

# CHEMISTRY

## FYBSc - Semester I

<b>USCH 101 General Chemistry</b>	<b>1.1 – Chemical Thermodynamics</b>	<b>CO 1</b>	Explain the various terms of thermodynamics and thermochemistry
		<b>CO2</b>	Write sign conventions and relation between heat capacities
		<b>CO 3</b>	Calculate heat ,work , internal energy, enthalpy, bond energy, bond dissociation energy and resonance energy from thermodynamic data.
		<b>CO 4</b>	Know derivation of Kirchhoff's equation
		<b>CO 5</b>	Solve numerical problems based on this topic
	<b>1.2 – Chemical calculations</b>	<b>CO 1</b>	Know expressions for various concentration units
		<b>CO 2</b>	Solve numerical on concentration units and their interconversion
	<b>2.1 – Atomic structure</b>	<b>CO 1</b>	Write the mathematical statements and physical significance of atomic structure
		<b>CO 2</b>	Explain Rutherford's atomic model, Bohr's theory & atomic spectrum of hydrogen atom
		<b>CO 3</b>	Know principles of quantum mechanics
	<b>2.2- Periodic Table and periodicity</b>	<b>CO 1</b>	Elaborate on periodic table and periodic trends
		<b>CO 2</b>	Classify elements as main group, transition and inner transition elements
		<b>CO 3</b>	Explain Slater's rule, Pauling, Mulliken and Alred Rochow electronegativities
	<b>3.1 – Classification &amp; Nomenclature of</b>	<b>CO 1</b>	Apply basic rules of IUPAC nomenclature

	<b>Organic Compounds</b>	<b>CO 2</b>	Draw structures of organic compounds and name using IUPAC nomenclature
	<b>3.2 Bonding and Structure of Organic compounds</b>	<b>CO 1</b>	correlate bonding and structure to reactivity of organic compounds
	<b>3.3 - Fundamentals of organic reaction mechanism</b>	<b>CO 1</b>	Understand electronic effects within a molecule and correlate with reactivity
		<b>CO 2</b>	Describe and identify types of organic reactions
<b>USCH 102 ( General Chemistry )</b>	<b>1.1 Chemical Kinetics</b>	<b>CO 1</b>	Write the terms involved in chemical kinetics
		<b>CO2</b>	Define order and molecularity of reaction
		<b>CO 3</b>	Derive expressions for half-life period and rate constant of 1st and 2nd order reaction
		<b>CO 4</b>	Determine order of reaction by Integration, Graphical , Half-life and Ostwald's isolation method.
		<b>CO 5</b>	Write characteristics and examples of 1st and 2nd order reactions
		<b>CO 6</b>	Solve numerical based on expressions of chemical kinetics
	<b>1.2 Liquid State</b>	<b>CO 1</b>	Explain concept of surface tension, viscosity and refractive index
		<b>CO2</b>	Determine surface tension by drop number method, viscosity by Ostwalds viscometer and refractive index by Abbe's refractometer
		<b>CO 3</b>	Know the classification and applications of liquid crystals
		<b>CO 4</b>	Solve numerical
	<b>2.0 - Comparative chemistry of Main Group elements</b>	<b>CO 1</b>	Compare chemistry of main group elements and the periodic trends
		<b>CO2</b>	Elaborate on the methods of synthesis of compounds from main group elements

	<b>3.0 -Stereochemistry-I</b>	<b>CO 3</b>	Review the harmful effects of environmental pollutants namely oxides of C, S & N.
		<b>CO 1</b>	Establish relationship between stereoisomers and conformers
		<b>CO2</b>	Draw and interconvert projections
		<b>CO 3</b>	Visualize 3D structure and correlate to stability

### FYBSc - Semester II

<b>USCH 201 ( General Chemistry )</b>	<b>1.1 – Gaseous State</b>	<b>CO 1</b>	Know the concept of ideal and real gases, gas laws and deviations , kinetic theory of gases, Maxwell Boltzmann distribution of velocities, Joule Thomson effect , Le Chatelier’s principle
		<b>CO2</b>	Write steps involved in the derivation of van der waals equation
		<b>CO 3</b>	Solve numerical on ideal and non ideal
		<b>CO 4</b>	Discuss Joule Thomson effect
	<b>1.2 – Chemical Equilibria and Thermodynamic Parameters</b>	<b>CO 1</b>	Identify the type of equilibrium constant
		<b>CO2</b>	Elaborate on 2nd law of thermodynamics, law of mass action, Le Chatelier’s principle
		<b>CO 3</b>	Explain concept of free energy and its significance
		<b>CO 4</b>	Write steps involved in the derivation of equilibrium constant
		<b>CO 5</b>	Solve numerical based on chemical equilibria and thermodynamic parameters
	<b>2.1 – Concept of Qualitative Analysis</b>	<b>CO 1</b>	elucidate on the principle of qualitative analysis (Detection of cations and anions)
		<b>CO2</b>	Balance chemical equations.

	<b>2.2 - Acid Base theories</b>	<b>CO 3</b>	analyze effect of common ions and buffer action
		<b>CO 1</b>	Review different acid-base theories (Arrhenius, Lowry-Bronsted, Lewis )
		<b>CO2</b>	Apply acid base chemistry in understanding organic reactions
		<b>CO 3</b>	Write calculation of acid - base titration curve
	<b>3.0 - Chemistry of Aliphatic Hydrocarbons</b>	<b>CO 1</b>	Correlate bonding and structure to reactivity of organic compounds
		<b>CO2</b>	Write reactions for interconversion of functional groups
	<b>USCH 202 ( General Chemistry )</b>	<b>1.1 - Ionic Equilibria</b>	<b>CO 1</b>
<b>CO2</b>			Define pH scale, buffers, buffer capacity
<b>CO 3</b>			Write derivation of Henderson's equation
<b>1.2 - Molecular Spectroscopy</b>		<b>CO 1</b>	Elaborate on regions of electromagnetic radiation
		<b>CO2</b>	Describe Planck's equation
		<b>CO 3</b>	Derive Beer-Lambert's law
		<b>CO 4</b>	Explain various phenomenon taking place during interaction of electromagnetic radiation with matter
<b>1.3 - Solid state chemistry</b>		<b>CO 1</b>	Know the types of solids
		<b>CO2</b>	Write laws of crystallography
		<b>CO 3</b>	Define unit cell, space lattice, lattice plane
<b>2.1 - Chemical Bond and Reactivity</b>		<b>CO 1</b>	Determine the structure of chemical compounds by calculation of steric number
		<b>CO2</b>	Review Sidgwick Powell theory and VSEPR theory
<b>2.2 - Oxidation Reduction Chemistry</b>		<b>CO 1</b>	Illustrate balancing redox reaction
		<b>CO2</b>	Draw Frost , Latimer diagram of redox couple
<b>3.1 - Stereochemistry – II</b>		<b>CO 1</b>	Visualize 3D structure and correlate to stability

		<b>CO2</b>	Establish relationship between stereoisomers and conformers
	<b>3.2 Aromatic Hydrocarbons</b>	<b>CO 1</b>	Correlate aromaticity and stability of compounds
		<b>CO2</b>	Write mechanism for electrophilic substitution in aromatic compounds

S.Y.B.Sc : Semester III

<b>USCH 301 (General Chemistry)</b>	<b>1.1 - Chemical Thermodynamics – II</b>	<b>CO 1</b>	Define free energy functions
		<b>CO2</b>	Write derivations of Gibbs Helmholtzequation, van't Hoff reaction isotherm , van't Hoff reaction isochore and Gibb's Duhem equation
		<b>CO 3</b>	Know the concept of partial molal properties, fugacity and activity
		<b>CO 4</b>	Solve numerical on thermodynamic relations
	<b>1.2 - Electrochemistry</b>	<b>CO 1</b>	Define specific resistance, specific conductance, cell constant, equivalent and molar conductivity and their units.
		<b>CO2</b>	Explain variation of specific and equivalent conductance of strong and weak electrolyte with dilution
		<b>CO 3</b>	Know Kohlrausch's law of independent migration of ions and its applications to determine equivalent conductance of weak electrolyte at zero conc., degree of ionization of weak electrolyte, solubility and solubility product of sparingly soluble salt and ionic product of water
		<b>CO 4</b>	Explain Transport number of an ion and factors affecting it
		<b>CO 5</b>	Know determination of transport number by moving boundary method
		<b>CO 6</b>	Solve the numerical
	<b>Chemical Bonding – 2.1 – Non Directional 2.2 – Directional Bonding : Orbital</b>	<b>CO 1</b>	To review the conditions for the formation of ionic bond
		<b>CO2</b>	To elaborate on the different types of ionic crystals & radius ratio rules

	<b>Approach</b>	<b>CO 3</b>	To determine lattice energy of ionic compounds by Born Lande equation, Kapustinski equation and Born Haber's cycle	
		<b>CO 4</b>	To explain the basic tenets of Valence bond theory to explain covalent bonding	
		<b>CO 5</b>	To elucidate the potential energy curve w.r.t formation of H <sub>2</sub> molecule.	
		<b>CO 6</b>	To debate on the improvements suggested to the Valence bond theory for the formation of Hydrogen molecule.	
		<b>CO 7</b>	To determine the resonance structures of different covalent molecules and calculate the formal charge.	
		<b>CO 8</b>	To discuss the concept of hybridization and the different types of hybridization observed in covalent molecules	
		<b>2.3 - Molecular Orbital Theory</b>	<b>CO 1</b>	Write mechanisms of reactions of halogenated hydrocarbons
			<b>CO2</b>	Synthesized various classes of organic compounds using Grignard reagent
	<b>3.1 – Reactions &amp; reactivity of halogenated hydrocarbons</b>	<b>CO 1</b>	Write mechanisms of reactions of halogenated hydrocarbons	
		<b>CO2</b>	Synthesized various classes of organic compounds using Grignard reagent	
	<b>3.2 – Alcohols, phenols and epoxides</b>	<b>CO 1</b>	Name alcohols , phenols and epoxides using IUPAC nomenclature	
		<b>CO2</b>	Write reactions for interconversion of functional groups	
	<b>USCH 302 (General Chemistry)</b>	<b>1.1- Chemical kinetics – II</b>	<b>CO 1</b>	Explain types of complex chemical reactions with example
			<b>CO2</b>	Know the effect of temperature on rate constant k and derivation of Arrhenius equation

		<b>CO 3</b>	Explain and calculate energy of activation
		<b>CO 4</b>	Elucidate on the theories of reaction rate – Collision theory and activated complex theory of bimolecular reactions
	<b>1.2 - Solutions</b>	<b>CO 1</b>	Define ideal and non-ideal solutions on the basis of Raoult's law
		<b>CO2</b>	Draw vapour pressure composition diagrams and temperature – composition diagrams for ideal and non-ideal solutions
		<b>CO 3</b>	Demonstrate distillation techniques for miscible & immiscible liquids
		<b>CO 4</b>	Explain Lever rule and Azeotropes
		<b>CO 5</b>	Describe the term critical solution temperature associated with partially miscible liquid
		<b>CO 6</b>	Draw and explain temperature – composition diagram of phenol-water, Triethanolamine-water and nicotine-water system
		<b>CO 7</b>	Elaborate on principle of solvent extraction technique, Nernst distribution law and its applications
	<b>2.1 - Chemistry of Boron Compounds</b>	<b>CO 1</b>	To elaborate on the electron deficient nature of Lewis acid compounds like Boron hydrides and Boron halides
		<b>CO2</b>	To review the methods of preparation of diborane and tetraborane.
		<b>CO 3</b>	To review the occurrence and extraction process of Germanium.
		<b>CO 4</b>	To describe the preparation of extra pure Germanium
	<b>2.2 - Chemistry of Silicon and Germanium</b>	<b>CO 1</b>	To elucidate on the occurrence, structure and inertness of SiO <sub>2</sub> .
		<b>CO2</b>	To explain the preparation of SiCl <sub>4</sub> .
		<b>CO 3</b>	To review the occurrence and extraction process of Germanium.

	<b>2.3- Chemistry of Nitrogen family</b>	<b>CO 4</b>	To describe the preparation of extra pure Germanium
		<b>CO 1</b>	To discuss trends in chemical reactivity with respect to hydrides and oxides of nitrogen family.
		<b>CO2</b>	To review the preparation, properties and structure of different oxides of nitrogen
		<b>CO 3</b>	To elaborate on the Haber's process for synthesis of ammonia
	<b>3.0 - Carbonyl Compounds</b>	<b>CO 1</b>	Name carbonyl compounds using IUPAC nomenclature
		<b>CO2</b>	Write reactions for interconversion of functional groups
<b>USCH 303 (Basics of Analytical Chemistry)</b>	<b>Unit I – Introduction to Analytical Chemistry and Statistical Treatment of analytical data</b>	<b>CO 1</b>	Explain important terms and their significance
		<b>CO2</b>	Know purpose of analytical chemistry and different methods of analysis
		<b>CO 3</b>	Select a method of analysis
		<b>CO 4</b>	Decide how to identify a sample and prepare it for analysis
		<b>CO 5</b>	Select a procedure for analysis
		<b>CO 6</b>	Identify types and sources of errors in results
		<b>CO 7</b>	Solve numerical on errors in analysis
	<b>Unit II – Classical Methods of Analysis</b>	<b>CO 1</b>	Explain various method of chemical analysis
		<b>CO2</b>	Define terms involved in titrimetric methods
		<b>CO 3</b>	Know the types and tools of titrimetric analysis
		<b>CO 4</b>	Distinguish primary and secondary standards
		<b>CO 5</b>	select proper titrimetric method
		<b>CO 6</b>	Construct titration curves on the basis of change in pH.

		<b>CO 7</b>	Determine end point by using indicators, by potentiometry or conductometry Determine end point by using indicators, by potentiometry or conductometry
		<b>CO 8</b>	Learn principle and steps involved in gravimetry
		<b>CO 9</b>	Identify suitable gravimetric method
		<b>CO 10</b>	Perform the required calculations involved in titrimetry & gravimetry
	<b>Unit III -Instrumental Methods – I</b>	<b>CO 1</b>	Know about a generalized diagram of an analytical instrument
		<b>CO2</b>	Select a suitable instrumental method for analysis
		<b>CO 3</b>	Appreciate the basic terms in spectrometry
		<b>CO 4</b>	Use the relationship between absorbance (and its variations) and concentration of the analyte.
		<b>CO 5</b>	Choose a suitable method for photometric titrations

**S.Y.B.Sc : Semester IV**

<b>USCH 401 (General Chemistry)</b>	<b>1.1 - Electrochemistry – II</b>	<b>CO 1</b>	Explain Electrochemical cell with example
		<b>CO2</b>	Construct and represent electrochemical cell
		<b>CO 3</b>	Identify reversible and irreversible electrochemical cell
		<b>CO 4</b>	Know concept of electrochemical series and types of electrodes
		<b>CO 5</b>	Derive relation of EMF with $\Delta G$ , $\Delta G^\circ$ , $\Delta H$ , $\Delta S$ & equilibrium constant
		<b>CO 6</b>	Classify concentration cell with and without transference
		<b>CO 7</b>	Explain liquid junction potential and use of salt bridge

		<b>CO 8</b>	Determine pH using hydrogen & quinhydrone electrode
		<b>CO 9</b>	Solve the numerical problems based on this topic
	<b>1.2 –Phase Equilibria</b>	<b>CO 1</b>	Write Gibbs phase rule and its thermodynamic derivation
		<b>CO2</b>	Explain meaning of phase, component and degree of freedom
		<b>CO 3</b>	Write derivation and importance of Clausius – Clapeyron equation
		<b>CO 4</b>	Draw & explain phase diagram of water , sulphur and Pb-Ag system
	<b>2.1 – Comparative Chemistry of the transition metals</b>	<b>CO 1</b>	To discuss the position of transition metals in periodic table, their occurrence
		<b>CO2</b>	To elaborate on the electronic configuration, oxidation states and anomalous oxidation state exhibited by transition elements
		<b>CO 3</b>	To discuss the properties of first transition series elements w.r.t color, magnetic properties and associated properties
		<b>CO 4</b>	To review the chemistry of Titanium and Vanadium w.r.t oxides and chlorides and use of these compounds in qualitative analysis
		<b>CO 5</b>	To discuss qualitative tests for detection of transition metal ions
	<b>2.2 – Coordination Chemistry</b>	<b>CO 1</b>	To know the historical background of coordination compounds
		<b>CO2</b>	To explain the basic terms involved in coordination chemistry.
		<b>CO 3</b>	To name coordination compounds as per IUPAC Nomenclature.
		<b>CO 4</b>	To debate on different types of isomerism exhibited by coordination compounds
<b>CO 5</b>		To discuss Werner’s theory of coordination compounds	

		<b>CO 6</b>	To elucidate on the basic assumptions of Valence bond theory as applied to coordination compounds
		<b>CO 7</b>	To determine the structure of coordination compounds with coordination number 4, 5 and 6.
		<b>CO 8</b>	To differentiate between inner and outer orbital complexes
		<b>CO 9</b>	To review the applications of complex compounds
	<b>3.1 – Carboxylic acids and their Derivatives 3.2 – Sulphonic acids</b>	<b>CO 1</b>	Name carboxylic acid and sulphonic acids using IUPAC nomenclature
		<b>CO2</b>	Predict acid strength of different acids and correlate to structure
		<b>CO 3</b>	Write reactions for interconversion of functional groups
<b>USCH 402 (General Chemistry)</b>	<b>1.1 - Solid State</b>	<b>CO 1</b>	Describe laws of crystallography and types of crystals
		<b>CO2</b>	Write characteristics of simple , FCC and BCC system
		<b>CO 3</b>	Know use of X rays in crystallography
		<b>CO 4</b>	Derive Bragg's equation
		<b>CO 5</b>	Draw and explain structure of NaCl and KCl
		<b>CO 6</b>	Determine Avogadro's No.
		<b>CO 7</b>	
	<b>1.2 - Catalysis</b>	<b>CO 1</b>	Explain types of catalysis and terms involved in catalysis
		<b>CO2</b>	Write mechanism and kinetics of acid-base and enzyme catalysis
		<b>CO 3</b>	Elaborate on effect of particle size and efficiency of nanoparticles as catalyst
	<b>2.1 - Acidity of Cations and Basicity of Anions</b>	<b>CO 1</b>	Predict degree of hydrolysis of cations when variables are charge & radius
		<b>CO2</b>	Write Latimer equation, relationship between pKa

		<b>CO 3</b>	Classify cations & anions on the basis of acidity and basicity	
		<b>CO 4</b>	Discuss effect of charge and radius on hydration of anions	
	<b>2.2 - Uses and Environmental Chemistry of volatile Oxides and oxo – acids</b>	<b>CO 1</b>	Write uses and environments aspects of oxo acids	
		<b>CO2</b>	Describe physical properties of sulfuric , Nitric and Phosphoric acid	
	<b>3.0- Nitrogen containing compounds and heterocyclic compounds</b>	<b>CO 1</b>	Name Nitrogen containing compounds & heterocycles using IUPAC nomenclature	
		<b>CO2</b>	Write reactions for interconversion of functional groups	
		<b>CO 3</b>	Analyse the stability of 5 & 6 – membered heterocycles to their aromatic character	
	<b>USCH 403 (Basics in Analytical Chemistry - II)</b>	<b>Unit - I : Methods of Separation</b>	<b>CO 1</b>	The importance of separation in sample treatment
			<b>CO2</b>	Various methods of separations
<b>CO 3</b>			How to select a method of separation of an analyte from the matrix	
<b>CO 4</b>			How a solute gets distributed between two immiscible phases	
<b>CO 5</b>			Principle of solvent extraction and various terms involved there in	
<b>CO 6</b>			Effect of various parameters on solvent extraction of a solute	
<b>CO 7</b>			The Classification of Chromatographic methods	
<b>CO 8</b>			Paper and thin layer chromatography and using them in practice.	
<b>Unit – II Instrumental Methods - II</b>		<b>CO 1</b>	The nature of interaction between applied electrical potential and the concentration of the analyte.	
		<b>CO2</b>	The nature of chemical reactions that influence potential of a cell	
		<b>CO 3</b>	The various types of electrodes or half cells.	

		<b>CO 4</b>	The nature, need and importance of pH
		<b>CO 5</b>	The applications of potentiometry , pH metry and conductometry
	<b>Unit – III Statistical Treatment of Analytical data - II</b>	<b>CO 1</b>	The use of statistical methods in chemical analysis.
		<b>CO2</b>	The nature of indeterminate errors
		<b>CO 3</b>	The randomness of such errors and its distribution around a correct or acceptable result
		<b>CO 4</b>	Computation of Confidence limits and confidence interval
		<b>CO 5</b>	Test for rejection of doubtful result
		<b>CO 6</b>	Method to draw best fitting straight line

**T.Y.B.Sc : Semester V**

<b>USCH 501 (Physical Chemistry)</b>	<b>Unit - I : 1.1 - Colligative Properties of dilute solutions 1.2 - Phase Rule</b>	<b>CO 1</b>	Discuss Raoult's law and relative lowering of vapour pressure
		<b>CO2</b>	Write thermodynamic derivation relating elevation in the boiling point , depression in the freezing point & molar mass of non-volatile solute.
		<b>CO 3</b>	Derive van't Hoff equation for osmotic pressure
		<b>CO 4</b>	Elaborate on abnormal masses of solute and van't Hoff factor
		<b>CO 5</b>	Calculate degree of dissociation and association
		<b>CO 6</b>	Solve Numerical based on colligative properties
		<b>CO 7</b>	Know Gibbs phase rule and terms involved in it
		<b>CO 8</b>	Draw & explain phase diagrams of 1,2 and 3 component systems
		<b>CO 9</b>	Explain phase diagram for three liquids forming one immiscible pair

<p style="text-align: center;"><b>Unit – II</b> <b>2.1 - Surface Chemistry &amp; catalysis</b> <b>2.2 – Colloids</b></p>	<b>CO 1</b>	Describe types of adsorption isotherm
	<b>CO2</b>	Derive Langmuir adsorption isotherm
	<b>CO 3</b>	Write B.E.T equation and explain terms involved in it
	<b>CO 4</b>	Solve Numerical on surface area determination using BET equation
	<b>CO 5</b>	Explain types of catalysis and terms involved in catalysis
	<b>CO 6</b>	Write mechanism and kinetics of acid-base and enzyme catalysed reaction (Michaelis – Menten equation)
	<b>CO 7</b>	Know types of colloids
	<b>CO 8</b>	Explain origin of charge on colloidal particles, concept of zeta potential and electro-kinetic phenomena
	<b>CO 9</b>	Elaborate on colloidal electrolyte and Donnan Membrane Equilibrium
	<b>CO 10</b>	Write applications of surfactants in detergent, food industry and in pesticide formulation
<p style="text-align: center;"><b>Unit - III</b> <b>Electrochemistry – Electrochemical cells</b></p>	<b>CO 1</b>	Write expressions for activities of electrolytes of different valence type
	<b>CO2</b>	Identify cells as chemical and concentration cell
	<b>CO 3</b>	Derive expressions for emf of concentration cell
	<b>CO 4</b>	Explain liquid junction potential and use of salt bridge
	<b>CO 5</b>	Determine pH of a solution using quinhydrone & Glass electrode
	<b>CO 6</b>	Construct cell to determine solubility and K <sub>sp</sub> of sparingly soluble salt
	<b>CO 7</b>	Apply emf measurements to determine liquid junction potential
<p style="text-align: center;"><b>Unit – IV</b> <b>4.1 - Introduction to Polymers</b> <b>4.2 – Crystalline state</b></p>	<b>CO 1</b>	Define terms associated with polymers
	<b>CO2</b>	Classify polymers based on source, structure, thermal response etc

		<b>CO 3</b>	Know different expressions to represent molar mass of polymer		
		<b>CO 4</b>	Discuss ultracentrifuge & viscosity method for molecular weight		
		<b>CO 5</b>	Solve numerical on molecular weight of polymers		
		<b>CO 6</b>	Know characteristics, method of preparation and applications of LEPs		
		<b>CO 7</b>	Write characteristics of simple , FCC and BCC system		
		<b>CO 8</b>	Know use of X rays & derivation of Bragg's eqn.		
		<b>CO 9</b>	Draw and explain structure of NaCl and KCl		
		<b>CO 10</b>	Determine Avogadro's No.		
		<b>CO 11</b>	Elaborate on elementary ideas of crystal defects		
		<b>CO 12</b>	Solve numerical based on this topic		
		<b>USCH 502 (Inorganic Chemistry)</b>	<b>Unit - I : Chemical Bonding and Solid State Chemistry</b>  <b>Unit II : Solid Materials</b>  <b>Unit III : Chemistry of elements</b>  <b>Unit IV : Solution Chemistry</b>	<b>CO 1</b>	Debate on Importance of symmetry in Chemistry
				<b>CO2</b>	Determine different symmetry operations and point groups in molecules
<b>CO 3</b>	Elucidate on the differences in the Molecular Orbital theory applied to diatomic and polyatomic molecules				
<b>CO 4</b>	Illustrate the bonding in different diatomic and polyatomic molecules by Molecular orbital diagram.				
<b>CO 5</b>	Explain the different types of terms involved in the study of solids				
<b>CO 6</b>	Evaluate the packing density id different types of close packed structures				
<b>CO 7</b>	Debate on the different types of point defects in solids				
<b>CO 8</b>	Elaborate on the history of Superconductivity and the recent advances in the field f superconductivity				

		<b>CO 9</b>	Describe the position of inner transition elements in the periodic table, their electronic configuration, and properties
		<b>CO 10</b>	Debate on the methods used for separation of lanthanons and their applications
		<b>CO 11</b>	Evaluate the different types of non aqueous solvent and their properties
		<b>CO 12</b>	Illustrate different types of reactions in non aqueous solvents.
		<b>CO 13</b>	Relate the periodic properties of Group 16 and 17 elements
		<b>CO 14</b>	Elucidate on the properties and structure of oxyacids of halogens and interhalogens by VSEPR theory
<b>USCH 503 (Organic Chemistry)</b>	<b>Mechanism of Organic reactions</b>	<b>CO 1</b>	After studying this unit learner will be able to
	<b>Stereochemistry</b>	<b>CO2</b>	Visualise 3 –D structure of molecules and correlate to stability and reactivity
	<b>Carbohydrates</b>	<b>CO 3</b>	Interconvert projection of carbohydrates
		<b>CO 4</b>	Write reactions of monosaccharides
		<b>CO 5</b>	Interconvert monosachharides
	<b>IUPAC Nomenclature</b>	<b>CO 1</b>	Name using IUPAC nomenclature the following special classes of organic compounds – Biphenyls, Cummulenes and Bicyclic compounds
	<b>Heterocyclic chemistry</b>	<b>CO 1</b>	Explain aromaticity of heterocycles
		<b>CO 2</b>	Compare reactivity of 5 & 6 membered heterocycles
	<b>Organic Synthesis</b>	<b>CO 1</b>	Explain newer methods of organic synthesis & their advantages
		<b>CO 2</b>	Synthesize some drugs and dyes

<b>USCH 504 (Analytical Chemistry)</b>	<b>Unit I : 1.1- Treatment of Analytical data, 1.2- Sampling</b>	<b>CO 1</b>	Identify and calculate types of errors in analysis
		<b>CO2</b>	Distinguish between accuracy and precision
		<b>CO 3</b>	Know concept of central tendency, standard deviations of a data
		<b>CO 4</b>	Solve numerical based on error, accuracy & standard deviation
		<b>CO 5</b>	Define terms involved in sampling
		<b>CO 6</b>	Know significance & purpose of sampling
		<b>CO 7</b>	Write steps involved in sampling of solids, liquids & gases
		<b>CO 8</b>	Analyse difficulties encountered in sampling
	<b>Unit II : 2.1- Acid-base titrations 2.2- Precipitation titrations 2.3 – U.V Visible spectroscopy</b>	<b>CO 1</b>	Construct titration curves and discuss choice of indicator in different acid-base titration
		<b>CO2</b>	Construct titration curves of Argentimetric titration
		<b>CO 3</b>	Describe theory and applications of Volhard's and Mohr's method
		<b>CO 4</b>	Know components of Photometer and Spectrophotometer
		<b>CO 5</b>	Differentiate between single beam and double beam spectrophotometer
	<b>Unit III : Methods of separation 3.1 – Solvent Extraction 3.2 – Chromatography 3.3 – Planar chromatography</b>	<b>CO 1</b>	Know Principles of solvent extraction.
		<b>CO2</b>	Differentiate between partition coefficient and Distribution ratio
		<b>CO 3</b>	Describe types of techniques of solvent extraction such as- Batch extraction and continuous extraction
		<b>CO 4</b>	Write advantages and applications of solvent extraction.

		<b>CO 5</b>	Solve the numerical problems
		<b>CO 6</b>	Know principle and classification of chromatographic technique
		<b>CO 7</b>	Learn technique and applications of PC and TLC
	<b>Unit IV : Optical Methods</b> <b>4.1- Atomic Spectroscopy</b>  <b>4.2 – Molecular Florescence &amp; Phosphorescence</b>  <b>4.3 – Turbidimetry &amp; Nephelometry</b>	<b>CO 1</b>	Learn absorption and emission spectra
		<b>CO2</b>	Describe components, principle and technique of flame photometry and AAS
		<b>CO 3</b>	Interpret data by different methods
		<b>CO 4</b>	Know quantitative applications of atomic spectroscopy
		<b>CO 5</b>	Describe theory, instrumentation and applications of fluorescence and phosphorescence spectroscopy
		<b>CO 6</b>	Know the difference between Nephelometry and Turbidimetry
		<b>CO 7</b>	Learn instrumental techniques for measurement of turbidance
		<b>CO 8</b>	Write Applications of Turbidimetry and Nephelometry
<b>USACDD 505 (Pharmaceutical Chemistry and Dye stuffs)</b>	<b>Unit I :</b>	<b>CO 1</b>	Understand the pharmacological terms used with respect to the medicinal chemistry
		<b>CO2</b>	know the ingredients of drug formulation and different modes of drug administration and formulations
	<b>Unit II :</b>	<b>CO 1</b>	classify the drugs used in different general ailments

		<b>CO2</b>	know the chemical constituent and application of different classes of drugs
		<b>CO 1</b>	correlate colour and structure of different dye molecule
		<b>CO2</b>	Correlate class of dyes to mode application
	<b>Unit III :</b>	<b>CO 3</b>	To understand benzene, naphthalene & anthracene chemistry w.r.t. to conversion and introduction of functional group
		<b>CO 1</b>	know fundamental properties of colorants
		<b>CO2</b>	Correlate class of dyes to mode of application
	<b>Unit IV :</b>	<b>CO 3</b>	Write reaction for synthesis of different dyes using appropriate conditions

**T.Y.B.Sc : Semester VI**

<b>USCH 601 (Physical Chemistry)</b>	<b>Unit - I : Molecular Spectroscopy</b>	<b>CO 1</b>	Identify structure of molecules on the basis of dipole moment
		<b>CO2</b>	Identify structure of molecules on the basis of dipole moment
		<b>CO 3</b>	Define terms used in rotational, vibrational & Raman spectroscopy
		<b>CO 4</b>	Know conditions for obtaining pure rotational spectrum, vibrational spectrum and rotational vibrational spectrum and selection rule
		<b>CO 5</b>	Identify types of vibrations in a molecule
		<b>CO 6</b>	Interpret structure of water and carbon dioxide according to IR and Raman spectroscopy
		<b>CO 7</b>	Elaborate on quantum theory and Rule of Mutual Exclusion

		<b>CO 8</b>	Solve numerical based on internuclear distance , isotopic mass, Raman shift, vibrational and IR spectroscopy
	<b>Unit II :</b>  <b>2.1 - Basics of Quantum Chemistry</b>  <b>2.2 – Applied electrochemistry</b>	<b>CO 1</b>	Describe limitations of classical mechanics
		<b>CO2</b>	Know Concept of quantization and wave particle duality
		<b>CO 3</b>	Explain Uncertainty principle and its physical significance
		<b>CO 4</b>	Elaborate on ‘Boundary conditions’ and time independent Schrodinger wave equation.
		<b>CO 5</b>	Interpret properties of Wave function
		<b>CO 6</b>	Describe postulate of quantum mechanics
		<b>CO 7</b>	Know types of polarization and its elimination
		<b>CO 8</b>	Write experimental set up for determination of decomposition potential and overvoltage
		<b>CO 9</b>	Write objectives and procedure of electroplating
	<b>Unit III :</b> <b>3.1 – Renewable energy sources</b>  <b>3.2 – Nuclear Magnetic Resonance Spectroscopy</b>  <b>3.3 – Chemical Kinetics</b>	<b>CO 1</b>	Describe principle , construction and working of fuel cells, Lithium ion cell & solar cells
		<b>CO2</b>	Elaborate on hydrogen as universal energy medium
		<b>CO 3</b>	Know principle and terms involved in NMR spectroscopy
		<b>CO 4</b>	Explain relaxation processes and chemical shift
		<b>CO 5</b>	Draw low resolution NMR spectrum of methanol and ethanol
		<b>CO 6</b>	Classify reactions on the basis of rate
		<b>CO 7</b>	Know stop flow method to study kinetics of fast reaction
		<b>CO 8</b>	Elaborate on collision theory and its application to unimolecular and bimolecular reaction

	<b>Unit IV : Nuclear Chemistry</b>	<b>CO 1</b>	Identify types of nuclear radiation
		<b>CO2</b>	Write principle , construction & working of G.M Counter and Scintillation counter
		<b>CO 3</b>	Define units of radioactivity and explain Decay kinetics
		<b>CO 4</b>	Know types of radioactive equilibrium & nuclear transmutation
		<b>CO 5</b>	Write fissile and fertile material with example
		<b>CO 6</b>	Describe components of a nuclear reactor, Breeder and Power reactor
		<b>CO 7</b>	Write applications of tracer technique
		<b>CO 8</b>	Solve numerical based on Q-value and threshold energy
<b>USCH 602 (Inorganic Chemistry)</b>	<b>Unit - I : Coordination Chemistry</b>	<b>CO 1</b>	Review the limitations of Valence bond theory in explaining bonding in complexes.
		<b>CO2</b>	Elaborate on the postulates of crystal field theory and crystal field splitting in octahedral, tetrahedral and Square Planar complexes.
	<b>Unit II : Properties of Coordination compounds</b>	<b>CO 3</b>	Calculate Crystal field stabilization energies for tetrahedral and octahedral complexes.
		<b>CO 4</b>	Comment on Jahn Teller distortion in octahedral complexes.
	<b>Unit III : Organometallic Chemistry</b>	<b>CO 5</b>	Elucidate on the limitations of Crystal field theory
		<b>CO 6</b>	Identify central metal orbitals and construct ligand group orbital
	<b>Unit IV : Inorganic Polymers , Characteristics and Treatment of liquid effluent , Nanomaterials, Inorganic Pharmaceuticals</b>	<b>CO 7</b>	Construct $\sigma$ molecular orbital for an octahedral complex
		<b>CO 8</b>	Evaluate the difference between thermodynamic stability and kinetic stability of complexes and comment on the factors affecting thermodynamic stability

		<b>CO 9</b>	Compare on different types of reactions undergone by complexes
		<b>CO 10</b>	Evaluate and identify inert and labile complexes
		<b>CO 11</b>	Elaborate on the mechanisms of acid hydrolysis, base hydrolysis anation reactions of octahedral complexes.
		<b>CO 12</b>	Review the different types of electronic transitions responsible for electronic spectra of atoms
		<b>CO 13</b>	Identify allowed and forbidden transitions on the basis of selection rules.
		<b>CO 14</b>	Determine terms and term symbols for transition metal ions.
		<b>CO 15</b>	Determine terms for p <sup>2</sup> and d <sup>1</sup> electronic configuration
		<b>CO 16</b>	Elucidate the different types of organometallic compounds
		<b>CO 17</b>	Elaborate on the various synthetic routes for the preparation of organometallic compounds and the associated chemical reactions.
		<b>CO 18</b>	Explain the synthesis ,structure and properties of sandwich compound Ferrocene
		<b>CO 19</b>	Review the different types of metallurgies and the general steps involved.
		<b>CO 20</b>	Elaborate on the pyrometallurgical extraction of Copper
		<b>CO 21</b>	Review the historical perspectives of Noble gases and recent advances in the chemistry of Noble gases
		<b>CO 22</b>	Elucidate on the preparation, properties and structure of Xenon fluorides by VSEPR THEORY
		<b>CO 23</b>	Evaluate the importance of essential and non-essential elects in biological systems

		<b>CO 24</b>	Explain the importance of some selected metal ions (Na <sup>+</sup> , K <sup>+</sup> , Fe <sup>2+</sup> , Cu <sup>2+</sup> )	
<b>USCH 603 (Organic Chemistry)</b>	<b>Spectroscopy</b>	<b>CO 1</b>	Predict spectral details and identify structural features of organic compounds from spectra	
		<b>CO2</b>	Interpret spectra	
	<b>Polymers</b>	<b>CO 1</b>	Prepare polymers from respective monomers and list their uses	
	<b>Photochemistry</b>	<b>CO 1</b>	Explain fate of photochemically excited molecules and photochemical reactions	
	<b>Catalysts and Reagents</b>	<b>CO 1</b>	Prepare organic compounds by converting functional groups by use of appropriate catalyst and reagent.	
	<b>Natural Products</b>	<b>CO 1</b>	Discuss the distinguishing features and properties of different natural products	
		<b>CO2</b>	Predict structural features on the basis of analytical evidence	
		<b>CO 3</b>	Synthesize some listed natural products	
	<b>Organometallic Chemistry</b>	<b>CO 1</b>	Compare reactivity of organometallics	
		<b>CO2</b>	Synthesize various classes of organic compounds using organometallics	
	<b>Biomolecules</b>	<b>CO 1</b>	Describe structure and properties of important biomolecules	
	<b>USCH 604 (Analytical Chemistry)</b>	<b>Unit I : 1.1- D.C. Polarography 1.2- Amperometric titrations</b>	<b>CO 1</b>	Know polarography as an analytical tool
			<b>CO2</b>	Write construction, working, advantages and disadvantages of DME
<b>CO 3</b>			Derive polarographic wave equation	
<b>CO 4</b>			Explain different terms involved in Ilkovic equation	
<b>CO 5</b>			Know need of removal of dissolved oxygen from analyte solution	
<b>CO 6</b>			Draw polarographic cell	

		<b>CO 7</b>	Discuss qualitative and quantitative methods of analysis
		<b>CO 8</b>	Write applications and solve numerical problems
		<b>CO 9</b>	Describe rotating platinum electrode & different titration curve
		<b>CO 10</b>	Know principle, applications, advantages and limitations of amperometric titration
	<b>Unit II :</b> <b>2.1 – Gas Chromatography</b> <b>2.2- HPLC</b> <b>2.3- Ion Exchange Chromatography</b>	<b>CO 1</b>	Know principle , instrumentation and applications of GLC & HPLC
		<b>CO2</b>	Elaborate on types of elution, U.V and I.R detectors in HPLC
		<b>CO 3</b>	Describe types of ion exchangers & mechanism of ion exchange
		<b>CO 4</b>	Determine separation factor and ion exchange capacity
		<b>CO 5</b>	Know factors affecting separation of ions and applications
	<b>Unit III :</b> <b>3.1 – Treatment of Analytical data</b> <b>3.2- Complexometric Titrations</b> <b>3.3- Redox titrations</b>	<b>CO 1</b>	Describe distribution of random error
		<b>CO2</b>	Explain Gaussian curve, student t.
		<b>CO 3</b>	Know criteria for rejection of result
		<b>CO 4</b>	Solve numerical on 2.5d rule, 4.0 rule, Q test, method of averages and least square method.
		<b>CO 5</b>	Write advantages & limitations of EDTA as titrant
		<b>CO 6</b>	Explain types of EDTA titrations
		<b>CO 7</b>	Discuss theory and applications of metallochromic indicators, redox indicators
		<b>CO 8</b>	Understand criteria for selecting an indicator for a redox titration
		<b>CO 9</b>	Construct titration curves of listed titration
		<b>CO 10</b>	Know use of diphenylamine and ferroin as redox indicator
	<b>Unit IV :</b> <b>4.1- Total Quality Management</b>	<b>CO 1</b>	Elaborate on concept of quality, quality control, TQM, ISO series and Good laboratory practices

	<b>4.2- Mass spectrometry</b> <b>4.3- Thermal methods</b> <b>4.4- Radioanalytical techniques</b>	<b>CO2</b>	Know principle and instrumentation of mass spectrometry
		<b>CO 3</b>	Classify thermal methods of analysis
		<b>CO 4</b>	Discuss basic principle, instrumentation involved in TGA
		<b>CO 5</b>	Write factors affecting TG curve and applications
		<b>CO 6</b>	Classify radio analytical techniques
		<b>CO 7</b>	Explain principle and applications of NAA
<b>USACDD 605</b> <b>(Pharmaceutical Chemistry and Dye stuffs)</b>	<b>Unit I :</b>	<b>CO 1</b>	understand the different aspect of drug discovery and drug designing
		<b>CO2</b>	know the mode by which the drug interact in biological system and drug metabolism
	<b>Unit II :</b>	<b>CO 1</b>	understand the mode of action of drug in general
		<b>CO2</b>	know the chemo therapeutic drug and their application, mode of action and side effects
	<b>Unit III :</b>	<b>CO 1</b>	classify dyes on the mode of application to understand the fiber and the different techniques of dyeing.
	<b>Unit IV :</b>	<b>CO 1</b>	distinguish b/w dyes and pigments