COURSE OUTCOMES

M.Sc. Chemistry	
SEM-I	
PAPER 1	**Course Title: Physical Chemistry** **Course Code: PSCH101**
CO1	After successfully completing this course on **Thermodynamics**, Learners understand principles of thermodynamics, Maxwell equation and its application to ideal gases. Joule Thomson effect and its applications. Learners will also understand laws of thermodynamics, especially the third law in detail , entropy change for phase transition, absolute entropy, residual entropy etc.
CO2	By studying the course on **Basics of Quantum Mechanics,** the learner understands the limitations of classical mechanics and how it is possible to explain the behaviour of subatomic particles with the application of quantum mechanics . They will learn about Schrodinger's wave equation and its interpretation, particle waves, wave functions, properties of wave function.They will also be able to learn about Operators,Eigen function and Eigen values and solve problems on it; derive Schrodinger's time independent wave equation. They will be able to understand the concept of particle in one , two and three dimensional box , separation of variables, quantization and introduction of quantum numbers; Harmonic Oscillator, Hermite Polynomials.
CO3	After completing this course on **Chemical Dynamics** students have knowledge of steady state approximation, microscopic reversibility, detailed balanced chain reaction,some inorganic reactions like decomposition of phosgene, decomposition of ozone etc. they will also understand theories of reaction mechanism, explosion limits, kinetics of polymerisation reactions in details and theories of reactions in gas phase .

CO4	After studying the topic of **Electrochemistry,** the learner is able to understand the advanced concepts of electrochemistry like Debye Huckel theory of activity coefficient, Debye Huckel limiting law, electrolytic conductance and ionic interaction, Debye- Falkenhagen effect and Wien effect. The learner will be able to derive the Debye Huckel Onsager equation. He will also get knowledge of different types of Fuel cells like alkaline fuel cell, solid -oxide fuel cell etc. The student will also get introduced to Biochemistry . He will be able to understand cells and membranes, membrane potential and theory of membrane potential. interfacial electron transfer in biological systems, enzymes as electrodes. He will be able to derive the Goldmann equation. The student will be able to solve numerical and theoretical problems from all topics of each unit
PAPER 2 Course Title: Inorganic Chemistry Course Code: PSCH102	
CO1	After studying Chemical bonding students will get knowledge of hybridization involving sigma bonding, VBT, MOT and importance of weak forces of attraction such as hydrogen bonding etc.
CO2	In Molecular symmetry and Group theory unit students learn about the symmetry operations and applications of group theory.
CO3	In the Solid state Chemistry unit students learn about electronic structure of solids, band theory, methods of preparation of inorganic solids and nanomaterials along with applications.
CO4	In characterization of coordination compounds students get the idea of the preparation of coordination compounds and how their characterization is done.
PAPER 3 Course Title: Organic Chemistry Course Code: PSCH103	
CO1	In the topic **Physical Organic Chemistry,** the students learn about the fundamentals of rate, equilibrium constant, transition state, activated complex and its nature, reactivity, selectivity, Curtin-Hammett principle, microscopic reversibility and kinetic Vs. thermodynamic control of organic reactions; various methods of determining reaction mechanism; factors affecting the acidity and basicity of acids and bases.

CO2	In the topic **Nucleophilic Substitution Reactions**, the students are able to clear their ideas about SN1, SN2, SNi, SET, NGP participation and the factors affecting these reactions; Aromatic nucleophilic substitution reactions like SN1, Ipso, benzyne, cine, tele and vicarious substitution. Students will also learn about Ester Hydrolysis and their various types.
CO3	In the topic **Aromaticity**, the students learn about basics of aromaticity, various criteria for aromaticity, application of HMO Theory, Huckel rules, Frost-Musulin diagram; aromatic, homoaromatic and antiaromatic ; and aromaticity of various types of compounds like metallocenes, azulenes, annulenes, aromatic ions and Fullerenes.
CO4	In the topic **Stereochemistry**, the students learn about Chirality, Symmetry elements; stereochemistry of- molecules with tri-and tetra-coordinate centers, molecules with two or more chiral centres; axial and planar chirality and the concept of Prochirality.
CO5	In the topic **Oxidation and Reduction**, the students learn about Oxidation, Dehydrogenation by using metal and organic reagents; Oxidation of alcohols to aldehydes and ketones by using chromium reagents and other name oxidations; Oxidations involving C-C bond cleavage, replacement of H by O; reduction of CO to -CH2 in aldehydes and ketones; Reduction by using metal hydrides, hydrazine, dissolving metals in liq. NH3.
PAPER 4 Course Title: Analytical Chemistry Course Code: PSCH104	
CO1	LANGUAGE OF ANALYTICAL CHEMISTRY:outcome:It prepares the learner completely for his entry in industrial and corporate sector .the learner is made fully aware of the common analytical problems faced in production and quality control .The learner is given detailed knowledge of the various instrumental and non instrumental methods used in industries and research analytical laboratories the determinate and indeterminate errors discussed involved and their calculations makes the student full aware of the statistical methods used for quality control in industries the discussion in the topic Accreditation and safety in laboratories prepares the learner to work in analytical laboratories in the industrial sector TQM total quality management is a management topic gives the learner clear idea of the pattern of working in corporate sector the frequently used techniques,in corporates for continuous improvement in quality .processes and systems of 5s .Kaizen and Six sigma are discussed in detail to make the learner aware of the atmosphere and ambience of corporate sector

CO2	CALCULATIONS BASED ON CHEMICAL PRINCIPLES : outcome :the learner will be able to prepare any type of solution required for analysis from ppb ppm to large concentrations, fully understanding the theoretical aspect behind the calculation used in the preparation The theoretical concepts of stoichiometry of the reactions ,formation constant ,stability constant are clearly discussed to give the learner a holistic information about chemical calculations
CO3	OPTICAL METHODS: The main objective of coaching this course is to impart knowledge in students about basic principle, instrumentation, and application of Recapitulation and FT Technique, Molecular Ultraviolet and Visible Spectroscopy, Applications of Ultraviolet and Visible spectroscopy, Infrared Absorption Spectroscopy . This enables learners to understand the function of various instruments and its application in chemical industries.
CO4	THERMAL METHODS: Thermal Methods: The main objective of coaching this course is to impart knowledge in students about basic principle, instrumentation, application , types of thermal methods, comparison between TGA and DTA, Differential Scanning Calorimetry, automation in chemical analysis, need for automation, Objectives of automation, An overview of automated instruments and instrumentation, process control analysis, flow injection analysis, discrete automated systems, automatic analysis based on multi-layered films, gas monitoring equipment and Automatic titrators. This enables learners to understand the function of various instruments and its application in chemical industries.
SEM-II	
PAPER 1	**Course Title: Physical Chemistry Course Code: PSCH201**
CO1	After studying this module of **Chemical Thermodynamics II** students shall be able to: know the concept of fugacity, determine the coefficient of fugacity, understand the concept of partial molal quantities for real solutions and derivation of Gibbs Duhem Margules equation , know the thermodynamics of surfaces, understand relation between surface tension and adsorption and derivation of Gibbs and BET adsorption equations, understand free energy changes accompanying biochemical reactions.
CO2	After studying this module of **Quantum Chemistry II** students shall be able to: write the Schrödinger equation for Rigid Rotator, solve the Schrödinger equation for Rigid Rotator, write the Schrödinger equation for Hydrogen atom ,solve the Schrödinger equation for Hydrogen atom,write the radial wave-function of electronic hydrogen atom Schrödinger equation, write the

	expressions for the total wave function for 1s,2s, 2p and 3d orbitals of hydrogen, study the application of the Schrödinger equation to two electron system
CO3	After studying this module **Chemical Kinetics and Molecular Reaction Dynamics**, student shall be able to- learn about Solution Kinetics, learn about ionic reactions, learn about effect of solvent on the rate of ionic reaction, know about ionic strength, learn about the effect of solvent on the rate of the reaction, derive the relationship between the rate constant of the reaction and dielectric constant of the solvent, learn about primary and secondary salt effects, study of free energy changes accompanying biochemical reactions, specificity of enzyme substrate reactions and their catalytic power, learn the derivation of the Michaelis-Menten equation in understanding enzyme kinetics and its applications, also learn the Lineweaver-Burk and Eadie Analyses , learn the importance and significance of Vo, Km, Vmax , understand the Inhibition of Enzyme action i.e. Competitive, Noncompetitive and Uncompetitive Inhibition , study the Kinetics of reactions in solid states such as rate laws .
CO4	After the course on **Solid State Chemistry** the student will be able to- understand the origin and nature of defects in crystals, learn types of crystal defects and Stoichiometry, learn thermodynamics of formation of defects and mathematical derivation to find concentration of defects.
CO5	After the course on **Phase equilibria** the student will be able to- understand the main definitions of terms and thermodynamic derivation of phase rule equation,Read the information given in various phase diagrams, learn the applications of phase rule to two component systems like solid-gas and solid –liquid systems, understand Composition and temperature diagrams defined in binary systems , learn the formations of congruently-incongruently melted intermediate compounds and solid solutions , understand composition - temperature diagrams defined in ternary systems.
PAPER 2	**Course Title:Inorganic Chemistry Course Code: PSCH202**
CO1	In this unit students will study Inorganic reaction mechanism where rate of reaction, factor affecting it and techniques for its determination. Ligand substitution reactions and redox reaction along with

	stereochemistry of substitution reactions of octahedral complexes is studied.
CO2	In this unit Organometallic Chemistry of Transition metals is studied for some compounds with their preparation and properties, structure and bonding of some organometallic compounds is studied on the basis of VBT and MOT.
CO3	Learner will get knowledge of environmental chemistry with respect to heavy metals toxicity along with radioactive materials and their effect on living things.
CO4	In Bio-inorganic Chemistry unit students will get knowledge of biological oxygen carriers, copper containing enzymes, nitrogen fixation, metal ion transport and cis-platin related compounds with their applications.
CO5	
PAPER 3 Course Title: Organic Chemistry Course Code: PSCH203	
CO1	In the topic **Alkylation of Nucleophilic Carbon Intermediates**, the students will learn about Carbanions, formation and alkylation of enolates,alkylation of aldehydes, ketones, esters, amides and nitriles; Reactions of Carbon nucleophiles with carbonyl groups, their mechanism, a few name reactions like Aldol condensation, Robinson annulation, Knoevengel reaction, Mannich reaction.
CO2	In the topic **Reactions and Rearrangements**, the students shall learn about mechanisms, stereochemistry and applications of reactions like Baylis-Hilman reaction, McMurry coupling, Corey-Fuchs reaction, etc.; rearrangements like Hoffman, Curtius, Lossen, Schmidt, Wolff, etc.
CO3	In the topic Introduction to **Molecular Orbital Theory for Organic Chemistry**, the students will learn about molecular orbitals of various alkene systems; concepts of FMO, HOMO-LUMO, Application of FMO concepts to organic reactions.
CO4	In the topic **Applications of UV and IR Spectroscopy**, the students will get clear ideas about fundamentals of UV and IR spectroscopy, factors affecting the position and intensity of uv bands, calculation of absorption maxima by using Woodward-Fischer rules; characteristics and factors affecting vibrational frequencies and study of vibrational frequencies of organic compounds.
CO5	From the topic **NMR Spectroscopy and Mass Spectrometry**, the students shall learn about the fundamentals, principles, theory,applications in structural elucidation, factors affecting the values of H1-NMR, 13C, and Mass spectrometry (m/z) and various terminologies involved in them.
PAPER 4 Course Title: Analytical Chemistry Course Code: PSCH204	
CO1	Recapitulation of basic concepts in chromatography:outcome:The basic concepts of chromatography ,detectors used in GC andLC their comparison and applications are clarified is to the learner very well

	outlining to the learner the principles of a very versatile method of separation and analysis Outcome of the topic on gas chromatography is that it gives a overview of all the advanced and modern systems of injection.detectors such as mass spectrometric used in GC to the learner which will help them in handling the instrument easily HPLC:outcome:All the sophisticated and recent applications ,systems used commercially available columns are discussed which will update the learner about the industrial applications of HPLC
CO2	X RAY Spectroscopy:outcome: XRay Diffraction and absorption methods are discussed in detail which totally equips the learner for its use commercially Mass spectroscopy:outcome :since it the most widely used technique when accurate results are required .the topic gives a good overview to the learner about its instrumentation electron impact ,chemical and field ionisation mass analysers and its applications Radioanalytical methods :outcome:It prepares the learner to takeup further studies in Forensic sciences since it has vast applications in forensic studies the topic discusses in detail isotope,single and double dilution method applications to enhance the knowledge of the learner
CO3	Surface Analytical Techniques: the core purpose of coaching this course is to impart knowledge in students in the subject of Introduction, Principle, Instrumentation and Applications of Scanning Electron Microscopy (SEM), Scanning Tunneling Microscopy (STM), Transmission Electron Microscopy (TEM) Electron Spectroscopy (ESCA and Auger), Atomic Spectroscopy. AAS, Atomic Spectroscopy.
CO4	Electroanalytical Methods: the core purpose of coaching this course is to impart knowledge in students in the subject of Ion selective potentiometry and Polarography, Ion selective electrodes and their applications, ion selective field effect transistors, biocatalytic membrane electrodes and enzyme-based biosensors. In the subject of Polarography, Coulometry and Electrogravimetry students learn Ilkovic equation, derivation starting with Cottrell equation, effect of complex formation on the polarographic waves. Introduction, principle, instrumentation, factors affecting the nature of the deposit, applications.
CO5	
SEM-III	
PAPER 1 Course Title: Theoretical Organic Chemistry Course Code: PSCH301	

CO1	After studying this course the learner will be able to: Predict the pathway of reaction mechanism and the stability of intermediates.
CO2	Study the stereochemistry of pericyclic reactions
CO3	Determine the point group based on symmetry elements and carry out conformational analysis of ring compounds.
CO4	Understand the photochemical reactions with special reference to cleavage of carbonyl compounds and photochemistry of olefins.
CO5	
PAPER 2 Course Title: Synthetic Organic Chemistry Course Code: PSCH302	
CO1	After studying this course the learner will be able to: Write mechanism for various name reactions including multicomponent reactions and click reactions.
CO2	Predict the product formed in the above reactions.
CO3	Methods for the preparation of synthetically important compounds involving radicals.
CO4	Methods for the preparation of synthetically important compounds involving enamines and ylides.
CO5	Understand and explore the applications of various metals and non-metals in organic synthesis.
PAPER 3 Course Title: Natural Product & Spectroscopy Course Code: PSCH303	
CO1	After studying this course the learner will be able to: Know the basic structure elucidation of carbohydrates, natural organic pigments,insect pheromones and alkaloids.
CO2	Understand the synthetic strategies towards the synthesis of bioactive molecules.
CO3	Develop a problem solving approach towards structure elucidation from spectral data.
PAPER 4; Course Title: Medicinal, Biogenesis & Green Chemistry; Course Code: PSCHOEC-I 304	
CO1	After studying this course the learner will be able to: Know basic terms involved in medicinal chemistry,procedures involved in drug design & factors affecting the activity and potency of a particular drug.
CO2	Understand the effect of structure-activity relationship of drug function and the concept of pro-drug.
CO3	Biogenesis and biosynthesis of natural products,general pathway of amino acid biosynthesis.
CO4	Summarize the twelve principles of green chemistry and study their applications in synthetic organic chemistry.
SEM-IV	

PAPER 1 Course Title- Theoretical Organic Chemistry-II Course Code: PSCHO401	
CO1	After studying this course the learner will be able to: Correlate the effect of substituents on a substrate with its reactivity.
CO2	Understand the concept of molecular assembly and intermolecular bond in macromolecules and their effects with reference to catalytic activity.
CO3	Determine enantiomeric and diastereomeric compositions using various available methods,understand the properties of molecules by studying physical phenomena like Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD).
CO4	Types of asymmetric synthesis,controlled by chiral auxiliary, chiral catalyst,chiral substrate & chiral reagent with examples.
CO5	Appreciate the importance and challenges in the asymmetric synthesis, exemplified by Felkin-Anh and chelation models & asymmetric aldol reactions.
PAPER 2 Course Title: Synthetic Organic Chemistry -II Course Code: PSCHO402	
CO1	Propose a retrosynthetic strategy for an organic compound. Give the forward synthesis, recognizable starting material and steps involved in the synthesis of compound
CO2	Know the current trends in synthesizing organic compounds. Explore the applications of modern and greener methods of organic synthesis.
CO3	Understand the application of transition metal reagents and catalysts in organic synthesis
CO4	Know the use of electrochemical methods for organic synthesis.
CO5	
PAPER 3 Course Title: Natural Products & Heterocyclic Chemist Course Code: PSCHO403	
CO1	After studying this course, the learner will be able to: Understand the occurrence & biological roles of steroids. vitamins, terpenoids and antibiotics.
CO2	Have an enhanced approach towards structural elucidation.
CO3	Apply the rules of IUPAC nomenclature and other methodologies towards the nomenclature of heterocyclic compounds.

CO4	Understand the reactivity of various heterocyclic molecules and their importance towards synthesis of certain bioactive molecules.
PAPER 4 Course Title: Research Methodology Course Code: PSCHOOC-II404	
CO1	After studying this course, the learner will be able to:Know the basics of research methodology.
CO2	Get the technical know-how of research for developing a problem.
CO3	Write a research paper, study formats of existing research papers and review papers.
CO4	To increase the awareness about the importance of laboratory safety and the safety protocols in R&D laboratories.