaction kinetics.
6. Mechanism and kinetics of substitution reactions in square planar and octahedral complexes.
7. Mechanism of Organometallic catalysis and their application in different industrial process.

Practical:

They will be able to do qualitative semimicro analysis of mixtures containing 3 anions and 3 cations.

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CHEMCC14 : ORGANIC CHEMISTRY – 5

UNIT 1 : Organic Spectroscopy

UV Spectroscopy:

After studying this topic students will know

1. The difference between absorption and emission spectroscopy.
2. General concept of electronic transitions and some basic terminology of UV-VIS spectroscopy like Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts.
3. How to calculate 3max value employing the Woodward Rules.

IR Spectroscopy:

After studying this topic student will know the fundamental concept of IR spectroscopy and will able to identify the functional group present in a molecule with the help of their corresponding stretching frequency data.

NMR Spectroscopy:

After completion of this module, the student will gain knowledge on

1. Basic principles of ^{1}H-NMR, chemical shift and factors influencing it.
2. Spin – Spin coupling and coupling constant; Anisotropic effects,

Student will able to interpret NMR spectra of simple compounds and also able to apply IR, UV and NMR for identification of simple organic molecules.

UNIT 2 : Carbohydrates

1. After completion of this module, the student will gain an understanding of immense chemistry constituting carbohydrates.

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2. The student will able to distinguish between monosaccharides, disaccharides, and polysaccharides.

3. They will learn different reactions of monosaccharides.

4. They will able to identify several major functions of carbohydrates.

UNIT 3 : Dyes

After this course, the student will get a brief idea on classification of dyes, reason for showing coloration, chemistry of dyeing, synthesis and applications of azo dyes, triphenyl methane dyes and edible dyes.

Practical:

Students will be able to synthesize some important organic molecules like urea formaldehyde resin, sodium polyacrylate and methyl orange.

They will also be able to analyze Carbohydrate based on aldoses and ketoses, reducing and non-reducing nature.

They will be able to identify simple organic compounds by IR spectroscopy and NMR spectroscopy.

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DSE COURSES

CHEMDSE1 : ANALYTICAL METHODS IN CHEMISTRY

After completion of the course, the student shall be able to understand

1. Familiarization with fundamentals of analytical chemistry.
2. Basics of spectroscopic, thermal, electrochemical techniques.
3. Basics of separation techniques and its applications.
4. Analytical tools, statistical methods applied to analytical chemistry.
5. Principle of UV-Vis spectroscopy and its applications.
6. Principles of thermo-gravimetric analysis and study of thermal decomposition of materials/characterization of materials.
7. Basics of electro-analytical techniques and its applications.
8. Principles of separation technology and its use in advanced instrumentations.

Practical:

1. After completion of this course, students will able to know the principle, types and uses of chromatography (Paper chromatography, TLC, and Column chromatography).
2. By employing the gained knowledge on chromatography, they will able to separate mixture of two amino acids by paper chromatography, mixture of two phenols by TLC. They will also capable to separate the leaf pigments from green vegetables and mixture of dyes with the help of column chromatography.

CHEMDSE2 : INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

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After completion of the course, the student shall be able to understand

1. Silicate materials, glass ceramic and cement.
2. Properties, classifications, manufacturing processes and applications of glass ceramics and cement.
3. Classifications, manufacture and application of different fertilizers. 4. Surface coatings and their applications.
5. Preparation, classification and application of paints.
6. Batteries and their components.
7. Working process of different types of batteries.
8. Alloys and their classification.
9. Preparation procedure of different types of steels.
10. Classifications of Catalysis and their properties.
11. Applications of homogenous and heterogeneous catalysis.
12. Chemical explosives originated from organic compounds.
13. Properties and preparation of some explosive chemicals.

Practical:

1. After completion of this course, students will able to determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.

CHEMDSE3 : POLYMER CHEMISTRY

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Introduction and history of polymeric materials

Students will learn the basic elementary concept about the polymers. They also learn about the various type of classification of polymers.

Functionality and its importance

They will learn about functionality principle. Students also introduce with Carothers equation and the implication of the equation on the polymerization.

Kinetics of Polymerization

They will learn on details on various modes of polymerization *viz.* radical, cationic, anionic and its associated mechanism. They will also learn on details kinetic of condensation polymerization both in presence and absence of mineral acid.

Crystallization and crystallinity

They will learn about the morphology of the polymer. They learn how the polymer is different from traditional molecular system in crystalline nature.

Nature and structure of polymers

They will understand about Structure Property relationships among the polymers.

Determination of molecular weight of polymers

They will come to the importance of averaging the molecular weight of polymer. Next, they know about the four types of avg. molecular weight *viz.* number-, mass-, viscosity- and z- avg. molecular weight of polymer. They will further learn how each of this can be determined graphically from various tools, techniques and procedure.

Glass transition temperature (Tg) and determination of Tg

Students come to know about glass transition temperature and crystalline melting point.

Polymer Solution

They will learn details on the thermodynamics behind the polymeric solution and the related parameters govern the solubility. They will learn about Flory-Huggins theory and its implication.

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Properties of Polymers

They will learn about plenty of literature reported polymer synthesis, structure and uses.

Practical:

They can prepare urea-formaldehyde resins.

They can perform viscometry experiment and average molecular weight.

SEC COURSES

CHEMSEC1 : PHARMACEUTICAL CHEMISTRY

Upon successful completion of this course, the student will be able to

1. Know the history of drug discovery and development.
2. Classification of drug categories with examples.
3. Knowledge on the method of preparation of different drugs (analgesics agents, antipyretic agents, anti-inflammatory agents; antibiotics, Cardiovascular, antilaprosy and HIV-AIDS related drugs).
4. Understand the chemistry and role of various bio-molecules.
5. Understand the basic idea of Aerobic and anaerobic fermentation.

Practical:

After the course students will be able to prepare some important drug molecules in laboratory with proper precautions e.g. Aspirin.

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CHEMSEC2 : GREEN METHODS IN CHEMISTRY

After completion of this course, student will able to

1. Know what is Green Chemistry; and why do we need Green Chemistry.
2. Know the twelve principles of green chemistry and will gain the basic understanding of toxicity, threat and risk of chemical compounds.
3. Understand the stoichiometric calculations and relate them to various green chemistry metrics. They will also learn about atom economy, its calculation for different types of reactions and how it is different from percentage yield.
4. Design safer chemicals, products and processes that are less toxic, than current alternatives.
5. Familiar with the green solvents and auxiliary substances.
6. Understand the profits of use of catalyst as well as bio catalyst, use of renewable feed stock and renewable energy sources.
7. Practical application of green synthesis using MW irradiation, Ultrasound etc.
8. Know how can chemistry help to achieve sustainable civilization.

Practical:

After completion of this course, students will able to acquire some practical knowledge regarding synthetic methodology, work up procedure and recrystallization on the following aspects

1. Application of multicomponent reactions (Biginelli reaction, Hantzsch 1,4-dihydropyridine synthesis etc.),
2. Use of renewable resources (Preparation of biodiesel from vegetable/ waste cooking oil),
3. Use of safer starting materials (Preparation and characterization of nanoparticles of gold using tea leaves),
4. Use of enzyme as catalyst (Preparation and characterization of nanoparticles of gold using tea leaves),

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5. Use of alternative sources of energy (Photoreduction of benzophenone to benzopinacol in the presence of sunlight).

GE and DSC COURSES

Semester-I

GE-1 and DSC-1 (Inorganic Chemistry-1, Organic Chemistry-1)

On completion of this course, the students will be able to learn and understand about

1. Atomic theory and its evolution.
2. Learning scientific theory of atoms, concept of wave function.
3. How to predict the atomic structure, chemical bonding, and molecular geometry based on accepted models.
4. Atomic theory of matter, composition of atom.
5. Identity of given element, relative size, charges of proton, neutron and electrons, and their assembly to form different atoms.
6. Definition of isotopes, isobar and isotone.
7. Characterize bonding between atoms, molecules, interaction and energies.
8. hybridization and shapes of atomic, molecular orbitals, bond parameters, bond- distances and energies.
9. Valence bond theory incorporating concepts of hybridization predicting geometry of molecules.
10. Molecular orbital approach related to homonuclear and heteronuclear diatomic molecules.
11. Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms.

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12. Stereochemistry of organic molecules – conformation and configuration, asymmetric molecules and nomenclature.

13. Aromatic compounds and aromaticity, mechanism of aromatic reactions.

14. Understanding hybridization and geometry of atoms, 3-D structure of organic molecules, identifying chiral centers.

15. Reactivity, stability of organic molecules, structure, stereochemistry.

16. Electrophile, nucleophiles, free radicals, electronegativity, resonance, and intermediates along the reaction pathways.

Semester-II

GE-2 and DSC-2 (Physical Chemistry-1, Organic Chemistry -2)

On completion of this course, the students will be able to learn and understand about

1. Laws of thermodynamics and concepts.

2. The concept of system, variables, heat, work, and laws of thermodynamics.

3. The concept of heat of reactions and use of equations in calculations of bond energy, enthalpy, etc.

4. The concept of entropy; reversible, irreversible processes. Calculation of entropy using 3rd law of thermodynamics.

5. Chemical equilibrium and Le Chatelier's principle.

6. Gibbers free energy, equilibrium constants and their relations.

7. Ionic equilibria – electrolyte, ionization, dissociation.

8. Salt hydrolysis (acid-base hydrolysis) and its application in chemistry.

9. Familiarization about classes of organic compounds and their methods of preparation.

10. Basic uses of reaction mechanisms.

11. Mechanism of organic reactions (effect of nucleophile/leaving group, solvent), substitution vs. elimination.

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12. Name reactions, uses of various reagents and the mechanism of their action.
13. Preparation and uses of various classes of organic compounds.
14. Organometallic compounds and their uses.
15. Organic chemistry reactions and reaction mechanisms.
16. Use of reagents in various organic transformation reactions.

Semester-III

GE-3 and DSC 3(Physical Chemistry-2, Organic Chemistry-3)

On completion of this course, the students will be able to learn and understand about

1. The theories/thermodynamics of solutions.
2. Phases, components, Gibb's phase rule and its applications, construction of phase diagram of different systems, the application of phase diagram.
3. Laws of conductivity, transference number, ionic mobility and their applications.
4. Applications of conductance measurement and condutometric titrations.
5. Electrochemistryμ cells, electrode, EMF, standard electrode potential, Nernst equation and its application and thermodynamic relations with the term involved in electrochemistry.
6. pH determination using different electrodes and potentiometric titrations.
7. Preparation and reactions of carboxylic acids and carboxylic acid derivatives.
8. Preparation and reactions of amines and diazonium salts.
9. The properties, classifications and synthesis of amino acids, peptides and proteins.
10. The properties, classifications and synthesis of carbohydrates.

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Semester-IV

GE-4 and DSC 4 (Inorganic Chemistry -2, Physical Chemistry-3)

On completion of this course, the students will be able to learn and understand about

1. Transition metals, its stability, color, oxidation states, complexes and magnetic properties.
2. Coordination compounds – its nomenclature, theories, d-orbital splitting in complexes, chelate.
3. Lanthanides, Actinides – separation, color, spectra and magnetic behavior
4. The separation of Lanthanoids and Actinoids, its color, spectra and magnetic behavior.
5. The nomenclature of coordination compounds/complexes.
6. Molecular orbital theory, d-orbital splitting in tetrahedral, octahedral, square planar complexes, chelate effects.
7. Familiarization with various states of matter.
8. Physical properties of each state of matter and laws related to describe the states.
9. Calculation of lattice parameters.
10. Understanding Kinetic model of gas and its properties.
11. Maxwell distribution, mean-free path, kinetic energies.
12. Behavior of real gases, its deviation from ideal behavior, equation of state, isotherm, and law of corresponding states.
13. Liquid state and its physical properties related to temperature and pressure variation.
14. Properties of liquid as solvent for various household and commercial use.
15. Solids, lattice parameters – its calculation, application of symmetry, solid characteristics of simple salts.
16. The basics of chemical kinetics, rate and order, determination of order, molecularity, and theories of reaction rates.

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SEMESTER-V (Programme course)

PHARMACEUTICAL CHEMISTRY

Upon successful completion of this course, the student will be able to

1. Know the history of drug discovery and development.
2. Classification of drug categories with examples.
3. Knowledge on the method of preparation of different drugs (analgesics agents, antipyretic agents, anti-inflammatory agents; antibiotics, Cardiovascular, antilaprosy and HIV-AIDS related drugs).
4. Understand the chemistry and role of various bio-molecules.
5. Understand the basic idea of Aerobic and anaerobic fermentation.

Practical:

After the course students will be able to prepare some important drug molecules in laboratory with proper precautions e.g. Aspirin.

SEMESTER-VI (Programme course)

INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

After completion of the course, the student shall be able to understand

1. Silicate materials, glass ceramic and cement.
2. Properties, classifications, manufacturing processes and applications of glass ceramics and cement.
3. Classifications, manufacture and application of different fertilizers. 4. Surface coatings and their applications.

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5. Preparation, classification and application of paints.
6. Batteries and their components.
7. Working process of different types of batteries.
8. Alloys and their classification.
9. Preparation procedure of different types of steels.
10. Classifications of Catalysis and their properties.
11. Applications of homogenous and heterogeneous catalysis.
12. Chemical explosives originated from organic compounds.
13. Properties and preparation of some explosive chemicals.

Practical:

1. After completion of this course, students will able to determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.

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