Estd. June 1964

"Education for Knowledge, Science and Culture."
– Shikshanmaharshi Dr. Bapuji Salunkhe
Shri. Swami Vivekanand Shikshan Sanstha's
VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)
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Department of Chemistry

Course Outcomes (COs): Chemistry

M.Sc. Part II Analytical Chemistry (Introduced in the year 2023-24)	
Semester III	
Advanced Analytical Techniques	
CO No.	**On completion of the course, student will be able to:**
CO1	Learn mass spectrometry by outlining its principles, historical context, compound-based classification, ionization techniques, and diverse mass analyser comparisons.
CO2	Understand the importance of nanomaterials and nanotechnology, distinguish between diverse nanomaterial dimensions, elucidate synthesis methods with examples, and evaluate application areas across fields.
CO3	Attain expertise in advanced microscopy techniques by comprehending working principles, recognizing practical applications, and distinguishing between methods based on strengths and limitations.
CO4	Gain comprehensive proficiency in a spectrum of spectroscopic techniques, encompassing principles, instrumentation, data analysis and practical applications.
Organo Analytical Chemistry	
CO No.	**On completion of the course, student will be able to:**
CO1	Develop a profound grasp of UV-Visible, IR, 1H-NMR, ^{13}C NMR, and Mass Spectrometry, encompassing fundamental principles, advanced organic analysis, and the ability to solve intricate structural determination challenges.
CO2	Proficiently classify drugs, pinpoint potential impurity sources in pharmaceutical raw materials, execute limit tests for Pb, As, Fe, and utilize a range of analytical techniques, including UV, colorimetric,

	and biological assays, for the comprehensive analysis of drugs and vitamins.
CO3	Gain a comprehensive knowledge of clinical analysis and enzyme assay techniques, showcase adeptness in collecting, preserving, and analysing physiological fluids, conduct estimations of key constituents in blood and urine samples, and effectively employ analytical methods for diagnosing diseases.
CO4	Engage in a comprehensive exploration of pesticide introduction, classification, and analysis, utilizing colorimetric and chromatographic techniques like GC-MS, HPLC-MS to examine pesticide residues, and the estimation of toxic substances such as lead, mercury, arsenic in biological samples for forensic applications.
Electroanalytical Techniques in Chemical Analysis	
CO No.	**On completion of the course, student will be able to:**
CO1	Develop a comprehensive comprehension of voltammetry principles, encompassing cyclic voltammetry, pulse voltammetry, and stripping voltammetry, for analyte determination and showcasing their real-world applications in analytical chemistry and research.
CO2	Understand the classification, properties, theories of charge origin, stability, factors influencing coagulation and spontaneous ageing of colloids, as well as differentiate types of emulsions, elucidating their preparation, properties, and demulsification methods.
CO3	Attain a thorough understanding of particle size analysis methodologies such as LASER light scattering, dynamic light scattering, and photosedimentation, including theoretical models like Mie theory and Fraunhofer diffraction theory and to apply diverse techniques like XRD, SEM, and TEM for real-world particle size measurements.
CO4	Explain different ion-selective electrode types, encompassing glass, solid-state, liquid-liquid membrane, enzyme, and gas electrodes, detailing their construction and applications.
Environmental Chemical Analysis and Control	
CO No.	**On completion of the course, student will be able to:**
CO1	Develop a comprehensive grasp of sampling theory, techniques, and criteria for gases, liquids, and solids; implement strategies to

	minimize variables during sampling and ensure efficient transmission and storage of collected samples.
CO2	Acquire expertise in performing comprehensive environmental analyses through a range of electrochemical techniques, including conductometry, potentiometry, cyclic voltammetry, amperometry, and coulometry, fluorescence spectrometry, inductively coupled plasma spectrometry, turbidimetry, and non-dispersive infrared analysis (NDIR) for diverse environmental applications.
CO3	Develop a comprehensive understanding of the chemistry, sources, characterization, and analysis methods for air pollutants, major minor components in potable and industrial water, conducting measurements for parameters including DO, COD, and BOD; and perform in-depth analyses of pollutants such as Pd, Cd, Hg, Cr, As in water, including quality assessments of organic and inorganic constituents in industrial wastewater.
CO4	Grasp the lifecycle of phenolic residues, including their sources, disposal, treatment, and analysis, with a focus on recovery methods from liquid effluents; adeptly conduct analysis of organomercurials, organochlorine pesticides, and volatile organic pollutants, employing suitable analytical methods.
Semester IV	
Modern Separation Methods in Analysis	
CO No.	**On completion of the course, student will be able to:**
CO1	Understand the advanced gas and liquid chromatographic techniques. They will be well-versed in the principles, instrumentation, working mechanisms.
CO2	Utilize hyphenated techniques, such as gas chromatography-mass spectrometry (GC-MS) and liquid chromatography-mass spectrometry (LC-MS), to enhance compound identification and quantification.
CO3	Apply their knowledge to practical scenarios and research projects. They will possess the skills to select appropriate chromatographic techniques based on the characteristics of analytes, separation requirements, and analytical objectives.
CO4	Grasp the modern extraction and separation techniques, including solid-phase extraction, solid-phase microextraction, sonic extraction, and accelerated solvent extraction.

Organic Industrial Analysis	
CO No.	**On completion of the course, student will be able to:**
CO1	Understand the various chemical analysis techniques used in the industrial context.
CO2	Perform quality control analyses and ensure compliance with regulations in various industries. They will be capable of analyzing raw materials, additives, and finished products to assess their composition, purity, and adherence to industry standards.
CO3	Understand the principles of various techniques such as chromatography, spectrophotometry, titration, and bomb calorimetry.
CO4	Develop problem-solving skills to address issues related to contamination, adulteration, impurity identification, and quality assurance.
Advanced Methods in Chemical Analysis	
CO No.	**On completion of the course, student will be able to:**
CO1	Understand the fluorescence and phosphorescence spectrophotometry. They will be able to explain the different types of luminescence, understand the theories behind fluorescence and phosphorescence, and discuss electronic transitions, solvatochromism, and solvation dynamics.
CO2	Adopt various kinetic methods of analysis. They will understand the theoretical basis behind kinetic techniques and be able to apply methods such as the Tangent Method, Fixed Time and Concentration Method, and Addition Method to determine the amount of substances in various samples.
CO3	Grasp the photoelectron spectroscopy and X-ray spectroscopy techniques. They will understand the basic principles of photoelectric effects, photoionization processes, Koopman's theorem, and the interpretation of photoelectron spectra.
CO4	Apply their knowledge of spectroscopic techniques to practical applications in analytical chemistry and research. They will understand how fluorescence sensing, synchronous spectra, and fluorescent nanomaterials can be utilized for specific analytical purposes.

Industrial Analytical Chemistry	
CO No.	**On completion of the course, student will be able to:**
CO1	Apply the various spectrochemical methods used for analytical purposes. They will understand the principles behind electronic spectra and molecular structure, be familiar with near-infrared (NIR) spectrometry for non-destructive testing, and comprehend the use of FTIR spectrometry, fluorometry, and optical sensors
CO2	Analyze metals and alloys. They will understand the composition analysis of foundry materials, ferroalloys, special steels, and various alloys like bronze, brass, Alnico, and Nichrome.
CO3	Understand the soil fertility determination, analysis of inorganic constituents in plant materials, and the chemical analysis as a measure of soil fertility. Students will be able to analyze fertilizers for their nutrient content and quality.
CO4	Understand the analysis of explosive materials such as TNT, RDX, lead azide, and EDNA. Additionally, students will be proficient in analyzing conducting polymers, resins, rubber, luminescent paints, lubricants, and adhesives, utilizing appropriate analytical techniques and methods.

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

Dr. (Mrs). S, D, Shirke
HEAD
DEPARTMENT OF CHEMISTRY
VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)