Maratha Vidya Prasarak Samaj's

Karmaveer Shantarambapu Kondaji Wavare Arts, Science and Commerce College, CIDCO, Nashik

Uttamnagar, Nashik- 422 008 (Maharashtra)

Affiliated to Savitribai Phule Pune University Id. No. PU/NS/ASC/047/1993

AISHE C-42086 NAAC Re-accredited 'A' Grade (III Cycle 2017-22, CGPA 3.20)

Best College Award of Savitribai Phule Pune University Pune in 2009-10 and 2021-22

Internal Quality Assurance Cell

Programme Outcomes (PO's)

Programme Specific Outcomes (PSO's)

Course Outcomes (CO's)

Syllabus: 2013 Pattern

Programme Outcome (PO's), Programme Specific Outcome (PSO's), Course Outcome (CO's)

Department: Chemistry

Syllabus: 2013 Pattern

Sr. No.	Name of the Programme	Year of introduction of programme	Duration of introduction of Programme
2	M.Sc.Organic Chemistry	2008-2009	2 Years

Programme Specific Outcomes (PSO):

Sr. No.	Programme Specific Outcome (M.Sc Chemistry)
PSO1	Apply the knowledge of Organic Chemistry in the domain of advanced research, education and perspective entrepreneurship.
PSO2	To analyze and interpret the UV-Vis, IR, NMR and HRMS spectral data of Organic compounds to understand the functional groups and their structural framework.
PSO3	Develops analytical skills and problem solving skills requiring application of chemical principles
PSO4	Develop an understanding of eco-friendly chemical processes and impact of chemistry on health and environment.
PSO5	M.Sc. chemistry student understands the background of organic reaction mechanisms, complex chemical structures, Instrumental method of chemical analysis, molecular rearrangements and separation techniques

Class	Subject Code	Title	Cos: After successful completion of This course, student will be able to
M.Sc.-I Sem-I	CHP-110 Fundamentals of Physical Chemistry	Thermodynamics	CO 1: Understand basics of Chemical Thermodynamics: Calculation of ΔH, ΔS, ΔG and K
			CO 2: Gain the knowledge of Effect of temperature and pressure dependence for various chemical reaction partial molar quantities, concept of activity.
			CO 3: Learn Molecular Thermodynamics: Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics
			CO 4: Understand and Quantum Chemistry: Classical mechanics, black body radiation, photoelectric effect, orthonormal functions, hermitian operators, Schrodinger equation, particle in a box.
		Chemical kinetics and reaction dynamics	CO 1: To understand and learn zero, first, second, third, nth order rate equation,
			CO 2: To learn different kinetic reactions such as, Reversible reactions, parallel (side) reactions, consecutive (sequential) reactions, steady state approximation.
			CO 3: To understand different theories: Arrhenius theory, collision theory and transition state theory.
			CO 4: Gain the knowledge of Debye Huckel Limiting law, primary and secondary salt effects and understand Enzyme catalysis-Michaelis-Menten mechanism.
	CHI-130 Inorganic Chemistry	Molecular Symmetry and its Applications	CO 1: To develop a deep knowledge about Molecular Symmetry and Symmetry Groups.
			CO 2: To have a well defined idea on Representations of Groups: Matrix representation and matrix notation for geometric transformation
			CO 3: Understand Group theory and quantum mechanics:
			CO 4: To know and understand the Symmetry Adapted Linear Combinations, Molecular Orbital Theory and Application of Group theory to Infrared Spectroscopy

		Chemistry of Main group elements	CO 1: To familiarize about Hydrogen and its compounds, Alkali and alkaline earth metals, Organometallic Compounds of Li, Mg, Be, Ca, Na
			CO 2: To acquire knowledge about Boron Hydrides, preparation, structure and Bonding with reference to LUMO, HOM
			CO 3: To learn Allotropes of Carbon, C60 and compounds, Carbon nanotubes, synthesis, properties, structure-single walled, multi walled, applicati
			CO 4: To gain the knowledge of Oxidation states of nitrogen and their interconversion, PN and SN Compounds, Metal Selenides and Tellurides, oxyacids, and oxoanions of sulphur & nitrogen, Interhalogens, pseudohalagen.
	CHO-150 Basic organic chemistry	Structure reactivity and Stereochemistry	CO 1: To understand the Chemical bonding and basis of reactivity and MOT and VBT approach.
			CO 2: To familiarize about the bonding other than covalent bonding: Ionic, hydrogen bond, inclusion compounds, rotaxanes, catenanes, cyclodextrins, cryptands, fullerenes, crown ethers.
			CO 3: To learn about aromaticity: Benzenoid and non-benzenoid compounds, Huckels rule, antiaromaticity, Application to carbocyclic and heterocyclic systems,
			CO 4: Create knowledge on sterochemical principles, enantiomeric relationship, distereomeric relationship, R and S, E and Z nomenclature
		Organic reactions	CO 1:To recollect and familiarize the basic concepts of substitution reaction: SN1, SN2, SET and SNV mechanism
			CO 2: To develop a deep knowledge about the Aromatic Electrophilic substitution: like Friedel crafts alkylation and acylation, Nitration, halogenation, formylation, chloromethylation, sulponation.
			CO 3:To have a well defined idea on Aromatic nucleophilic substitution: SNAr, SN1, Benzyne and SNR1 reactions

			CO 4: Understand and solve Addition reactions and Elimination reactions E1, E2, E1cb mechanisms
	CHP-107 Physical Chemistry Practical		CO 1: Students will be able to understand standardization of Conductometry, Potentiomerty, pH metry, Polarography.
			CO 2: Uderstand kinetic decomposition of diacetone alcohol by dilatometry.
			CO 3: Analyse and apply the theoretical principles of chemical kinetics
			CO 4: Evaluation of unknown concentration of solutions using techniques like conductometry, potentiometry and viscosity measurements
	CHI-147 Inorganic Chemistry Practical		CO 1:To analyze alloys and ores
			CO 2: To acquire knowledge about synthesis and properties of nano particles
			CO 3: To familiarize the preparation of inorganic complexes.
			CO 4: To be aware of the characterization of inorganic complexes.
M.Sc.-I Sem-II	CHP-210 Fundamentals of Physical Chemistry II	Molecular Spectroscopy	CO 1: To understand the basic principles and theory of IR, Raman, and Electronic spectroscopy.
			CO 2:Apply the theory to simple problems
			CO 3: To learn Rotation spectra- based on moment of inertia, rigid rotor, most intense line, isotopic effect on the rotational spectra, non-rigid rotator, diatomic molecules, linear triatomic molecules, symmetric top molecules, stark effect
			CO 4: To understand vibrational rotational spectra, fine structure in diatomic molecules, Born-Oppenheimer approximation, effect due to nuclear spin, parallel and perpendicular vibrations.
		Nuclear and radiation Chemistry	CO 1:To learn about applications of radioactive isotopes in various fields
			CO 2:To develop a deep knowledge about valence bond theory, hybrid orbitals, geometry and hybridization, molecular orbital
			CO 3:To understand the basic principles of crystallography
			CO 4:To acquire knowledge about Unit Cell, types of crystals, Miller Indices, Bragg Equation,

			Crystal structure determination from X-ray data, Bravais Lattices.
	CHI-230 Inorganic Chemistry	Coordination Chemistry	CO 1:To acquire deep knowledge in coordination compounds
			CO 2:To understand the scope of ligand fields theory of coordination complexes
			CO 3:To learn and understand the Russell-Saunders terms, strong field effect, correlation diagrams, Tanabe-Sugano Diagrams, Spin-Pairing energies.
			CO 4:To know and understand the Magnetic Properties of Coordination Complexes
		Bioinorganic Chemistry	CO 1:To have a detailed idea on overviews of bioniorganic chemistry
			CO 2: Students will be able to know Principles of Coordination Chemistry related to Bioinorganic Research and Protein, Nucleic acids and other metal binding biomolecules.
			CO 3: Create knowledge on Iron: Ferritin, Transferrin, Fe-S clusters, Porphyrin based systems.
			CO 4: To acquire knowledge about Biochemistry of Na, K and Ca w.r.t. Na/K pumps, Calmodulin and blood coagulation.
	CHO-250 Synthetic organic chemistry and spectroscopy	Synthetic Organic Chemistry	CO 1:To Learn about the application of various oxidising and reducing agents used in organic synthesis
			CO 2:Knowledge of Beckmann, Hofmann,, Curtius, Smith, Wolff, Lossen, Bayer-villiger, Sommelet, Favorskii, Pinacol-pinacolone, Benzil-benzilic acid, Calsien, Cope, Fries
			CO 3:Gain knowledge about Ylides
			CO 4: To know and learn role of different reagents such as, Grignard, organo zinc, organo copper, organo lithium.
		Spectroscopy	CO 1: The learners should be able to apply the different spectroscopic methods to solve problems
			CO 2: Using spectral data for explaining important organic reactions and functional transformations.
			CO 3: To understand PMR: Fundamentals of

			NMR, CW and FT-NMR,
			CO 4: Know and understanding CMR and mass spectrometry
	CHA-290 General Chemistry	Concept of Analytical Chemistry	CO 1: Understand Data Handing and Spreadsheets in Analytical Chemistry
			CO 2:To learn the Sampling, Calibration and Standardization
			CO 3: To gain the detail knowledge about the Separation by precipitation, separation by distillation, separation by extraction, separation by ion exchange chromatography.
			CO 4: Acquired the knowledge of Chemical aspects to Nanomaterials
		Organometallic and Inorganic Reaction Mechanism	CO 1:Learn and understand 18 electron rule, ligands in organometallic chemistry, Fullerene complexes, carbine and carbine complexes,
			CO 2: To acquire deep knowledge of reactions involving gain and loss of ligands, reactions involving modification of ligands, organometallic catalysis and heterogeneous catalysis
			CO 3: Detail idea about Substitution reactions: Inert and labile complexes, Kinetics Consequences of reaction pathway, Stereochemistry of reactions:
			CO 4: Understand the trans effect
	CHO-247 Organic Chemistry Practical		CO 1: Use the computational tools to draw the reaction schemes and spectral data to various organic reactions.
			CO 2:Apply class room learning in separation and purification of organic compounds and binary mixtures
M.Sc.-II Sem-III	CHO-350	Organic Reaction Mechanism	CO 1: Gains complete knowledge about Carbanions-Formation, stability and related name reactions.
			CO 2: Be able to describe the Enamines –formation and applications and Reactions of carbenes and nitrenes.
			CO 3: Student should able to learn the Generation of radiacls, Stable free radicals, Nucleophilic and electrophilic radicals.
			CO 4: To understand the characteristics reactions, -Free radical substitution.

	CHO-351	Spectroscopic Methods in Structure Determination	CO 1:The learners should be able to apply the different spectroscopic methods to solve problems
			CO 2: Students learn the basic principles and applications of 1H NMR, 13C NMR, 2D NMR and Mass Spectrometry
	CHO-352	Organic Stereochemistry	CO 1: students will able to explain Stereochemistry of six membered rings.
			CO 2: To learn and understand fused Bridged and caged rings
			CO 3: To understand geometrical Isomerism and Stereochemistry of olefins
			CO 4: Familiarize the Determination of stereochemistry of organic compounds using NMR.
	CHO-353	Photochemistry, Pericyclic Reactions and Heterocyclic Chemistry	CO 1: To understand the General basic principle of photochemistry and their application in synthesis
			CO 2: Student should able to learn different pericyclic reactions
			CO 3: Able to gain and acquire the knowledge of heterocyclic chemistry
M.Sc.-II Sem-IV	CHO-450	Chemistry of Natural Products	CO 1: To understand structure and stereochemistry of Hardwickiic acid, Camptothecin and podophyllotoxin
			CO 2: Able to know about Taxol, Estrone and Mifepristone synthesis
			CO 3: To learn the building blocks and construction mechanism of Terpenoids and Alkaloids
	CHO-451	Advanced Synthetic Organic Chemistry	CO 1: To know and understand transition metal complexes in organic synthesis ; only Pd, Ni, Co, Fe
			CO 2: To learn C=C formation reactions: Wittig, Horner-Wordworth-Emmons, Shapiro, Bamford-Stevens, McMurry, Julia-Lythgoe and Peterson olefination reactions
			CO 3: Familiarize the Ring formation reactions: Pausan-Khand, Bergman and Nazerov cyclization
			CO 4: Understand Click chemistry: criterion for click reaction, Sharpless azides cycloadditions
	CHO-	Carbohydrate	CO 1: Able to know about carbohydrates: structures

	452	and Chiron approach, Chiral Drugs and Medicinal Chemistry	of triose, tetrose, pentose, hexose,
			CO 2: should be understand the concept of chiral templates and chirons wherein the carbon skeleton is the chiral precursor.
			CO 3: To learn utilisation of the basic concepts for retrosynthetic strategy and synthesis of (S) Propanediol, (R) and (S) – Epichlorohydrin, L (+)-Alanine,(-) Multistratin, (-) Pentenomycin, (-) Shikimic acid,
			CO 4: Able to gain the knowledge of Introduction of chiral drugs, Eutomer, Distomer and eudesmic ratio,Distomers
	CHO-453	Designing Organic Synthesis and Asymmetric Synthesis	CO 1: Gain knowledge about the designing of organic synthesis: Protection and de-protection of hydroxyl, amino, carboxyl, ketone and aldehyde
			CO 2: To know the Principles and applications of asymmetric synthesis:
	CHO-347	Single stage preparations	CO 1:To acquire knowledge on the various reagents employed for their synthesis
			CO 2: Students will be able to performed Fourteen single stage and three Isolation of Natural products on micro scale.
	CHO-447	Two stage preparations	CO 1: know the methodology to handle chemicals, heating methods and error analysis
			CO 2: Students will be able to performed ten two stage preparations and
	CHO-448	Project/Industrial training/Green Chemistry and Chemical biology experiments	CO 1: Able to know about Literature survey, research methodologies,
			CO 2: To understand Data Analysis, Column and TLC chromatographic techniques, Characterization of the products by analytical and spectral methods
			CO 3: understand the procedure for handling chemicals and analysis
			CO 4: understand the principle of techniques used for the purification of compounds
			CO 5: know about importance of various titrimetric methods

HOD

IQAC Coordinator

IQAC

Principal
Maratha Vidya Prasarak Samaj's
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Arts,science and Commerce College,
Uttamnagar,CIDCO,Nashik-422008

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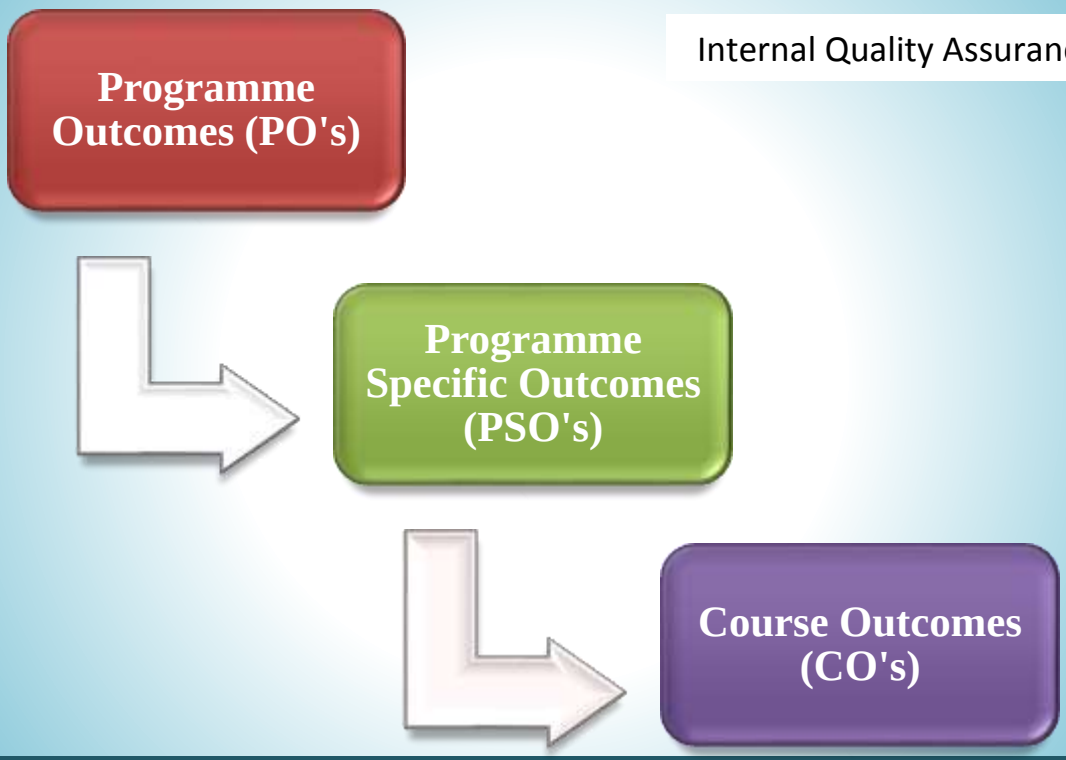

Syllabus: 2019 Pattern

Principal
Prof. (Dr) S. K. Kushare
M.Sc., Ph. D.

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Programme Outcome (PO's), Programme Specific Outcome (PSO's), Course Outcome (CO's)

Department: Chemistry

Syllabus: 2019 Pattern

Sr. No.	Name of the Programme	Year of introduction of programme	Duration of introduction of Programme
2	M.Sc.Organic Chemistry	2008-2009	2 Years

Programme Specific Outcomes (PSO): (B.Sc Chemistry)

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PSO1	Apply the knowledge of Organic Chemistry in the domain of advanced research, education and perspective entrepreneurship.
PSO2	To analyze and interpret the UV-Vis, IR, NMR and HRMS spectral data of Organic compounds to understand the functional groups and their structural framework.
PSO3	Develops analytical skills and problem solving skills requiring application of chemical principles
PSO4	Develop an understanding of eco-friendly chemical processes and impact of chemistry on health and environment.
PSO5	M.Sc. chemistry student understands the background of organic reaction mechanisms, complex chemical structures, Instrumental method of chemical analysis, molecular rearrangements and separation techniques

Course Specific Outcome (M.Sc Chemistry)

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
M. Sc Sem-I	CHP-110 Physical Chemistry	Fundamentals of Physical Chemistry	CO 1:Understand State function, path function, exact differential and inexact differential, internal energy and enthalpy, entropy of irreversible changes, the Helmholtz and Gibbs function, Entropy and entropy change in an ideal gas with temperature and pressure
			CO 2: Understand Partial molar quantities, methods

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
			for determination of molar quantities, ideal solutions, Raoult's and Henery's law,
			CO 3: Understand applications of quantum chemistry, Learn Schrödinger wave equation, particle in one dimensional box, Normalization and orthogonality of wave function, particle in three dimensional box
			CO 4: Learn valence bond theory, hybrid orbitals, geometry and hybridization, molecular orbital theory for di and tri atomic molecule, linear variation method, approximations underlying Huckel theory
		Chemical Kinetics and Reaction Dynamics	CO 1: Understand basic concept of the temperature dependent reaction rates, To learn consecutive reaction, parallel reactions, pre-equilibria, unimolecular reactions.
			CO 2: Acquire the knowledge of different reactions such as, Fast reactions: flash photolysis, flow technique, stopped flow technique, relaxation method. Learn the steady state approximation, chain reactions - free radical polymerization reaction
			CO 3: Gain and understand the knowledge of Collision theory of bimolecular gas phase reactions, diffusion controlled and activation controlled reaction in solution, activated complex theory of reaction rate and Learn Eyrings equation.
			CO 4: Understand and learn Michaelis mechanism, effect of pH and temperature on enzyme catalyzed reactions, limiting rate, Lineweaverburk and Eadie equation and plots, inhibition of enzyme action, competitive inhibition and non- competitive inhibition
			CO 5: Learn and understand Molecular energy levels, Boltzmann distribution law, partition functions and ensembles, Maxwell- Boltzmann and Fermi-Dirac

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
	CHI-130 Inorganic Chemistry	Molecular Symmetry and its Applications	CO 1: Student should visualize/ imagine molecules in 3 dimensions. understand the concept of symmetry and able to pass various symmetry elements through the molecule
			CO 2: understand the concept and point group and apply it to molecules. understand product of symmetry operations
			CO 3: apply the concept of point group for determining optical activity and dipole moment. Student should understand the importance of Orthogonality Theorem,
			CO 4: They should able to learn the rules for constructing character table. Using reduction formulae should be able to find out the possible type of hybridization
			CO 5: Student should know the concept of SALC. Student able to find out character for reducible representation.
			CO 6: To know about projection operator. Apply projection operator to find out the normalized wave function for atomic orbital
			CO 7: Student should correlate the application of symmetry to spectroscopy. Students able to find out the possible modes of vibration. From the previous knowledge of symmetry student must able to find out which mode are IR active.
		Chemistry of Main Group Elements	CO 1: understand the detail chemistry of S and P block elements w.r.t. their compounds, their reactions and applications
			CO 2: learn the advance chemistry of boranes, fullerene, zeolites, polymers etc.
			CO 3: Acquire the knowledge of Organometallic chemistry of some important elements from the main groups and their applications.
	CHO-	Basic	CO 1:Understand the criteria for aromaticity in

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
	150 Organic Chemistry	Organic Chemistry	nonbenzenoid molecules and other advanced polycyclic aromatics
			CO 2: Understand the chemistry of monocyclic heterocycles, nomenclature and reactions
			CO 3: Learn the concept stereochemistry and its importance; their rules and the concept of chirality
			CO 4: Understand the role of various reaction intermediates like carbocation, carbanion, carbenes, radicals, and nitrenes in organic reactions; concept of NGP
			CO 5: Able to describe mechanism of different rearrangement reactions. Appreciates the various steps involved in the molecular rearrangements.
			CO 6: Use synthetic reagent of oxidation and reduction for solving the problems
		Basic Organic Chemistry	CO 1: Understand some fundamental aspects of organic chemistry, to learn the concept aromaticity,
			CO 2: Learn heterocyclic compound containing one and two hetero atoms with their structure, synthesis and reactions.
			CO 3: know stereochemistry of organic compounds; able to do interconversion of Fischer to Newmann, Newmann to Sawhorse and vice versa, Able to assign R and S to given molecules; understand stereoselective and stereospecific reactions; acquire knowledge on topicity
			CO 4: Understand structure, formation, stability and related name reaction of intermediates like Carbocation, Carbanion, Free Radical, Carbenes and nitrenes
			CO 5: Learn rearrangement reaction with specific mechanism and migratory aptitude of different groups. study Ylides and their reaction
			CO 6: understands the basis of redox reaction; acquire knowledge about the reagents which causes selective oxidation / reduction in various

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
			compounds; learn the basic mechanism of oxidation / reduction in organic compounds.
	CHG – 190 General Chemistry	Introduction to Chemical Biology-I	CO 1: Gain and acquire the knowledge of research in both chemistry and allied fields of science and technology.
			CO 2: Students will be able to function as a member of an interdisciplinary problem solving team.
			CO 3: To impart the students thorough idea in the chemistry of carbohydrates, amino acids, proteins and nucleic acids etc.
			CO 4: Be able to describe the chemical basis for replication, transcription, translation and how each of these central processes can be expanded to include new chemical matter.
			CO 5: Develop skills to critically read the literature and effectively communicate research in a peer setting.
	CHG-190 Inorganic Chemistry Practical	Inorganic Material Analysis, Synthesis and Applications	CO 1: Analysis of Silica and Manganese from pyrolusite ore and silica and iron from hematite ore.
			CO 2: Identification of tin and lead from solder alloy and iron and chromium from stainless steel alloy.
			CO 3: Synthesis of ZnO from zinc oxalate - precursor method and determine band gap by absorption spectroscopy
			CO 4: Synthesis of Colloidal silver nanoparticles and determine band gap by absorption spectroscopy
	CHP-107 Physical Chemistry Practical	Basic Practical Chemistry	CO 1: Calculation of mean and standard deviation for Given data and least square method for calibration curve method.
			CO 2: Chemical Kinetics: Understand the concept of rate of reaction and order of reaction, Determination of rate of reaction, overall order of reaction and half life period.
			CO 3: Determine the radius of Glycerol molecule from viscosity measurement.

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
			CO 4: Estimation of concentration of metal ions by spectrophotometri method
	CHP-107 Organic Chemistry Practical	Basic Practical Chemistry	CO 1: Learn and understand laboratory safety, handling of glassware, handling flammable and toxic solvent.
			CO 2: Purification of two organic solids by recrystallization method and liquids by distillation method
			CO 4:Understand the concept of green chemistry
			CO 5:Monitoring of reactions using TLC
M. Sc Sem II	CHP-210 Physical Chemistry	Molecular Spectroscopy	CO 1: Studied details of Microwave Spectroscopy
			CO2: Learn a Infra-red Spectroscopy
			CO 3: Acquire the knowledge of Raman Spectroscopy
			CO 4: Understand electronic spectra of diatomic molecules
			CO 4: Learn Mossbauer Spectroscopy and understand Principle, Instrumentation and Applications of Mossbauer Spectroscopy.
		Nuclear Chemistry	CO 1: Understand types of radioactive decay, general characteristics of radioactive decay, decay kinetics, general expression for the activity of a daughter nuclide, Geiger- Nuttalis law, α-decay
			CO2: Solved a problem in classical physics, Internal conversion and the Auger effect. Learn Interaction of radiation with matter, interaction of γ radiation with matter, units for measuring radiation absorption, Radiation dosimetry, Radiolysis of water, free radicals in water radiolysis, Radiolysis of some aqueous solutions.
			CO 3: Gain and acquire the knowledge nuclear fission, fission fragments and their mass distribution, charge distribution, Ionic charge of

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
			fission fragments, fission energy, fission cross-section and threshold, fission neutrons, theory of nuclear fission, Neutron evaporation and spallation.
			CO 4: Understand and learn typical reaction involved in the preparation of radioisotopes, The Szillard- Chalmers reaction, Radiochemical principles in the use of tracers
	CHI-230 Inorganic Chemistry	Coordination Chemistry	CO 1: Student should able to find out the no of microstates and meaningful term symbols, construction of microstate table for various configuration
			CO 2: Student able to find out splitting of the free ion terms in weak ligand field and strong ligand field
			CO 3: Student should know basic d-d transition, d-p mixing, charge transfer spectra.
			CO 4: Understand the concept of spectro chemical series and Nephelauxetic series.
			CO 5: Should able to solve numerical based on crystal field parameters.
		Bioinorganic Chemistry	CO 1: Understand Importance of bioinorganic chemistry and Role of metals in Metalloprotein and metalloenzymes
			CO 2: Learn Importance and transport of metal ions and Passive transport metal ions by ionophores and gramicidin
			CO 3: Mechanism for active transport of Na^+ and K^+ and Nerve impulse generation in rod cell of retina.
			CO 4: Importance and function of Ca, Fe and Mg in metalloprotein
			CO 5: Learn Catalytic role of Mn in photosynthesis.
	CHO-250 Organic Chemistry	Photochemistry and Pericyclic reaction	CO 1: Learn Principles of Photochemistry, photochemistry of carbonyl compounds, alkenes, dienes, and aromatic compounds, photo rearrangements, Barton reaction
			CO 2: Students should able to understand free radicals formation, stability and reactivity and should also be able to use the basic understanding in writing probable reaction mechanisms.

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
			CO 3: MOT and will be able to extend this in predicting reaction mechanism and stereochemistry of electro cyclic reactions.
		Organic spectroscopy	CO 1: Students should able to solve 1H-NMR problems and interpret the structure using ^{13}C-NMR data
			CO 2: Students should able to calculate wavenumber of organic compounds and able to correlate IR bands with functional groups using numerical data
			CO 2: Students should know various key factors responsible for the spectroscopic data acquisition and should able to solve Problems based on UV, IR, MS, 1H-NMR,^{13}C-NMR.
			CO 3: The concepts in free radical reactions, mechanism and the stereo chemical outcomes.
			CO 4: The basic principle of spectroscopic methods and their applications in structure elucidation of organic compounds using given spectroscopic data or spectra.
	CHG-290 General Chemistry	Introduction to Chemical Biology	CO 1: Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
			CO 2: Students will be able to function as a member of an interdisciplinary problem solving team.
			CO 3: To impart the students thorough idea in the chemistry of carbohydrates, amino acids, proteins and nucleic acids etc.
			CO 4: Develop skills to critically read the literature and effectively communicate research in a peer setting.
	CHG-290 General Chemistry	Electroanalytical Techniques of Analysis	CO 1: Calibration of pH-meter and To determine dissociation constant,
			CO 2: To standardized potentiometer and find out stability constant, solubility and ionic products.

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
	Practical		CO 3: Calibration of conductometer and analyze the data to determine λ0 or λα and dissociation constant of acetic acid and ΔG, ΔH, and ΔS of silver benzoate
	CHP-227 Inorganic Chemistry Practical	Basic Practical Chemistry	CO 1: Synthesis of coordination complexes and determine their % purity
			CO 2: To verify the Debye Huckel theory of ionic conductance for strong electrolytes
			CO 3: Determine solubility product and Structural determination of metal complexes by conductometric measurement
			CO 4: To understand equilibrium constant of M – L systems by Job's continuous variation method
	CHP-227 Organic Chemistry Practical	Basic Practical Chemistry	CO 1: Students are trained to different purification techniques in organic chemistry like recrystallization, distillation, steam distillation and extraction.
			Students are made aware of safety techniques and handling of chemicals.
			CO 2: Students are made aware of carrying out different types of reactions and their workup methods.
			CO 3: This practical course is designed to make student aware of green chemistry and role of green chemistry in pollution reduction.
			CO 4: The course includes synthesis of some derivatives and organic compounds, which will help them while working in research laboratory in future.
Class	Subject code	Title	Cos:Aftersuccessfulcompletionof thiscourse, studentwillbeableto
MSc Sem-III	CHO-350	Organic Reaction Mechanism	CO 1: Understand the Methods for determining Reaction Mechanisms
			CO 2: Learn Free Radicals: Generation, stability, reactivity, Free radical substitution, addition to multiple bonds, radicals in synthesis, Inter- and intra-molecular bond formation.

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
			CO 3: Able to understand Linear Free Energy Relationships
			CO 4: Understand Hammet plots, Hammet equation, substituent constants, reaction constants, use of Hammet plots.
			CO 5: To learn calculation of k and K, Deviations from straight line plots, Taft equation, solvent effects.
		Biogenesis: The Bbuilding Blocks and Cconstruction Mmechanism	CO 1: Understand Terpenoids: Mono-, Sesqui-, Di-, tri-terpenoids and cholesterol,
			CO 2: Learn Alkaloids: Derived from ornithine, lysine, nicotinic acid, tyrosine and tryptophan.
			CO 3: Gain the knowledge of Shikimate pathway: Cinnamic acids, lignans and lignin, coumarins, flavonoids and stilbens, isoflavanoids and terpenoid quinones.
			CO 4: To know a case study: Alkaloids isolated from the Roots of Piper nigrum
	CHO-351	Structure Determination of Organic Compounds by Spectroscopic Methods	CO 1: Learn NMR in Stereochemistry Determination
			CO 2: Acquire the knowledge of ^{13}C NMR spectroscopy - APT, DEPT and INEPT
			CO 3: Understand ^{15}N, ^{19}F and ^{31}P NMR spectroscopy
			CO 4: Learn 2D NMR spectroscopy in structure elucidation.
		Mass Spectrometry	CO 1: Understand Mass Spectrometry: Principle, ionization methods and FAB Fragmentation of typical organic compounds.
			CO 2: Learn applications of Mass Spectrometry: Determination of the elemental composition, Isotopic Abundance in structure establishment; Analysis of Biomolecules

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
			CO 3: Problems solving: Structure elucidation using UV, IR, 1D NMR and 2D NMR, APT, DEPT and MS data as well as spectra
	CHO-352	Stereochemistry	CO 1: Learn Conformations of polysubstituted cyclohexane, six membered rings with SP^2 carbon, heterocycles with N and O, anomeric effect, stereochemical concept of I- Strain
			CO 2: Understand Stereochemistry of fused and bridged ring system
			CO 3: Learn configuration, Cram's rule, Cram's cycle model, Cram's dipolar model, Felkin-Anh Model;
			CO 4: Understand Resolution and analysis of stereomers - formation of racemization and methods of resolution, Stereochemistry of a polymer chain – Types and examples of Tacticity
		Asymmetric Synthesis	CO 1: Understand Introduction of Asymmetric Synthesis, Chirol pool and Chiral auxillaries.
			CO 2: Acquire the knowledge of Asymmetric Organocatalysis
			CO 3: Learn Asymmetric Aldol Reaction, Enantioselective, diastereoselective and double diastereoselective Aldol reactions.
			CO 4: Understand Transition Metal-Catalyzed Homogeneous Asymmetric Hydrogenation
			CO 5: Able to know Transition Metal-Catalyzed Homogeneous Asymmetric Hydroxylation and Epoxidation
	CHO-353-A	Protection - De-protection, Chiron approach and	CO 1: Learn Protection and de-protection of functional group in organic synthesis: Hydroxyl group- alkyl ether, benzyl ether,acyl, PMB, Trityl, TMS, TBDMS, THP, MOM, MEM, MIP ether, Diol, Amines, Carboxyl group, Ketone and aldehydes

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
			CO 2: Able to understand Chiron approach: a) Introduction, b) The concept of chiral templates and chirons, c) Utilization of the basic concepts in synthesis of (S) Propanediol, (R) and (S) – Epichlorohydrin, L (+)-Alanine, (-) Multistratin, (-) Pentenomycin and (-) Shikimic acid
		Carbohydrate Chemistry	CO 1: Understand the Basics of Carbohydrates:
			CO2: Learn glycosyldonar acceptor concept, general methods for glycosyl bond formation: Glycosyl halides, Trichloroacetimides, Glycals and Glycal derivatives, Thioglycosides, Phosphites, n-Pentyl glycosides, SulfoxidesDiazarines, Alkylation of reducing sugars
			CO 3: Learn the synthesis of disachharides, trisachharides and polysachharides
	CHO-354 Practical	Solvent Free Organic Synthesis	CO 1: Students are made aware of carrying out different types of reactions such as, Pinacol coupling reaction, Reformatsky reaction, Knoevenagel condensation, Dieckmann condensation, Corrole Synthesis and their workup methods.
			CO 2: Able to learn different reactions such as, C–N, C–S, C–X bond formation reaction
			CO 3: Students are made aware of safety techniques and handling of chemicals.
			CO 4: Able to perform Other Solvent-Free Reactions and Solvent free supramolecular assembly formation
MSc Sem-IV	CHO-450	Chemistry of Natural Products	CO 1: To understand total synthesis while maintaining the stereochemistry. Learn a case study: Longifolene – (All Nine syntheses from Advanced Organic Chemistry Carey, Sundberg; Part B).
			CO 2: Perform total Synthesis of i. Hirsutellone B, ii. Ribisins A and B, iii. Subincanadine E
			CO 3: Able to learn Vannusals
			CO 4: To understand Pinnaic acid

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
	CHO-451	Organometallic Reagents in Organic Synthesis	CO 3: Gain the knowledge of Transition metal complexes in organic synthesis.
			CO 4: Learn C=C formation reactions: Wittig, Horner-Wordworth-Emmons, Shapiro, BamfordStevens, McMurry, Julia-Lythgoe and Peterson olefination reactions.
			CO 3: Understand Ring formation reactions: Pausan-Khand, Bergman and Nazerov cyclization
			CO 4: Able to understand Click chemistry: criterion for click reaction, Sharpless azides cycloadditions. Click reactions in synthesis of bioconjugates.
	CHO-452	Medicinal Chemistry	CO 1: To Learn Peptides and proteins and Problem solving.
			CO 2: Able to Understand Peptides, sequencing and their applications in therapeutics, Solution phase and solid phase peptide synthesis and Modern techniques for biomolecules and disease diagnosis.
			CO 3: Able to know Introduction to medicinal Chemistry.
			CO 4: Know about Pharmacokinetics and Pharmacodynamics of drug.
			CO 1: To understand structure and activity Relationship: QSAR, Applications of SAR and QSAR in drug design
			CO 2: Know about Introduction, Developments, SAR, Mode of action, limitations and adverse effect of Anti-infective Agents, Beta lactam antibacterial agents
	CHO-453 Practical	Ternary Mixture Separation	CO 1: Understand and employ concept of type determination and separation
			CO 2: Meticulously record physical constants
			CO 3: Perform micro scale chemical elemental analysis
			CO 4: Perform qualitative estimation of functional groups

Class	Subject code	Title	Cos: After successful completion of This course, student will be able to
			CO 5: Recrystallize /distill the separated compounds
			CO 6: Extend these skills to organic synthesis
		Carbohydrates Synthesis and Isolation of Natural Products	CO 1: To understand the meaning of dry condition in reaction.
			CO 2: Workup of reaction in minimum quantity of water.
			CO 3: To acquire skill in handling of carbohydrates reaction.
			CO 4: Students should be able to collect reasonable quantities of color pigments to do the characterization and encouraged to use these pigments for developing food grade natural colors from lesser known plant sources.
			CO 5: Students should be able to collect a reasonable quantities of essential oils to do the characterization and They are encouraged to use these essential oils for the development of the products like soap, perfumes etc.
			CO 6: Students should be able to collect a reasonable quantities natural products to do the characterization and encouraged to study novel medicinal plants from their local area.
		Project / Industrial Training/ Internships / Summer Project	CO 1: Able to know about Literature survey, research methodologies,
			CO 2: To understand Data Analysis, Column and TLC chromatographic techniques, Characterization of the products by analytical and spectral methods
	CHO-454 Practical	Convergent and Divergent Organic Syntheses.	CO 1: Students should acquire pre-experiment (Reading MSDS, purification of reactants and reagents, mechanism, stoichiometry etc)
			CO 2: Students should understand post-experiment skills (work-up, isolation and purification of products, physical constants characterization using any spectroscopic methods etc.)

Class	Subject Code	Title	Cos: After successful completion of This course, student will be able to
M.Sc.-I Sem-I	CHP-110 Fundamentals of Physical Chemistry	Thermodynamics	CO 1: Understand basics of Chemical Thermodynamics: Calculation of ΔH, ΔS, ΔG and K
			CO 2: Gain the knowledge of Effect of temperature and pressure dependence for various chemical reaction partial molar quantities, concept of activity.
			CO 3: Learn Molecular Thermodynamics: Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics
			CO 4: Understand and Quantum Chemistry: Classical mechanics, black body radiation, photoelectric effect, orthonormal functions, hermitian operators, Schrodinger equation, particle in a box.
		Chemical kinetics and reaction dynamics	CO 1: To understand and learn zero, first, second, third, nth order rate equation,
			CO 2: To learn different kinetic reactions such as, Reversible reactions, parallel (side) reactions, consecutive (sequential) reactions, steady state approximation.
			CO 3: To understand different theories: Arrhenius theory, collision theory and transition state theory.
			CO 4: Gain the knowledge of Debye Huckel Limiting law, primary and secondary salt effects and understand Enzyme catalysis-Michaelis-Menten mechanism.
	CHI-130 Inorganic Chemistry	Molecular Symmetry and its Applications	CO 1: To develop a deep knowledge about Molecular Symmetry and Symmetry Groups.
			CO 2: To have a well defined idea on Representations of Groups: Matrix representation and matrix notation for geometric transformation
			CO 3: Understand Group theory and quantum mechanics:
			CO 4: To know and understand the Symmetry Adapted Linear Combinations, Molecular Orbital Theory and Application of Group

			theory to Infrared Spectroscopy
		Chemistry of Main group elements	CO 1: To familiarize about Hydrogen and its compounds, Alkali and alkaline earth metals, Organometallic Compounds of Li, Mg, Be, Ca, Na
			CO 2: To acquire knowledge about Boron Hydrides, preparation, structure and Bonding with reference to LUMO, HOM
			CO 3: To learn Allotropes of Carbon, C60 and compounds, Carbon nanotubes, synthesis, properties, structure-single walled, multi walled, applicati
			CO 4: To gain the knowledge of Oxidation states of nitrogen and their interconversion, PN and SN Compounds, Metal Selenides and Tellurides, oxyacids, and oxoanions of sulphur & nitrogen, Interhalogens, pseudohalagen.
	CHO-150 Basic organic chemistry	Structure reactivity and Stereochemistry	CO 1: To understand the Chemical bonding and basis of reactivity and MOT and VBT approach.
			CO 2: To familiarize about the bonding other than covalent bonding: Ionic, hydrogen bond, inclusion compounds, rotaxanes, catenanes, cyclodextrins, cryptands, fullerenes, crown ethers.
			CO 3: To learn about aromaticity: Benzenoid and non-benzenoid compounds, Huckels rule, antiaromaticity, Application to carbocyclic and heterocyclic systems,
			CO 4: Create knowledge on sterochemical principles, enantiomeric relationship, distereomeric relationship, R and S, E and Z nomenclature
		Organic reactions	CO 1:To recollect and familiarize the basic concepts of substitution reaction: SN1, SN2, SET and SNV mechanism
			CO 2: To develop a deep knowledge about the Aromatic Electrophilic substitution: like Friedel crafts alkylation and acylation, Nitration, halogenation, formylation, chloromethylation, sulponation.

			CO 3:To have a well defined idea on Aromatic nucleophilic substitution: SNAr, SN1, Benzyne and SNR1 reactions
			CO 4: Understand and solve Addition reactions and Elimination reactions E1, E2, E1cb mechanisms
	CHP-107 Physical Chemistry Practical		CO 1: Students will be able to understand standardization of Conductometry, Potentiomerty, pH metry, Polarography.
			CO 2: Uderstand kinetic decomposition of diacetone alcohol by dilatometry.
			CO 3: Analyse and apply the theoretical principles of chemical kinetics
			CO 4: Evaluation of unknown concentration of solutions using techniques like conductometry, potentiometry and viscosity measurements
	CHI-147 Inorganic Chemistry Practical		CO 1:To analyze alloys and ores
			CO 2: To acquire knowledge about synthesis and properties of nano particles
			CO 3: To familiarize the preparation of inorganic complexes.
			CO 4: To be aware of the characterization of inorganic complexes.
M.Sc.-I Sem-II	CHP-210 Fundamentals of Physical Chemistry II	Molecular Spectroscopy	CO 1: To understand the basic principles and theory of IR, Raman, and Electronic spectroscopy.
			CO 2:Apply the theory to simple problems
			CO 3: To learn Rotation spectra- based on moment of inertia, rigid rotor, most intense line, isotopic effect on the rotational spectra, non-rigid rotator, diatomic molecules, linear triatomic molecules, symmetric top molecules, stark effect
			CO 4: To understand vibrational rotational spectra, fine structure in diatomic molecules, Born-Oppenheimer approximation, effect due to nuclear spin, parallel and perpendicular vibrations.
		Nuclear and radiation	CO 1:To learn about applications of radioactive isotopes in various fields

		Chemistry	CO 2:To develop a deep knowledge about valence bond theory, hybrid orbitals, geometry and hybridization, molecular orbital
			CO 3:To understand the basic principles of crystallography
			CO 4:To acquire knowledge about Unit Cell, types of crystals, Miller Indices, Bragg Equation, Crystal structure determination from X-ray data, Bravais Lattices.
	CHI-230 Inorganic Chemistry	Coordination Chemistry	CO 1:To acquire deep knowledge in coordination compounds
			CO 2:To understand the scope of ligand fields theory of coordination complexes
			CO 3:To learn and understand the Russell-Saunders terms, strong field effect, correlation diagrams, Tanabe-Sugano Diagrams, Spin-Pairing energies.
			CO 4:To know and understand the Magnetic Properties of Coordination Complexes
		Bioinorganic Chemistry	CO 1:To have a detailed idea on overviews of bioniorganic chemistry
			CO 2: Students will be able to know Principles of Coordination Chemistry related to Bioinorganic Research and Protein, Nucleic acids and other metal binding biomolecules.
			CO 3: Create knowledge on Iron: Ferritin, Transferrin, Fe-S clusters, Porphyrin based systems.
			CO 4: To acquire knowledge about Biochemistry of Na, K and Ca w.r.t. Na/K pumps, Calmodulin and blood coagulation.
	CHO-250 Synthetic organic chemistry and spectroscopy	Synthetic Organic Chemistry	CO 1:To Learn about the application of various oxidising and reducing agents used in organic synthesis
			CO 2:Knowledge of Beckmann, Hofmann,, Curtius, Smith, Wolff, Lossen, Bayer-villiger, Sommelet, Favorskii, Pinacol-pinacolone, Benzil-benzilic acid, Calsien, Cope, Fries
			CO 3:Gain knowledge about Ylides

			CO 4: To know and learn role of different reagents such as, Grignard, organo zinc, organo copper, organo lithium.
		Spectroscopy	CO 1: The learners should be able to apply the different spectroscopic methods to solve problems
			CO 2: Using spectral data for explaining important organic reactions and functional transformations.
			CO 3: To understand PMR: Fundamentals of NMR, CW and FT-NMR,
			CO 4: Know and understanding CMR and mass spectrometry
	CHA-290 General Chemistry	Concept of Analytical Chemistry	CO 1: Understand Data Handing and Spreadsheets in Analytical Chemistry
			CO 2:To learn the Sampling, Calibration and Standardization
			CO 3: To gain the detail knowledge about the Separation by precipitation, separation by distillation, separation by extraction, separation by ion exchange chromatography.
			CO 4: Acquired the knowledge of Chemical aspects to Nanomaterials
		Organometallic and Inorganic Reaction Mechanism	CO 1:Learn and understand 18 electron rule, ligands in organometallic chemistry, Fullerene complexes, carbine and carbine complexes,
			CO 2: To acquire deep knowledge of reactions involving gain and loss of ligands, **r**eactions involving modification of ligands, organometallic catalysis and heterogeneous catalysis
			CO 3: Detail idea about Substitution reactions: Inert and labile complexes, Kinetics Consequences of reaction pathway, Stereochemistry of reactions:
			CO 4: Understand the trans effect
	CHO-247 Organic Chemistry Practical		CO 1: Use the computational tools to draw the reaction schemes and spectral data to various organic reactions.
			CO 2:Apply class room learning in separation and

			purification of organic compounds and binary mixtures
M.Sc.-II Sem-III	CHO-350	Organic Reaction Mechanism	CO 1: Gains complete knowledge about Carbanions-Formation, stability and related name reactions.
			CO 2: Be able to describe the Enamines – formation and applications and Reactions of carbenes and nitrenes.
			CO 3: Student should able to learn the Generation of radiacls, Stable free radicals, Nucleophilic and electrophilic radicals.
			CO 4: To understand the characteristics reactions, -Free radical substitution.
	CHO-351	Spectroscopic Methods in Structure Determination	CO 1:The learners should be able to apply the different spectroscopic methods to solve problems
			CO 2: Students learn the basic principles and applications of ^{1}H NMR, ^{13}C NMR, 2D NMR and Mass Spectrometry
	CHO-352	Organic Stereochemistry	CO 1: students will able to explain Stereochemistry of six membered rings.
			CO 2: To learn and understand fused Bridged and caged rings
			CO 3: To understand geometrical Isomerism and Stereochemistry of olefins
			CO 4: Familiarize the Determination of stereochemistry of organic compounds using NMR.
	CHO-353	Photochemistry, Pericyclic Reactions and Heterocyclic Chemistry	CO 1: To understand the General basic principle of photochemistry and their application in synthesis
			CO 2: Student should able to learn different pericyclic reactions
			CO 3: Able to gain and acquire the knowledge of heterocyclic chemistry
M.Sc.-II Sem-IV	CHO-450	Chemistry of Natural Products	CO 1: To understand structure and stereochemistry of Hardwickiic acid, Camptothecin and podophyllotoxin
			CO 2: Able to know about Taxol, Estrone and Mifepristone synthesis
			CO 3: To learn the building blocks and construction mechanism of Terpenoids and

			Alkaloids
	CHO-451	Advanced Synthetic Organic Chemistry	CO 1: To know and understand transition metal complexes in organic synthesis ; only Pd, Ni, Co, Fe
			CO 2: To learn C=C formation reactions: Wittig, Horner-Wordworth-Emmons, Shapiro, Bamford-Stevens, McMurry, Julia-Lythgoe and Peterson olefination reactions
			CO 3: Familiarize the Ring formation reactions: Pausan-Khand, Bergman and Nazerov cyclization
			CO 4: Understand Click chemistry: criterion for click reaction, Sharpless azides cycloadditions
	CHO-452	Carbohydrate and Chiron approach, Chiral Drugs and Medicinal Chemistry	CO 1: Able to know about carbohydrates: structures of triose, tetrose, pentose, hexose,
			CO 2: should be understand the concept of chiral templates and chirons wherein the carbon skeleton is the chiral precursor.
			CO 3: To learn utilisation of the basic concepts for retrosynthetic strategy and synthesis of (S) Propanediol, (R) and (S) – Epichlorohydrin, L (+)-Alanine,(-) Multistratin, (-) Pentenomycin, (-) Shikimic acid,
			CO 4: Able to gain the knowledge of Introduction of chiral drugs, Eutomer, Distomer and eudesmic ratio,Distomers
	CHO-453	Designing Organic Synthesis and Asymmetric Synthesis	CO 1: Gain knowledge about the designing of organic synthesis: Protection and de-protection of hydroxyl, amino, carboxyl, ketone and aldehyde
			CO 2: To know the Principles and applications of asymmetric synthesis:
	CHO-347	Single stage preparations	CO 1:To acquire knowledge on the various reagents employed for their synthesis
			CO 2: Students will be able to performed Fourteen single stage and three Isolation of Natural products on micro scale.
	CHO-447	Two stage preparations	CO 1: know the methodology to handle chemicals, heating methods and error

			analysis
			CO 2: Students will be able to performed ten two stage preparations and
	CHO-448	Project/Industrial training/Green Chemistry and Chemical biology experiments	CO 1: Able to know about Literature survey, research methodologies,
			CO 2: To understand Data Analysis, Column and TLC chromatographic techniques, Characterization of the products by analytical and spectral methods
			CO 3: understand the procedure for handling chemicals and analysis
			CO 4: understand the principle of techniques used for the purification of compounds
			CO 5: know about importance of various titrimetric methods

HOD

IQAC Coordinator

IQAC

Principal
Maratha Vidya Prasarak Samaj's
Karmaveer Shantarambapu Kondaji Wavare
Arts,science and Commerce College,
Uttamnagar,CIDCO,Nashik-422008