



P.P.N.(P.G.)College, Kanpur

96@12MahatmaGandhiMarg,Kanpur-208001

•Telefax:(0512)2361924•Website:www.ppncollege.org•

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P.G. CHEMISTRY COURSE OUTCOMES (COs) DEGREE IN MASTER OF SCIENCE

FIRST YEAR	SEMESTER-I	INORGANIC CHEMISTRY-I		CODE:B020701T	THEORY	CREDIT:04	
		CO1	Importance of the stereochemistry and bonding in Main Group Compounds; VSEPR, Walsh diagrams (Tri- and Penta atomic molecules), $d\pi-p\pi$ bonds, Bent rule and energetics of hybridizations, some simple reactions of covalently bonded molecules.				
		CO2	To learn the Metal-Ligand Equilibria in solution through the stepwise and overall formation constants and their interaction, trends in stepwise constants, and factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand.				
		CO3	Understand the Reaction Mechanism of Transition Metal Complexes via the energy profile of a reaction, the reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, the kinetics of octahedral substitution, acid hydrolysis, factor affection, acid hydrolysis, base hydrolysis, conjugate base mechanism.				
		CO4	To develop the understanding of the Metal-Ligand Bonding via limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π -bonding and molecular orbital theory.				
		ORGANIC CHEMISTRY-I		CODE: B020702T	THEORY	CREDIT:04	
		CO1	Understand the nature of bonding, particularly delocalization, conjugation, cross-conjugation, resonance, hyperconjugation, tautomerism, etc.				
		CO2	Realize the terms aromaticity, anti-aromaticity, and homo-aromaticity in different organic molecules.				
		CO3	Know about the class of meso-ionic compounds and alternant and non-alternant hydrocarbons.				
		CO4	Know about the definition and significance of synthetic molecular receptors with their structure and synthesis.				
		CO5	Know about the various reactive intermediates in organic synthesis.				
		CO6	Know about the types of reactions and mechanisms by realizing the various factors which are affecting the reactions.				
		CO7	Understand the methods of determining mechanisms based on different factors.				
		CO8	Realize the concept of hard and soft acids and bases.				
		CO9	Understand the concept of stereochemistry by writing the different projection formulas.				
		CO10	Write the conformations of different molecules and understand the conformational analysis.				
		CO11	Write the nomenclature and conformations of fused and bridged ring systems.				
		CO12	Understand the concept of prochirality.				
		CO13	Know about carbohydrates and realize their reactions.				
CO14	Know about the heterocyclic compounds and write their names.						
CO15	Understand the structure and reactivity of various heterocyclic compounds.						
CO16	Know about the biological importance and synthesis of different vitamins.						



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PHYSICAL CHEMISTRY-I		CODE:B020703T	THEORY	CREDIT:04
CO1	Able to understand the origin of quantum mechanics and identify the phenomena responsible for the failure of classical mechanics.			
CO2	Able to understand the physical significance and commutation properties of angular momentum orbital and spin angular momentum operator in quantum mechanics.			
CO3	Able to appreciate the application of perturbation theory and variation methods for studying complex chemical systems.			
CO4	Capable of writing and solving the Schrödinger equation for complex systems using quantum mechanical concepts.			
CO5	Able to define rate law and rate constant, Arrhenius Equation, the physical significance of Activation Energy and capable of solving numerical problems.			
CO6	Capable of deriving the rate constant on the basis of collision theory, assumptions and principles of Transition State Theory.			
CO7	Understands and learns the skills used in various types of Flow Systems, different techniques for the study of the kinetics of fast reactions, relaxation time for the temperature jump method, and Pressure Jump Method.			

FIRST YEAR	SEMESTER-I	SPECTROSCOPY		CODE:B020704T	THEORY	CREDIT:04	
		CO1	After studying this module, students shall be able to learn about the nature and properties of electromagnetic waves.				
		CO2	Able to learn about the classical picture of light and electromagnetic waves, its spectrum and briefly the kinds of spectroscopy observed in each region of the electromagnetic spectrum.				
		CO3	Able to understand the different kinds of molecular spectroscopy and how it is different from atomic spectra.				
		CO4	Understand about rotational spectroscopy and the rigid rotator model to describe a rotating diatomic molecule, as well as the quantization of rotational energy levels.				
		CO5	The student will be able to: (a) Understand the interacting forces in species, (b) Understand the essentials of Simple Harmonic Motion (c) Get a brief introduction to normal coordinates.				
		CO6	The student will be able to: (a) Understand the electronic transitions of diatomic molecules (b) Use the Franck-Condon principle to predict the shape of the absorption curve.				
		CO7	The student will be able to understand: (a) the Use of Group Theory to predict the normal modes of vibration of polyatomic molecules (b) Determine their IR and Raman activity.				
		CO8	The student will be able to understand: (a) The electronic structure of diatomic molecules, (b) Molecular term symbols (c) Selection rules for electronic transitions.				
		CO9	The student will be able to understand: (a) Understand the vibrational Raman spectra (b) Understand the variation of the polarizability ellipsoid of a molecule during the vibration of tri-atomic molecules. (c) Understand and apply the Rule of Mutual Exclusion. (d) Understand the polarization of Raman lines.				
		PRACTICAL		CODE: B020705P	PRACTICAL	CREDIT:04	
CO1	To make students thorough in analyzing the given salt mixtures.						
CO2	(a) Less common metal ions- Tl, Mo, W, Ti, Zr, Th, Zr, V, U (Two metal ions in cationic/anionic forms). (b) Insoluble oxides, sulphates, and halides.						
CO3	Learn the separation of the cations and anions through various chromatography.						
CO4	Learn Separation, purification, and identification of compounds of the binary mixture (one liquid and one solid) using TLC and Column chromatography and chemical tests. IR spectra to be used for functional group identifications.						



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FIRST YEAR	SEMESTER-II	INORGANIC CHEMISTRY-II		CODE:B020801T	THEORY	CREDIT:04	
		CO1	To make the students understand the stability of complexes in solution and as the prepared condition.				
		CO2	To understand the geometry of complexes.				
		CO3	To make them completely understand the inorganic compounds using different instrumental methods.				
		ORGANIC CHEMISTRY-II		CODE: B020802T	THEORY	CREDIT:04	
		CO1	Understand the Electrophilic, nucleophilic substitution and addition reactions.				
		CO2	Learn the different ways of synthesis and reactions of amino acids.				
		CO3	Development of complete understanding of elimination and rearrangement reactions. Fundamentals of the reaction mechanism and orientation and reactivity of the various reactions. Knowledge of the various reagents and their applications in organic synthesis				
		PHYSICAL CHEMISTRY-II		CODE:B020803T	THEORY	CREDIT:04	
		CO1	To able the evaluation, interpretation and analysis to get to the crux of Statistical Thermodynamics and Electrochemistry.				
		CO2	Able to understand the basic and fundamental concepts of distribution laws and partition functions				
		CO3	Able to appreciate the importance of electrochemistry and its applications in various fields				
		CO4	Able to understand the physical, evaluative and interpreting skills such that it can help them in solving problems related to Statistical thermodynamics partition function and in electrochemistry				
		ENVIRONMENTAL CHEMISTRY		CODE:B020804T	THEORY	CREDIT:04	
		CO1	In this section, students will I aware of basic concepts of environments and various types of pollution measurement of COD, BOD, and DO.				
		CO2	To understand the soil composition, pollution, fertilizers, and pesticides.				
		CO3	Importance of atmosphere, composition, and analytical methods for measuring air pollution.				
		CO4	Learn about the Industrial pollution of Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants metallurgy. Radionuclide analysis, disposal of wastes and their management.				
		CO5	To make them completely understand environmental toxicology, Chemical solutions to environmental problems, biodegradability, principles of decomposition, a better industrial process.				
		SYMMETRYANDGROUPTHEORY		CODE: B020805T	THEORY	CREDIT:04	
		CO1	Understand the symmetry elements and symmetry operation, definitions of group, subgroup, and relation between orders of a finite group and its subgroup. Conjugacy relation and classes.				
		CO2	Learn the different types of symmetry point groups.				
		CO3	Development of complete understanding of the Schonflies symbols and representations of groups of matrices.				
		CO4	Understand the concept of the Character of a representation.				
		CO5	To utilize the great orthogonality theorem and its importance.				
		CO6	To understand the applications of character tables and their use in spectroscopy.				
		PRACTICAL		CODE:B020806P	PRACTICAL	CREDIT:04	
CO1	In this section students will learn Preparation of inorganic compounds, organic synthesis and separation.						



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	CO2	Learn the different ways to the determination of COD, BOD, and DO.
	CO3	Learn the different methods of the saponification of oil samples.



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SECOND YEAR	SEMESTER-III	BIO-INORGANIC, BIO-ORGANIC AND BIOPHYSICAL CHEMISTRY		CODE: B020901T	THEORY	CREDIT:04	
		CO1	Students will understand the importance of essential and trace metals in biological systems.				
		CO2	The importance of Na ⁺ /K ⁺ pump in biological process.				
		CO3	It will develop an understanding of the bio-energetic and ATP cycle.				
		CO4	They will understand the transport and storage of oxygen through various metalloenzymes in biological systems.				
		CO5	Study of enzyme-catalyzed chemical and biological processes and different properties of enzymes like catalytic power, specificity etc.				
		CO6	Understanding of the mechanism of enzymes catalyzed reactions like acid-base catalysis, covalent catalysis etc.				
		CO7	Understanding of Chemical and biological functions of different co-factor of vitamins and co-enzymes like as NAD ⁺ , NADP ⁺ , Vitamins B12 etc.				
		CO8	Importance of biological cell and its constituents.				
		CO9	Study of ATP formation from ADP and its hydrolysis.				
CO10	Understanding of thermodynamics of biopolymer solutions like osmotic pressure, membrane equilibrium etc.						
		APPLICATIONS OF SPECTROSCOPY		CODE:B020902T	THEORY	CREDIT:04	
		CO1	Understand the concept of symmetry and the shape of different types of molecules in vibrational spectroscopy and the application of Raman Spectroscopy in the characterization of the active site of metalloenzymes.				
		CO2	To understand the basis of Electron spin resonance and its application of transition metal complexes.				
		CO3	Learn the principle of Mossbauer spectroscopy and its application to Fe ⁺² /Fe ⁺³ and Sn ⁺² /Sn ⁺⁴ compounds and the detection of oxidation state and inequivalent MB atoms.				
		CO4	Introduction of UV-Visible Spectroscopy, Beer-Lambert Law's, effect of solvent on the electronic transition of carbon compounds and application of Fieser-Woodward rules for conjugate diene, carbonyl compound.				
		CO5	Instrumentation of Infrared-Spectroscopy, and vibration frequencies of different compounds like alkene, alkane, alkyne, aromatic compounds, phenol, ethers, ester etc. Effect of hydrogen bonding and solvent effect on IR spectra of the organic compound.				
		CO6	Introduction of C-13 NMR techniques and 2D-NMR techniques like COSY, NOESY, DEPT, INEPT, APT.				
		CO7	Understand the concept of Mass Spectrometry and its application to organic compounds and different ionization techniques and nitrogen rule, Mc-Lafferty rearrangement etc.				
		SOLID STATE CHEMISTRY		CODE:B020903T	THEORY	CREDIT:04	
		CO1	Introduction of solid-State reactions, different types of synthetic methods and their procedures, and kinetics of solid-state reactions.				
		CO2	Understanding of perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-Schottky defects and Frenkel defects, thermodynamics of Schottky and Frenkel defect formation, colour-centres, non-Stoi-chiometry defects				
		CO3	Introduction of Metals, insulators, and semiconductors, electronic structure of solid-band theory, the band structure of metals, insulators and semiconductors, and their optical and magnetic properties etc.				
		CO4	To learn about Electrically conducting solids, organic charge transfer complex, organic metals, new superconductors, and their application in the real world.				



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SECOND YEAR	SEMESTER-III	PHOTOCHEMISTRY		CODE:B020904T	THEORY	CREDIT:04
		CO1	Understand the interaction of electromagnetic radiation with matter, types of excitations, the fate of excited molecules, quantum yield, transfer of excitation energy, and actinometry.			
		CO2	Study the Classification, rate constants, and lifetimes of reactive energy states-determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions, types of photochemical reactions-photo dissociation, gas-phase photolysis.			
		CO3	Study of intramolecular reactions of the olefinic bond-geometrical isomerization, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes.			
		CO4	Introduction of intramolecular reactions of the carbonyl compounds-saturated, cyclic and acyclic, β , γ -saturated and α , β -unsaturated compounds, cyclohexadiene. Intermolecular cycloaddition reactions-dimerization, and oxetane formation.			
		CO5	To learn the Photochemistry of aromatic compounds like Isomerization, addition, and substitutions reactions.			
		CO6	Understanding of Photo-Fries reactions of anilides, Photo-Fries rearrangement. Barton reaction, Singlet molecular oxygen reactions, Photochemical formation of smog, Photodegradation of polymers, Photochemistry of vision.			
		ORGANOTRANSITION METAL COMPLEX		CODE:B020905T	THEORY	CREDIT:04
		CO1	To learn alkyls and aryls complexes of transition metals and fluxionality in compounds.			
		CO2	To know synthesis, nature of bonding and reaction of alkylidenes, alkylidynes, low valent carbenes and carbynes, and their role in organic synthesis.			
		CO3	To learn preparation properties, nature of bonding and reactions of transition metal π complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and triphenyl complexes.			
		CO4	To know about the bonding of hydrogen with transition metals.			
		CO5	To understand homogenous catalysis with an emphasis on the stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydro carbonylation of olefins (Oxo reaction), oxo palladation reactions, activation of C-H bond.			
		CO6	To understand the fluxionality and dynamic equilibria in η^2 -olefin, η^3 -allyl and dienyl complexes.			
		PRACTICAL		CODE:B020907P	PRACTICAL	CREDIT:04
		CO1	Learn how to prepare the transition metal complexes with different ligands and their thermal stability.			
		CO2	Importance of spectrophotometric determination of transition metal through different analytical methods.			
		CO3	Understand the importance of flame photometric determinations for s and p-block elements.			
		CO4	To learn the chromatographic separations of different metal ions, sugar and their R_f values			
		CO5	To study the surface tension concentration relationship for solutions (Gibbs equation).			
CO6	To understand the construct of the phase diagram for three-component systems (e.g. Chloroform- acetic acid -water).					
CO7	To learn the effect of (a) change of temperature, (b) change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reaction.					
CO8	To determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide, studying the kinetics as an iodine clock reaction.					
CO9	Importance of the degree of dissociation of weak electrolytes and to study the deviation from behaviors that occur with a strong electrolyte.					
CO10	Understand the importance of the velocity constant, order of the reaction and energy of activation for					



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	saponification of ethyl acetate by sodium hydroxide conductometrically.
CO11	To learn how to estimate the solubility and solubility product of sparingly soluble salts (e.g. $PbSO_4$, $BaSO_4$) conductometrically.
CO12	To determination of the strength of strong and weak acids in a given mixture using a Potentiometer/pH meter.
CO13	Introduction of the rate constant for hydrolysis/inversion of sugar using a polarimeter.
CO14	Importance of enzyme kinetics-inversion of sucrose.



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SECOND YEAR

SEMESTER-IV

ORGANIC SYNTHESIS		CODE: B021001T	THEORY	CREDIT:04
CO1	Students will gain an understanding of chemical processes such as oxidation, reduction, and rearrangements using various organo-metallic and nonmetallic reagents.			
CO2	Organic synthesis provides knowledge of the synthesis of various classes of compounds via Functional Group inter-conversion.			
CO3	Students will be able to synthesize several compounds from their precursors in well ordered & well-understood method by using a series of known reactions and reagents with the development of understanding of what happened at each step.			
CO4	After completing this course students can get a job in the production & quality control department of various industries like pharmaceuticals, Agrochemicals, polymers, pesticide and Insecticide formulation soap & detergents, paint & cosmetics, etc.			
CHEMISTRY OF NATURAL PRODUCTS		CODE: B021003T	THEORY	CREDIT:04
CO1	To understand the basis of Terpenoids and Carotenoids Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Geraniol, α -Terpeneol, Menthol, Zingiberene, Abiatic acid and β -Carotene.			
CO2	To learn the Alkaloids Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants.			
CO3	Learn the principle of Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation structure determination and synthesis of Cholesterol, Bile acids, Androsterone., Testosterone, Estrone, Progesterone, Aldosterone.			
CO4	Introduction of Plant Pigments Occurrence, nomenclature and general methods of structure determination, isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin Quercetin-3-glucoside, Vitexin, Cyanidin-7-arabinoside, Hirsutidin.			
CO5	Understand the Porphyrins Structure and synthesis of Hemoglobin and Chlorophyll.			
CO6	Introduction of Prostaglandins Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE ₂ , and PGF ₂			
CO7	Understand the concept of Pyrethroids and Rotenone Synthesis and reactions of Pyrethroids and Rotenone.			
MEDICINAL CHEMISTRY		CODE: B021004T	THEORY	CREDIT:04
CO1	Introduction of drug design development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structure- activity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism, spatial considerations. Theories of drug activity: occupancy theory, rate theory, induced fit theory, etc.			
CO2	Understanding the concept of drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in the rapapeutics. Mention of uses of pharmacokinetics in drug development process.			
CO3	Introduction of Pharmacodynamics Introduction, elementary treatment of enzyme stimulation, enzyme inhibition sulphonamides membrane active drugs, drug metabolism, xenobiotics biotransformation, significance of drug metabolism in medicinal chemistry.			
CO4	To learn about the antineoplastic Agents Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors.			
CO5	Understanding of the cardiovascular Drugs, cardiovascular diseases, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output. Direct acting arteriolar dilators.			
CO6	Introduction Of local anti infective Drugs and general mode of action. Synthesis of sulphonamides, furazolidone, acid ciprofloxacin, norfloxacin, dapsone, ethionamide, ethambutal and chloroquin.			



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		CO7	Importance of the psychoactive Drugs – The chemotherapy of Mind Introduction neurotransmitters, CNS depressants, general anaesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazepines, buspirone, neurochemistry of mental diseases, antipsychotic drugs – the neuroleptics, antidepressants, butyrophenones, serendipity and drug development, stereochemical aspects of psychotropic drugs.				
		CO8	To learn about the antibiotics Cell wall biosynthesis, inhibitors – Lactam rings, antibiotics inhibiting protein synthesis. Synthesis of penicillin G, penicillin V, ampicillin, amoxycillin, chloramphenicol, cephalosporin, tetracyclin and streptomycin.				
SECOND YEAR	SEMESTER-IV	POLYMERS		CODE: B021005T	THEORY	CREDIT:04	
		CO1	Basic concept of polymers, classification of polymers and different types of polymerization reaction.				
		CO2	Application of the molecular weight concept, molecular weight determination and its practical significance.				
		CO3	Study of the crystal structures and physical properties of polymers.				
		CO4	Introduction of polymer processing techniques and its practical significance.				
		CO5	To learn the properties and uses of various commercial polymers like functional polymer (fire retarding polymer, electrically conducting polymer), biomedical polymer.				
		PRACTICAL		CODE: B021011P	PRACTICAL	CREDIT:04	
		CO1	Learn how to Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid, two solids and one liquid), using TLC for checking the purity of the separated compounds, chemical analysis, IR, PMR and mass spectral data.				
		CO2	To learn the Multi-step Synthesis of Organic Compounds and the use of organic reagents and may involve Purification of the products by chromatographic techniques.				
		CO3	Extraction of Organic Compounds from Natural Sources; 1. Isolation of caffeine from, tea leaves. 2: Isolation of casein from milk (the students are required to try some typical colour reactions of proteins). Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and R _f value reported). Isolation of nicotine di-picrate from tobacco.				
		CO4	To learn paper chromatography separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper, chromatography and determination of R _f values.				
		CO5	Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR, CMR & MS).				
		CO6	Determination of partial molar volume of solute (e.g., KC1) and solvent in a binary mixture.				
		CO7	Determination of the temperature dependence of the solubility of a compound in two solvents having similar intermolecular interactions (benzoic acid in water and in DMSO- water mixture) and calculate the partial molar heat of solution.				
CO8	To learn the notations used in an electric circuit, study of electronic components and colour codes, conversion of chemical quantities into electrical quantities. Transducer illustration with electrodes, thermocouples and thermistors.						
CO9	Importance of the Passive components: Resistors, capacitors and inductors with some emphasis on solid state properties of materials. Net works of resistors. Thevenin's theorem, superposition theorem, loop analysis, R C circuits, L R circuits, LCR circuits. Illustration of the use of the circuits in NQR spectroscopy, Mossbauer spectroscopy, cyclic voltametry and in power supplies as filter circuits.						
CO10	Introduction to ordinary diodes and Zener diodes with some emphasis on p-n junction as a solid state property. Use of diodes as rectifiers, clipping and clamping circuits Power supplies.						
CO11	To learn Transistors: An extension of p-n junction to p-n-p and n-p-n transistors. Characteristics of transistors, hybrid parameters; transistor circuits as amplifiers, high impedance (pre-amplifier) circuits. Darlington pairs differential amplifiers.						

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