Shivaji University, Kolhapur

Name of Department: Chemistry

Name of Programme: M.Sc. Applied Chemistry

Vision: Engender Human Resource to Lead the Competitive Science World for Nation Building
Mission : Impart most advanced scientific knowledge and training to the students so that genuine researchers and skilled scientists of world standard will be made available for the advancement of national science and technology programs as well as to cater the needs of industrial and pharma sectors
Program Outcomes PO1: Students will have a thorough knowledge in the fundamentals and application of modern chemical and scientific theories including those in all branches of Chemical sciences. PO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments. PO3: Students will be able to use the evidence based comparative chemistry approach for organic, inorganic synthesis and analysis of the chemical compounds. PO4: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems. PO5: Applied Chemistry Students will be able to clearly communicate the results of scientific task in oral and written formats. Students will be able to function as a member of an interdisciplinary problem solving team. PO6: Students will be able to explain the role of Applied Chemistry for addressing social, economic, and environmental problems.

Program Specific Outcomes
PSO1: This course will be able to get global level research opportunities to students to pursue Ph.D programme, targeted approach of competitive Exams such as CSIR – NET/GATE/SET, Personality Development Programs, discipline specific competitive exams conducted by service commission, etc. PSO2: The students will be able to get employment opportunities in various chemical and pharmaceutical industries PSO3: Understands the background of Inorganic reaction and organic reaction mechanisms and instrumental methods of chemical analysis, separation techniques and analytical methods of general purpose. PSO4: To gains complete knowledge about all fundamental aspects Inorganic, Organic, , Physical and Analytical Chemistry.
Course Outcomes
Part-I Semester-I

CH-1.1	**(Inorganic Chemistry – I)**	1. CO1: Students will be able to explain the basic chemistry of transition metals and its compounds, spectroscopic characteristics of such compounds, nomenclature, reactions and applications. CO2: Students will obtain knowledge about Preparation, structure, physical and chemical properties of metal carbonyls of transition metals. CO3: Students will be able to understand the all aspects of synthesis, bonding, structure and reactivity of organometallic compounds and their applications in homogenous catalysis. CO4: Student will be able determine the stability of the complexes and will be able to explain the nuclear stability and reactions.

CH-1.2	**(Organic Chemistry – I)**	CO1: Students will able to differentiate between various organic reactive intermediates. CO2: Students can recognize, classify, explain, and apply fundamental organic reactions. CO3: Students will have ability to distinguish between different kinds of isomers. CO4: Course will develop interest in writing and finding mechanisms of new reactions. . .
CH-1.3	**(Physical Chemistry – I)**	CO1: Students will be able to understand basic principles of thermodynamics and statistical mechanics CO2: Able to learn advanced topics like quantum statistics and molecular dynamic simulation methods. CO3: Develop abilities to understand how to estimate and analyze the physicochemical properties of condensed and gas phase materials. CO4: Able to utilize spectral data to estimate molecular thermodynamic properties through partition function calculations. CO5: Understand properties of detergents and colloidal materials CO6: Learns the principles and techniques to understand gas and liquid adsorptions on solid surfaces CO7: Can learn spectral techniques to study surface adsorption phenomena. CO8: Learn principles and techniques for estimation

		of average molecular weight of a polymer or biological macromolecules CO9: Develop abilities to characterize polymers through understanding theories of virial coefficients, concepts of glass transition temperatures, etc.
CH.1.4:	**Analytical Chemistry-I**	CO1: Students would acquire the knowledge about the fundamentals of Analytical Chemistry including the sampling, sample pretreatment, basic techniques, methods and data handling, processing and statistical analysis of the same. CO2: Students would acquire the knowledge and understand the scope of Analytical Chemistry spanning various fields. The students will learn fundamentals of qualitative analysis using conventional techniques CO3: Students will learn the chromatographic techniques, choice of chromatographic techniques and tuning of the chromatographic technique as per the need based on the samples to deal with, learn electroanalytical techniques and computation chemistry which would groom them for alternative analytical strategies which form one of the important components of analytical chemistry. CO4: Students will learn about referring to the standard reference books and infer information from the same. Analytical case study problems would be discussed to familiarize with the scope and advantages of Analytical Chemistry.
PCH-1.1	**(Practical – I)**	CO1: Ability in professional sampling and sample

		treatment before actual analysis CO2: Ability to treat and evaluate the results of analysis CO3: Understanding and capability of performing basic chemical processes in a chemical laboratory CO4: Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes)
PCH-1.2	**(Practical – II)**	CO1: Students can be able to prepare various concentration solutions like molar, normal, ppm, etc. CO2: Determine the rate constants of various first order and second order reactions CO3: Determine the redox potential of a system, relative strength of acid etc using potentiometer, conductometer CO4: Know the formation of alloys like Brass, Bronze, phase diagram for binary and ternary systems studied in details like a composition, critical temperature, etc CO5: Validity of Freundlich adsorption isotherms to remove toxic material such as dye, acetic acid, and other industrial effluents
Part-I Semester-II		
CH-2.1	**(Inorganic Chemistry – II)**	CO1: Students will get the knowledge of the basic chemistry of non-transition elements and their compounds, synthesis and structural features, and applications. CO2: To be able to explain the structures of inorganic compounds based on different theories. Student will

		understand the chemistry of various types of solvents. CO3: Be well versed with the knowledge about the chemistry of Lanthanides and Actinides with respect to occurrence, separation, compounds and applications. CO4**:** To understand the three dimensional structures of solid-state materials of industrial importance and to get the knowledge of bio-inorganic Chemistry.
CH-2.2	**(Organic Chemistry – II)**	**Course Outcomes (COs)** CO1: Illustration of modern synthetic methods and applications of reagents. CO2: Provide knowledge of different organometallic compounds and various coupling reactions. CO3: Understand principle and applications of protection and deprotection of various functional groups. CO4: It will elaborate to understand the concept of chemoselectivity, regioselectivity and enantioselectivity.
CH2.3	**(Physical Chemistry – II)**	CO1: Students will learn basics of quantum mechanics. CO2: Knowledge of the course will form the basis or essential requirement for the course "Advanced Quantum Chemistry" CO3: Able to understand selection rules and to predict the electronic spectra of conjugated organic molecules. CO4: Able to study photochemical and photophysical phenomena

		CO5: Capable of qualitative and quantitative analysis of various ingredients from industrial, food and pharma samples using techniques of emission spectroscopy. CO6: Capable of understand the electrochemical aspects of materials, ionic processes and electrochemical sensors, battery materials and characterizations etc. CO7: Able to study electrokinetic effects and their applications in the field of protein separation, characterization etc. CO8: Understanding the molecular dynamics through kinetic studies. Applications to explore reaction pathways, protein-ligand binding rates, etc. will help to understand life governing processes.
CH.2.4:	**Analytical Chemistry-II**	CO1: Students will acquire the knowledge of spectroscopic tools/instruments used in chemical analysis and interpretation of the data. The scope and limitations of the spectroscopic tools would be discussed so that the students learn about the type of samples which could be analyzed by these tools offering choices among the spectroscopic tools. CO2: Students will learn about the simple and advanced instruments used for analysis like NMR, MS, AAS, ICP and thermal analysis (TGA, DTA, DSC etc.) techniques spanning wide variety of samples to be considered for analysis. CO3: Students will learn about the instrumentation, sample preparation and handling of sample, analysis and data interpretation and structural elucidation.

		CO4: Learning about different instruments will give them idea about appropriate choice of the instrument for analysis based on the source and type of analyte(s) in the sample under consideration.
PCH-2.1	**(Practical – III)**	CO1: Students developed for precise sample solution preparation and sample treatment before actual analysis. CO2: Students can be able to perform the calculations and error analysis CO3: Develop understanding of basic chemical processes and deciding methods of analysis. CO4: Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, high end thermometers, refractometer, pH meter etc.)
PCH-2.2	**(Practical – IV)**	CO1: Students can be able to prepare various concentration solutions like molar, normal, ppm, etc. CO2: Determine the unknown concentration and thermodynamic parameters using conductometer CO3: Student will explore how to estimate order of reaction and the catalysis CO4: students can estimate refractive index and molecular weights of species. CO5: Students can understand the estimation of equilibrium properties like redox potential, phase diagram etc
Part-II Semester-III		
APCH	**3.1 (Applied**	CO1: To understand basic facts and concepts in Electronic and Magnetic Properties of Transition Metal Complexes and its applications

	Inorganic Chemistry – I)	CO2: To be familiarized with the emerging areas of emergence of nanotechnology and their applications in Applied Inorganic Chemistry. CO3: To understand basic concepts and its classifications in Nanotechnologies used in Applied Inorganic Chemistry. CO4: Student will be able to understand the theory of transition metal Complexes and nanotechnology.
APCH-3.2	**(Applied Organic Chemistry – I)**	CO1: To impart the students a thorough knowledge about the mechanisms of several organic reactions of some selected functional groups in organic compounds. CO2: To understand concept of Applied organic chemistry in various spheres of chemical sciences. CO3: To give an elementary idea of organic reactions, molecular orbital theory, free radical reactions and organic synthesis in Applied Organic Chemistry. CO4: Students would acquire the knowledge about the Various organic reactions, PMO theory, concept of free radicals and ESR detections.
APCH- 3.3	**(Applied Physical Chemistry-I)**	CO1: This paper will provide an insight into some of the fundamental concepts in Equilibrium Properties of Electrolytes specifically Debye – Huckel Onsagar equation, Debye – Falkenhagen effect, Wein effect. CO2: To understand the Bjerrum Theory, principle and applications of catalysis, fuel cell and corrosion. CO3: Students would acquire the knowledge about basic understanding concepts of Applied Physical Chemistry concept. CO4: To get an overview of catalysis and its applications.
APCH-3. 4 (A)	**(Advanced Organic**	CO1: To get a brief idea about promising branches in chemistry like UV & IR Spectroscopy. CO2: To understand the NMR Spectroscopy, Mass spectroscopy, Carbon-13 NMR Spectroscopy its applications.

	Chemistry – I)	CO3: Students would acquire the knowledge about, to learn the principles, spectroscopic problems and its applications of various spectroscopic techniques. CO4: To know the basic aspects and idea of the spectroscopy.
APCHP – V	**Practical -V**	CO1: Students will get:Ability in professional sampling and sample treatment before actual analysis CO2: Ability to treat and evaluate the results of organic compounds. CO3: Understanding and capability of performing basic chemical processes in a chemical laboratory CO4: Capability of performing measurements on basic analytical instruments (p^Hmeters, spectrometers, colorimeter, chromatographs, ion-selective electrodes etc.)
APCHP – VI	**Practical-VI**	CO1: Students will get:Ability in professional sampling and sample treatment before actual analysis CO2: Ability to treat and evaluate the results of organic compounds. CO3:Understanding and capability of performing basic chemical processes in a chemical laboratory CO4: Capability of performing measurements on basic analytical instruments (p^Hmeters, spectrometers, colorimeter, chromatographs, ion-selective electrodes etc.)
Part-II semester-IV		
APCH4.1	**(Applied Inorganic Chemistry – II)**	CO1: To understand the concept of Infrared and Raman Spectroscopy and its problem CO2: This course will promote understanding about the microwave spectroscopy, CO3: Also to understand some microscopic characterization techniques such as Transmission Electron Microscopy [TEM]; High resolution Transmission Microscopy [HRTEM]; Scanning Electron Microscopy [SEM], Scanning Tunneling

		Microscopy [STM]. CO4: Also to gain skill of various characterization techniques in material science for research purposes.
APCH-4.2	**(Applied Organic Chemistry – II)**	CO1: Students will understand the concept building blocks of biomacromolecules. CO2: Students will have an idea regarding Classification, Structure and functions of different bioorganic molecules. CO3: The students will understand some fundamental aspects of applied organic chemistry. CO4: Student also will learn mechanism of some organic reactions, classification of pericyclic reactions, Heterocycles and uses of some commercial and natural substances.
APCH-4.3	**3 (Advance Organic Chemistry – II)**	CO1: To develop interest among students in advanced organic chemistry. CO2: To impart essential theoretical knowledge about aromaticity, Kinetic and thermodynamics, natural products and selected organic reactions and reagents. CO3: The students can apply their knowledge for synthesis of various natural products in their research. CO4: To aware about the natural resources of important natural products.
APCH-4.4	**4 (A) (Inorganic Chemical Industry)**	**CO1:** To learn the important aspects in inorganic chemical Industries such as special materials for electronic industry, fertilizer industry. **CO2:** To understand the concept of glass, ceramics and manufacturing of inorganic heavy chemicals. **CO3:** To know the various industrial applications of glass and ceramics and its applications. **CO4:** To understand the concepts of fertilizers and heavy inorganic chemicals and its industrial applications.
APCHP – VII	**Practical-VII**	CO1: Students will get ability in professional sampling and sample treatment before actual analysis CO2: Ability to treat and evaluate the results organic compounds and its purity CO3: Understanding and capability of performing basic chemical processes and spectroscopic techniques in a chemical laboratory

		CO4: Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes)
APCHP – VIII	**Practical-VIII**	CO1: Students will get ability in professional sampling and sample treatment before actual analysis CO2: Ability to treat and evaluate the results organic compounds and its purity CO3: Understanding and capability of performing basic chemical processes and spectroscopic techniques in a chemical laboratory CO4: Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes)