Department of Chemistry, Govt. Degree College, Nowshera

Program Outcomes, Program Specific Outcomes and Course Outcomes

Under Graduate program In B.Sc Chemistry

Program outcomes

- To understand the basic facts and concepts in Chemistry
- To understand the importance of Chemistry in daily life.
- To develop a better understanding and reasoning of facts
- To skill-up for basic analytical tools.
- To skill-up for various laboratory techniques used in pharmaceutical
- Laboratories and chemical industries. To make efficient for various spectrometric analyses

Programme Specific Outcomes

- Gain the knowledge of Chemistry through theory and practical's.
- To explain nomenclature, stereochemistry, structures, reactivity, and mechanism of the chemical reactions.
- Identify chemical formulae and solve numerical problems.
- Use modern chemical tools, Models, Chem-draw, Charts and Equipments.
- Know structure-activity relationship.
- Understand good laboratory practices and safety.
- Develop research oriented skills.
- Make aware and handle the sophisticated instruments/equipments.

Course Outcomes

SEM-I

UCHTC-101: INORGANIC CHEMISTRY

This course gives a theoretical understanding about the basic constituents of matter – atoms, ions and molecules in terms of their electronic structure and reactivity. This also develops a basic quantum chemistry concept on structure and bonding. Student will learn the rules govern in writing the electronic configurations of any elements. The second chapter describes the basic of bonding and the

preliminary laws to describe the bonding between two atoms. Students will be able to draw Lewis structure and explain the boning with the help of valence bond theory, resonance, and hybridization. They will be able to calculate the percentage ionic character of a covalent bond.

After completion of this course student will be able to identify or determine the shape of a molecule by using VSEPR theory. This course provides an quantum mechanical aspect of molecular orbital theory. Students will be able to use the molecular orbital theory for homonuclear and heterodinuclear diatomic, triatomic molecule and metals. The students will also have the basic idea of ionic bonding. They will be able to identify the packing and crystal system of an ionic solid. They can find the Lattice energy of ionic solids bu using Born Haber cycle.

ORGANIC CHEMISTRY

The primary objective of this course is to apprise students with introduction to organic compounds and their hybridization, bond angle, length and energies, hydrogen bonding and its effects, electron displacement, type of reagents and reaction intermediates. Acid-base behavior of organic molecules and factors affecting acidity / basicity of organic compound are also included. The different types of stereoisorism – conformational, configurational, enantiomerism and diastereoisomerism, atropisomerism and their chemical behavior, different projection formulas are included.

PAPER: UCHPC102: PRACTICAL CHEMISTRY

After completion of this course students will be able to analyze the inorganic sample qualitatively. This will help students to work in some laboratory and find the chemical composition of an unknown inorganic compound or mixture.

SEM-II

PAPER: UCHTC201: PHYSICAL CHEMISTRY

In this course the chemical Energetic, chemical equilibrium, ionic Equilibria will be taught to the students. In chemical Energetic the students are expected to learn principles and definitions of thermo chemistry Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

In Chemical equilibrium chapter, the students will learn the Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between *G* and *G*o, Le Chatelier's principle. Relationships between *Kp, Kc* and *Kx* for reactions involving ideal gases.

In chapter Ionic Equilibria, the students will learn Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water.

Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

ORGANIC CHEMISTRY

In this course conformational analysis of cycloalkanes, aliphatic hydrocarbons and their stability, topocity and criteria for establishing topocity, prostereisomerism are included. The course also includes different types of both eletrophilic and nucleophilic aromatic substitution reactions, mechanism and various factors affecting the type of reaction mechanism.
General methods of preparation , physical properties , reactions and functional group transformations of compounds- saturated and unsaturated hydrocarbons, aromatic hydrocarbons, polynuclear hydrocarbons alkyl and aryl halides, 1° , 2° , 3° alcohols, aromatic and aliphatic amines, diols , triols, phenols , benzyl alcohols, aromatic and aliphatic carbonyl compounds, aromatic and aliphatic carboxylic acids, aromatic and aliphatic nitro compounds are also included.

PAPER UCHPC-202: PRACTICAL CHEMISTRY

After completion of this course students will be able to analyze the organic sample qualitatively. This will help students to work in some laboratory and find the chemical composition of an unknown organic compound. Students will be able to describe and classify organic compounds in terms of their functional groups and reactivity.

SEM-III

PAPER UCHTC-301: PHYSICAL CHEMISTRY

In this course the Solutions, Phase Equilibium, Conductance, Electrochemistry will be taught to the students. In the Solutions chapter the students are expected to learn Thermodynamics of ideal solutions, Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions.
Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

In chapter Phase Equilibrium the students will learn Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems (lead-silver, FeCl3-H2O).

In Conductance chapter the students will learn Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions. Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

In chapter Electro-chemistry the students will learn Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of

electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H, S and equilibrium constant from EMF data.
Concentration cells with transference and without transference. pH determination using hydrogen electrode and quinhydrone electrode. Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

ORGANIC CHEMISTRY

The primary objective of this course is to apprise students with introduction to organic compounds like Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Carboxylic acids (aliphatic and aromatic), *Reactions:* Hell – Vohlard - Zelinsky Reaction. Carboxylic acid derivatives (aliphatic)etc.

This course also includes different types of preparations and reactions from alkyl halides, Gabriel's Phthalimide synthesis, and Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation

Amino Acids, Peptides and Proteins, Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis. Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

PAPER UCHPC-302: PRACTICAL CHEMISTRY

This course provide advance physical laboratory experiments like determination of cell constant, Degree of dissociation, Equivalent of conductance and also qualitative analyses of organic compounds, separation of amino acids by paper chromatography etc. Student will be able to correlate the importance the theory with the practical experiments.

PAPER UCHTS-303: SKILL ENHANCEMENT COURSE

This course is introduced to make familiar with the Skill development methods like preparations and uses of hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.
Also essential oils and their importance in cosmetic industries and also practicals like preparations of hair remover, shampoo etc.

SEM-IV

PAPER UCHTC-401: INORGANIC CHEMISTRY

After completion of this course student will be able to identify the electronic spectra of a transition metal complexes. They will learn the variation of electronic spectra of a complex based on the ligand field.
The reaction mechanisms of inorganic metal complexes are included. With this course student can predict the reaction rates and have idea on factors affecting on associative and dissociative mechanism. This course also deals with the basic bioinorganic chemistry such as photosynthesis, respiration and nitrogen fixation.
Student will also learn the chemistry of Lanthanides and Actinides also included which give an idea of electronic configuration, oxidation states, lanthanide contractions, magnetic properties and electronic spectra of these elements.
This course gives the preliminary idea on symmetry operation and point group identification of inorganic complexes. The student will learn about the advanced theory of bonding in coordination chemistry, i.e crystal field theory and molecular orbital theory. They will also acquire preliminary idea on organometallic chemistry and simple preparation of alkene, alkyne, ally and cyclopentyl dienyl anion and arene complexes. They will have basic idea of the structure of those complexes. Some specific examples of homogeneous organometallic catalysis, viz., Wilkinson catalyst and other have been included in this course.

PHYSICAL CHEMISTRY

This course contains states of matter- gaseous and liquid states. The colligative property and electrochemistry is also used.
In gaseous state unit the students will learn the kinetic theory of gases, ideal gas and real gases. Besides they will also learn degrees of freedom, molecular basis of heat capacity etc.
In liquid state unit, the students are expected to learn the qualitative treatment of the structure of liquid along with the physical properties of liquid, viz, vapour pressure, surface tension and viscosity.
In the molecular and crystal symmetry unit they will be introduced to the elementary idea of symmetry which will be useful to understand solid state chemistry and group theory in some higher courses
In chemical kinetics chapter, the students will learn the rate laws of chemical transformations, experimental methods of determining the rate of a reaction. Also they will be able to understand different types of adsorption processes and basics of catalysis.

PAPER UCHPC-402: PRACTICAL CHEMISTRY

After completion of this course students will be able to analyze the inorganic sample qualitatively. This will help students to work in some laboratory and find the chemical composition of an unknown inorganic compound or mixture This course provide advance physical laboratory experiments like determination of viscosity, surface tension of a liquid, verification of adsorption etc. Student will be able to correlate the importance the theory with the practical experiments

PAPER UCHTS-403: SKILL ENHANCEMENT COURSE

This course is introduced to make familiar with the Skill development methods like general introduction to pesticides (natural and synthetic), benefits and adverse effects, Peptide management, Peptide classification on use, chemical nature, formulation, toxicity and action. Changing concepts of pesticides, structure activity relationship. Synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Lindane, Aldrin, Dialdrin, Gammexene); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

SEM-V

PAPER UCHTC-501: PHYSICAL CHEMISTRY

This course introduces most important and interdisciplinary topic. The basic principles of electronic, rotational, vibrational spectroscopy are included.Photochemistry like Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photosensitised reactions, quenching.

Optical activity, Polarization – (Clausius-Mossotti equation), Orientation of dipoles in an electric field, Dipole moment, Induced dipole moment, Measurement of dipole moment: temperature method and refractivity method, Dipole moment and structure of molecules, Magnetic properties: paramagnetism, diamagnetism and ferromagnetism.

INORGANIC CHEMISTRY

Inorganic chemistry like Oxidation states displayed by Cr, Fe, Co, Ni and Cu. They will also acquire preliminary idea on organometallic chemistry and simple preparation of alkene, alkyne, ally and cyclopentyl dienyl anion and arene complexes. They will have basic idea of the structure of those complexes. Some specific examples of homogeneous organometallic catalysis, viz., Wilkinson catalyst and other have been included in this course.

Biological role of metal in terms of oxygen transport and medicine are also included and student will have an basic idea on those topic.

PAPER UCHPC-502: PRACTICAL CHEMISTRY

After attending this course the students will be able to understand different types of Colorimeter experiments like Verify Lambert-Beer's law and determine the concentration of $CuSO_4/KMnO_4/K_2Cr_2O_7$ in a solution of unknown concentration, determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.

PAPER UCHTS-503: SKILL ENHANCEMENT COURSE

After attending this course the students will be able to understand classification of fuels and its values like Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal.Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Composition of crude petroleum, Refining and different types of petroleum products and their applications. Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants.

SEM-IV

PAPER UCHTC-501: INORGANIC CHEMISTRY

This course gives the preliminary idea on the topic of the S and P block elements and fertilizers batteries, catalysis etc.

In chapter S and P block elements the students will learn Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mulliken, and Alfred-Rochow scales). Allotropy in C, S, and P.
Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.
In chapter Fertilzers, batteries and catalyses they learn deifferent types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates
General principles and properties of catalysts, homogenous catalysis and hetrogenesis catalysts.
Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

ORGANIC CHEMISTRY

This course introduces most important and interdisciplinary topic. After completion of this course student will learn the basic principles and could be able to interpret the spectra for a simple molecule. In addition, spin resonance spectroscopy i.e. NMR and ESR are included. They will be able to identify the number of signals of a given sample and draw the pattern for NMR.
Mass spectrometry is also included which gives the idea about molecular ion peak, base peaks etc. They will learn different part of mass spectrometer and method of ionization of a sample.
Active Methylene group preparations and reactions like Claisen ester condensation. Keto-enol tautomerism Synthetic uses of ethylacetoacetate (2-hexanone, Pentanoic acid and β-ketoester).

PAPER UCHPC-602: PRACTICAL CHEMISTRY

After attending this course the students will be able to understand different types of experiments like preperations Beckmann rearrangement of Benzophenone oxime Benzilic acid from benzyl , 4-nitroacetanide from acetanilide , Acetanilide from aniline with Zn/AcOH
The students will be provided the hardcopies of Spectral data [UV, IR, NMR] for analysis of products and starling materials of above preparations.

PAPER UCHTS-603: SKILL ENHANCEMENT COURSE

After attending this course the students will be able to understand methods of the green Chemistry like principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity, green solvents, Green Chemistry and catalysis and alternative sources of energy, Green energy and sustainability

Surfactants for carbon dioxide – Replacing smog producing and ozone depleting solvents with CO2 for precision cleaning and dry cleaning of garments. Designing of environmentally safe marine antifoulant.Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments. An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

HOD
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