Deccan Education Society's

Fergusson College (Autonomous), Pune

Program Specific Outcomes(PSOs) and Course Outcomes (COs) 2019-20

Department of Chemistry

Programme: M.Sc. Organic Chemistry

PSO No.	Program Specific Outcomes(PSOs) Upon completion of this programme the student will be able to
PSO1	**Academic competence:** (i) Understand fundamental principles and advanced concepts of organic, inorganic and physical chemistry. (ii) Demonstrate understanding of various types of reactions, reaction mechanisms, stereochemistry, photochemistry, rearrangements, heterocyclic and medicinal chemistry, reactions involving use of metals. (iii) Interpret analytical data for structure elucidation obtained using NMR, IR, UV and Mass spectroscopy.
PSO2	**Personal and Professional Competence:** (i) Carry out experiments which include various chemical techniques and also setting of dry reactions, handling of hazardous reagents, assembling of apparatus, isolation of natural products, purification by column chromatography. (ii) Evaluate results obtained, observations and conclusion of experiments. Documentation of results. (iii) Formulate ideas, scientific writing and authentic reporting, effective presentation and communication skills.
PSO3	**Research Competence:** (i) Outline research problem related to research area of interest and planning of methodology for execution. (ii) Review scientific literature and findings in systematic manner and processing of information obtained to understand scope for novelty. (iii) Design novel synthetic routes using a retrosynthetic approach for development of elegant, economic and eco-friendly schemes.
PSO4	**Entrepreneurial and Social competence:** (i) Demonstrate importance of industrial applications of organic chemistry in various fields. (ii) Devise chemical processes with Green approach having advantage in safe operations.

Course Outcomes (COs)		
F.Y. M.Sc. Semester I		
Title of the Course and Course Code	**Fundamentals of Physical Chemistry (CHA4101)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall basic concepts and define different terminologies in thermodynamics, quantum chemistry and chemical kinetics. Differentiate order and molecularity, classical and quantum mechanics.	1
CO2	Classify the chemical reactions on the basis of order. Determine the rate equations for the given chemical reaction, Schrödinger equation, wave equation and energy for particle in box	2
CO3	Use simple models to predict the physical phenomenon associated with thermodynamics, quantum chemistry and chemical kinetics.	3
CO4	Explain and illustrate quantum mechanical models and statistical thermodynamic properties. Relate the role of quantum mechanics in statistical mechanics.	4
CO5	Criticize different theories of Reaction rates. Justify activation energy concept and Arrhenius theory for reaction rate.	5
CO6	Calculate and integrate the physical parameters for given problems. Formulate and solve scientific problems based on the fundamentals of physical chemistry.	6
Title of the Course and Course Code	**Fundamentals of Inorganic Chemistry (CHA4102)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Outline the concept of symmetry to imagine molecules in three dimensions and identify the symmetry elements and symmetry operations and be able to pass through the molecule. Describe the selection rule and construction of microstate tables for various configurations.	1
CO2	Classify the symmetry elements possessed by a molecule and assign it to a point group and determine optical activity and dipole moment. Explain the construction of a matrix representation.	2

CO3	Generalise the importance of Orthogonality Theorem and learn the rules for constructing character tables. Outline the fundamental requirement for interpretation of electronic spectra of metal compounds for prediction of their properties.	3
CO4	Explain molecular structure by the use of character tables and projection operator techniques. Identify the factors responsible for different magnetic behaviour of materials.	4
CO5	Review the concept of SALC, spectrochemical and Nephelauxetic series. Develop the ability to generate a representation of SALC and to reduce it to its irreducible components. Evaluate numerical based on crystal field parameters.	5
CO6	Specify and correlate the application of symmetry to spectroscopy to find out which modes are IR and Raman active. Specify the various Quenching of orbital angular momentum.	6
Title of the Course and Course Code	**Advanced Organic Chemistry and Spectroscopy – (CHA4103)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the concept of aromaticity and its application to identify various organic compounds. Predict and cite examples of aromaticity of heterocyclic and non-heterocyclic compounds.	1
CO2	Discuss aromatic substitution reactions and predict the products/intermediates and explain the type of reactions and write their mechanisms.	2
CO3	Applications of organometallic compounds, ylides and predict products. Determine selectivity and demonstrate their advantages.	3
CO4	Identify the products of oxidation-reduction reactions, give examples and determine selectivity of reagents and demonstrate their nature.	4
CO5	Review various terms in stereochemistry and explain aspects of configurations in various chiral compounds, prochirality, stereospecific and stereoselective reactions.	5
CO6	Revise basic principles of spectroscopy and demonstrate applications of spectroscopic techniques. Propose structures using spectroscopic data.	6

Title of the Course and Course Code	**Analytical Chemistry Practical – I (CHA4104)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Outline and recall basic knowledge of fundamentals and application of organic and physical chemistry through chemical and scientific theories.	1
CO2	Perform the experiment and tabulate the observations.	2
CO3	Use of safety responsibilities residing in working with chemicals.	3
CO4	Separate components from ternary mixture of organic compounds and determine type of given mixture and physical constants. 4 Demonstrate and employ skills in procedures and instrumental methods applied in organic and physical chemistry practical.	4
CO5	Standardize/calibrate the apparatus and instrument. Carry out purification techniques.	5
CO6	Write the experimental results and interpret it.	6
Title of the Course and Course Code	**Analytical Chemistry Practical – II (CHA4105)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Outline and recall basic knowledge of fundamentals and application of inorganic and physical chemistry through chemical and scientific theories.	1
CO2	Perform the experiment and tabulate the observations.	2
CO3	Illustrate safety measures related to experiments carried out.	3
CO4	Separate components from different analytes using various methods/techniques	4
CO5	Standardize/calibrate the apparatus and instrument.	5
CO6	Develop skills in procedures and instrumental methods applied in practical tasks. Interpret, conclude and write the experimental results.	6

	F.Y. M.Sc. Semester II	
Title of the Course and Course Code	**Advanced Physical Chemistry (CHA4201)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall and define basic terminologies in spectroscopy, chemical bonding and nuclear chemistry.	1
CO2	Illustrate, classify and compare theoretical and instrumental aspects for various spectroscopic and radio analytical techniques. Summarize different molecular spectroscopic concepts and rules to deduce the molecular structures.	2
CO3	Solve and work with numerical based on spectroscopic, radio analytical and chemical bonding concepts. Interpret different types of molecular spectra and structure to evaluate valuable data from it.	3
CO4	Explain molecular orbital theory for homonuclear, heteronuclear and polynuclear molecules using quantum rules.	4
CO5	Review and relate the concepts involved in different spectroscopic techniques.	5
CO6	Formulate and solve scientific problems based on the advanced physical chemistry concepts. Specify the applications of spectroscopy, radio analytical techniques and concepts of chemical bonding in chemistry and interdisciplinary fields.	6
Title of the Course and Course Code	**Advanced Inorganic Chemistry (CHA4202)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the importance of bioinorganic chemistry. Describe the structure and bonding aspects of simple organometallic compounds. Outline basics of substitution reactions of octahedral complexes.	1
CO2	Discuss the role of metals in Metalloproteins. Classify the different types of organo-transition metal complexes, catalyzed reactions and factors affecting it.	2
CO3	Illustrate the importance and transport of metal ions. Identify back bonding in organometallics and outline the mechanism of	3

	hydrolysis in the octahedral system.	
CO4	Explain catalytic reaction involving organometallic compounds. Describe the metal carbonyls, metal clusters, metal nitrosyls and its preparation, structures and properties.	4
CO5	Justify the importance and function of metal ions in metalloprotein. Evaluate problems based on electron count in organometallics.	5
CO6	Develop basic understandings about redox reaction or electron transfer reactions. Specify the environmental impact of the most inorganic compounds produced on the industrial scale and know different applications of organometallic compounds in medicines.	6
Title of the Course and Course Code	**Reaction Mechanism in Organic Chemistry (CHA4203)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Define and explain recall principles of photochemistry.	1
CO2	Explain pericyclic reactions and justify their mechanisms by using correlation diagrams and FMO approach	2
CO3	Demonstrate concepts of Carbanions, Enamines and Ynamines and explain their stability, reactivity, selectivity and predict the products.	3
CO4	Classify rearrangements. Predict the product and illustrate the reactions involving rearrangements	4
CO5	Review carbenes, nitrenes, free radicals and discuss their methods of synthesis and predict products in related reactions.	5
CO6	Specify neighbouring group participation (NGP) and predict the products in reactions involving NGP. Explain different mechanisms of ester and amide hydrolysis.	6
Title of the Course and Course Code	**Analytical Chemistry Practical – III (CHA4204)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the theoretical principles and concepts related to experiments.	1

CO2	Represent the results of scientific work in oral, written, graphical and electronic formats.	2
CO3	Apply laboratory skills in organic and physical chemistry. Carry out single stage preparation along. Demonstrate software related to chemistry.	3
CO4	Identify and analyse the product obtained by different techniques. Demonstrate purification technique.	4
CO5	Justify the steps to standardize the methods and instruments .	5
CO6	Perform experiments, analyze and interpret the experimental results	6
Title of the Course and Course Code	**Chemistry Practical Course - IV (CHA4205)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the theoretical principles and concepts related to experiments.	1
CO2	Represent the results of scientific work in oral, written, graphical and electronic formats.	2
CO3	Execute chemical analysis for different samples. Implement problem solving, critical thinking and analytical reasoning as applied to scientific problems.	3
CO4	Analyze data from a range of physical techniques to characterise different compounds.	4
CO5	Justify the steps to prepare and standardize different solutions.	5
CO6	Design and perform scientific experiments. Interpret and write the experimental results with standards.	6
	S.Y. M.Sc. Semester III	
Title of the Course and Course Code	**Stereochemistry of Organic Molecules (CHO5301)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**

CO1	Describe and explain the stereochemistry of six membered rings and predict correct stereochemical outcome in related reactions.	1
CO2	Explain the stereochemistry of rings other than six membered including stereochemical restrictions and predict their correct stereochemical outcome.	2
CO3	Demonstrate the stereochemistry of fused, bridged and caged rings.	3
CO4	Identify and explain the stereochemistry of polycyclic rings and their application in steroid chemistry. Predict the cyclization in various reactions using Baldwin's rule.	4
CO5	Determine various methods used in the separations of racemic mixtures	5
CO6	Specify stereochemistry and methods to evaluate the correct structure and stereochemistry of some important naturally occurring molecules.	6
Title of the Course and Course Code	**Structure Determination by Analytical Methods (CHO5302)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Define and describe basic principles of spectroscopy and Mass spectrometry and demonstrate their applications.	1
CO2	Explain spin systems and propose correct structures from spectral data. Distinguish compounds using spectroscopic methods.	2
CO3	Solve problems based on - UV, IR, NMR, CMR, mass spectral data. Use suitable experiments of 2D spectroscopy for structure elucidation.	3
CO4	Explain techniques used to interpret chemical shift for ^{13}C NMR	4
CO5	Determine structures from fragmentation data and discuss factors controlling fragmentation.	5
CO6	Propose structures of compounds using spectroscopic data.	6

Title of the Course and Course Code	Chemistry of Heterocycles and Medicinal Chemistry (CHO5303) (D.Elect-1)	Number of Credits : 04
On completion of the course, the students will be able to:		Bloom's Cognitive level
CO1	Describe the chemistry of five and six membered heterocycles and heterocycles with more than two hetero atoms.	1
CO2	Discuss chemistry of condensed five and six membered heterocycles.	2
CO3	Predict products of heterocyclic reactions.	3
CO4	Identify important terms used in medicinal chemistry and discuss various types of targets.	4
CO5	Evaluate drug properties of a compound using QSAR studies.	5
CO6	Write different theoretical approaches of drug designing and development.	6
Title of the Course and Course Code	**Pharmaceutical Chemistry CHO5304 (G Elect-1)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	List the importance and role of FDA. Define basic concepts related to pharmaceutical chemistry.	1
CO2	Discuss and explain various pharmaceutical concepts and techniques of analysis. Summarize different separation techniques and system suitability parameters.	2
CO3	Illustrate the role of drug activity in pharmaco-kinetics and dynamics. Solve the numericals based on pharmaceutical concepts.	3
CO4	Analyze different pharmaceutical samples. Explain analytical techniques used in pharmaceutical industries.	4
CO5	Compare different dosage forms, route of administration, pattern of drug release.	5
CO6	Propose and specify methods for analyzing pharmaceutical samples. Compile processes to increase separation efficiency of multicomponent products.	6
Title of the Course and	**Organic Chemistry Practical - V (CHO5306)**	**Number of Credits : 04**

Course Code		
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	List the importance and role of FDA. Define basic concepts related to pharmaceutical chemistry.	1
CO2	Discuss and explain various pharmaceutical concepts and techniques of analysis. Summarize different separation techniques and system suitability parameters.	2
CO3	Illustrate the role of drug activity in pharmaco-kinetics and dynamics. Solve the numericals based on pharmaceutical concepts.	3
CO4	Analyze different pharmaceutical samples. Explain analytical techniques used in pharmaceutical industries.	4
CO5	Compare different dosage forms, route of administration, pattern of drug release.	5
CO6	Propose and specify methods for analyzing pharmaceutical samples. Compile processes to increase separation efficiency of multicomponent products.	6
Title of the Course and Course Code	**Organic Chemistry Practical - VI (CHO5307)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe mechanism, particulars regarding nature of reactants, reagents, products, safety measures, reaction conditions and work up of the experiment.	1
CO2	Outline experiment involving two stage conversion of starting material into the products and examine the progress of reaction.	2
CO3	Carry out experiments based on rearrangements, aromatic substitution reactions and heterocycles synthesis. Measure yield and test purity of the products obtained.	3
CO4	Analyse progress of reaction and tabulate results obtained in each step	4
CO5	Determine purity of the product.	5
CO6	Perform experiments based on oxidation, reduction and condensation. Assemble apparatus for setting up the experiment.	6
	S.Y. M.Sc. Semester IV	

Title of the Course and Course Code	**Chemistry of Natural Products and Chiron Approach (CHO5401) (D.Elect-2)**	**Number of Credits : 04**
CO1	Explain retrosynthetic analysis of important natural products, roles of reagents, stereochemical and selectivity aspects in synthesis. Arrange reagents in synthetic route of target molecules.	2,4,6
CO2	State and explain the types of terpenoids, alkaloids and propose mechanism of their biogenesis.	1,2,4,6
CO3	Describe shikimate pathway and predict the product.	1,3
CO4	Define chirons and justify their use in synthesis of drug molecules along with retrosynthetic analysis.	1,5
CO5	Discuss the synthesis of chiral drugs.	2
CO6	Predict the products in chiral drug synthesis.	2,3
Title of the Course and Course Code	**Forensic science and Toxicology CHO5402 (G Elect-2)**	**Number of Credits : 04**
CO1	Outline the terms and role of forensic science, analytical toxicology and different units of crime lab.	1
CO2	Discuss the types of evidence, collection and preservation of samples. Explain different techniques involved in interpreting evidence obtained at a crime scene.	2
CO3	Outline the basic facts, concepts, principles related to various techniques used in forensic science.	3
CO4	Identify and explain different evidence, drugs, poisons from crime scenes and body fluids.	4
CO5	Review various techniques involved in crime scene investigation. Evaluate evidence obtained at crime scene.	5
CO6	Propose steps for analyzing various samples obtained at crime scenes and develop critical thinking and investigate in a stepwise manner.	6
Title of the Course and Course Code	**Advanced Synthetic Organic Chemistry (CHO5404) (D. Elect-3)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Define role of metals as catalyst and contribution of transition	1

	metals as catalyst.	
CO2	Discuss use of transition metal complexes in organic synthesis. Discuss various reactions for C=C formation.	2
CO3	Predict products in metal and non-metal mediated reactions and justify the nature of the product.	3
CO4	Explain and discuss Multi-component reactions (MCR) and metathesis.	4
CO5	Review boron and silicon chemistry.	5
CO6	Specify mechanisms of different name reactions.	6
Title of the Course and Course Code	**Analytical Spectroscopy CHO5405 (G Elect-3)**	**Number of Credits: 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the basic terminologies in spectroscopy and regions of the electromagnetic spectrum.	1
CO2	Illustrate, classify and compare theoretical and instrumental aspects for various advanced spectroscopy.	2
CO3	Solve numericals based on analytical spectroscopic techniques. Interpret and compute the spectral data.	3
CO4	Relate different concepts and apply them to identify the molecular structures and spectrum.	4
CO5	Review the concepts involved in different spectroscopic techniques.	5
CO6	Formulate and compile scientific problems based on analytical spectroscopy. Specify the applications of analytical spectroscopy in chemistry and interdisciplinary fields.	6
Title of the Course and Course Code	**Designing of Organic Synthesis and Asymmetric Synthesis (CHO5407)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Explain the use of retro synthetic analysis to work out and compare alternative syntheses of complex organic molecules. Outline the important classical and modern reactions used in organic synthesis.	1,2,4,5
CO2	Predict the correct product based on choice of reagents and	2,3,6

	conditions. Design and discuss synthetic routes for the target molecules and problems related to process development.	
CO3	Discuss various methods of protection and deprotection and apply them in designing synthetic strategies.	2,3
CO4	Explain the concept of umpolung, state its importance and use in organic synthesis.	1,2,3,4
CO5	Discuss different methods for asymmetric synthesis.	2
CO6	Identify the role and use of organocatalysts in asymmetric synthesis, stereochemistry of some important naturally occurring molecules and specify methods to evaluate correct structure and stereochemistry.	1,4,6
Title of the Course and Course Code	**Polymer Chemistry CHO5408 (G Elect-4)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the basic concepts and history of polymers. List the types of polymers based on their properties and type.	1
CO2	Discuss various synthesis mechanisms, polymer processing and testing methods.Illustrate the additives used in industrial products and specify their functions.	2
CO3	Generalise the molecular weight concept for polymers and predict average molecular weights with various physical methods.	3
CO4	Differentiate polymerization approaches and relate their analysis methods with properties of polymers.	4
CO5	Review properties of polymers, various factors affecting and separation techniques based on molecular size.	5
CO6	Propose applications of polymers for industrial utilization as well as interdisciplinary field of science. Specify mechanism of synthesis and applications of different industrially important polymers.	6
Title of the Course and Course Code	**Organic Chemistry Practical - VII (CHO5410)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Discuss principles of green chemistry, particulars regarding nature of reactants, reagents and products, safety measures, reaction conditions and work up of the experiment.	2

CO2	Outline experiment involving solvent free conditions, room temperature reactions.	1,2
CO3	Carry out experiments making use of eco-friendly reagents and catalysts.	3
CO4	Synthesize heterocycles under green chemistry conditions.	6
CO5	Carry out experiments and evaluate results using mild reactants and mechanical mixing of reactants at room temperature.	3,5
CO6	Examine progress of the reaction, analyse, confirm and tabulate the results obtained.	1,3,4
Title of the Course and Course Code	**Organic Chemistry Practical - VIII (CHO5411)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Discuss important applications of chemistry.	2
CO2	Outline experiment for synthesis of agrochemicals.	1,2,3
CO3	Carry out experiments for isolation of natural products.	3
CO4	Synthesize pharmaceutically important intermediates and scaffolds.	6
CO5	Perform experiments and evaluate results for synthesis of monomers of useful polymers and synthesize dyes.	5,6
CO6	Examine progress of the reaction, analyse, confirm and tabulate results obtained.	1,3,4
Title of the Course and Course Code	**Project / Internship (Optional for practical courses CHO5410 and CHO5411) (CHO5412) (P-Special 3)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Apply the fundamental concepts in chemistry to explore the corresponding literature and carry out project work to understand research methodology.	3
CO2	Identify the problem and carry out literature survey to articulate the stated problem using different research aspects.	1,2,3

CO3	Plan and execute independently defined scientific problem using different analytical tools.	3, 6
CO4	Compile and justify findings of the experiments. Compare and criticize results based on scientific literature.	2,4, 5, 6
CO5	Articulate ethical scientific experiment execution and art of reporting.	2
CO6	Appraise the best presentation approach for their project conclusions in the form of a dissertation and research articles	5