Ested-1969

KOYANA EDUCATION SOCIETIY'S

BALASAHEB DESAI COLLEGE, PATAN

Arts, Commerce, Science (UG &PG), B.C.A. & Vocational

Patan - 415206, Dist. - Satara (Maharashtra)

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NAAC :- 'A+' Grade

ISO 9001:2015 Certified

Principal

Dr. S. D. Pawar

M.A. Ph.D

Bachelor of Science (B.Sc.)

Department of Chemistry

Programme Outcomes (POs)

After completing B.Sc. degree programme, the students will be able to:

PO1: Offer theoretical as well as practical knowledge about different special subject areas.

PO2: Understand the academic field to pursue multi and interdisciplinary science careers in future that include Chemistry, Physics, Botany, Zoology, Mathematics, Microbiology and Computer Science.

PO3: Plan and execute experiments or investigations, analyze and interpret data information collected using appropriate methods.

PO4: Develop scientific temper and attitude which is more beneficial for the society as the scientific developments and make a nation or society to grow at a rapid pace through research.

PO5: Think critically; follow innovations and developments in science and technology.

PO6: Understand the issues of environmental contexts and sustainable development.

PO7: Acquire the skills and ability to engage in independent and life-long learning in the broadest context socio technological changes.

PO8: Demonstrate professional and ethical attitude with enormous responsibility to serve the society.

Programme Specific Outcomes (PSOs)

PSO1: Use the knowledge of Chemistry through theory and practical's.

PSO2: Identify the structure-activity relationship. **PSO3:** Explain good laboratory practices and safety.**PSO4:** Create the research-oriented skills.

PSO5: Use of sophisticated instruments/equipment's.

Course Outcomes (COs)

After completion of these courses students should be able to;

B. Sc. I Semester I

DSC-3A- Chemistry paper I (Inorganic Chemistry)

CO1: Explain the Bohr's theory of hydrogen atom and its limitations, Wave particle quality, Heisenberg uncertainty principle, Quantum numbers and their significance, Shape of s, p and d atomic orbitals.

CO2: Describe a) Aufbau's principle b) Hunds rule of maximum multiplicity c) Pauli's exclusion principle.

CO3: Predict the Periodicity of the elements.

CO4: Relate the Chemical Bonding and Molecular structure

CO5: Discuss Valence bond theory (VBT).

CO6: Compare the Molecular orbital theory (MOT) and Valence bond theory (VBT).

DSC-4A- Chemistry paper II (Organic Chemistry)

CO7: Describe Curved arrow notations, Cleavage of Bonds: Homolysis and Heterolysis Organic molecular species: Nucleophiles and electrophiles. Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyper conjugation effect

CO8: Explain Reactive Intermediates: Generation, Structure, Stability and Reactions of Carbocations, Carbanions and carbon free radicals.

CO9: Predict the Nomenclature of stereoisomers: D and L, erythro and threo, R and S, E and Z.

CO10: Discuss the Aromaticity concept and predict the Aromatic, Non aromatic,Anti-aromatic, Pseudoaromatic compounds.

CO11: Relate the Cycloalkanes, cycloalkanes and alkadienes.

CO12: Describe a) Photohalogenation b) Catalytic halogenations c)Catalytic hydrogenation d) Effect of heat e) Reaction with hydrogen halide.

B.Sc. I Semester II

DSC-4B-Chemistry Paper IV (Analytical Chemistry)

CO13: Explain Analytical processes (Qualitative and Quantitative), Methods of analysis (Only classification), Sampling of solids, liquids and gases, Errors, types of errors

CO14: Discuss the Basic Principle of Chromatography, Basic terms, Classification of Chromatography.

CO15: Comparison of paper chromatography and TLC

CO16: Outline of titrimetric Analysis such as Strong acid-strong base, Strong acid-weak base, Strong base-weak acid, Complexometric titrations.

CO17: Use and Applications Water Analysis.

CO18: Explain the Analysis of Fertilizers.

Chemistry-DSC 3B: Chemistry Paper-III (Physical Chemistry)

CO19: Explain the First law of thermodynamics, Statements of second law of thermodynamics, Carnot's cycle and its efficiency, Statement of Third Law of thermodynamics

CO20: Solve the Problem based on thermodynamics

CO21: Discuss the Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution.

CO22: Compare between ΔG and ΔGo, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.

CO23: Relate Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Ideal and Non ideal gases.

CO24: Illustrate Deviation of real gases from ideal behavior, compressibility factor, causes of deviation. Van der Waals equation of state for real gases.

CO25: Find the Derivation of Zero order reaction, first order reaction, Pseudo-unimolecular reactions, second order reaction.

B.Sc. Part II (CBCS) Sem III

Paper No. DSC- C3 - Chemistry paper no. V (Physical Chemistry)

CO26: Discuss Types of conductors, Conductivity, Equivalent and Molar conductivity and their variation with dilution for weak and strong electrolytes in aqueous solution

CO27: Illustrate the conductance by using Wheatstone bridge. Kolharausch law of independent migration of ions and its applications such as Ionic mobility, determination of degree of ionization of weak electrolyte, solubility and solubility products.

CO28: Describe all Physical Properties of Liquids and Third order reactions, derivation ofrate constant.

CO29: Explain the Adsorption as a surface phenomenon, Definition of adsorption, adsorbent, adsorbate, absorbent. Factors affecting adsorption, Types of adsorption

CO30: Compare between physical and chemical adsorption, Adsorption isotherms:Freundlich adsorption isotherm, Langmuir adsorption isotherm.

CO31: Outline of Types of Nuclear radiation, properties of α, β and γ radiations, Detectionand measurement of nuclear radiations by Scintillation and Geiger muller counter methods.

Paper No. DSC-C4- Chemistry paper no. VI (Industrial Chemistry)

CO32: Explain the Basic Concepts in Industrial Chemistry

CO33: Compare between classical chemistry and industrial chemistry.

CO34: Find the Normality, Equivalent weight, Molality, Molecular weight, Molarity, Molarity of mixed solution.

CO35: Describe the method of Size reduction- Principle, Jaw crusher, ball mill, Size Enlargement Principle, Pellet mill, tumbling agglomerators.

CO36: Discuss the Theory of Corrosion and Elecroplating.

CO37: Use and Manufacturing Paper Industry and Soaps and Detergent

B.Sc. Part II (CBCS) Sem IV

Paper No. DSC-D3- Chemistry paper no. VII (Industrial Chemistry)

CO38: Describe the concept in Co-ordination chemistryCO-39.Compare between doublesalt and complex salt

CO40: Find the IUPAC nomenclature of coordination compoundsCO-41.Explain the Chelation, classification and its applications.

CO-42: Outline of P- Block elementsand its characteristics.

CO43: Discuss the Characteristics of d-block elements with special reference to i) Electronic structure ii) Oxidation states, stability of oxidation states of Fe with respective to Latimer diagram iii) Magnetic character iv) Colored ions v) Complex formation.

CO44: Find the Application of complex formation

Paper No. DSC- D4 - Chemistry paper no. VIII (Organic Chemistry)

CO45: Explain the reaction and methods of Preparation of Carboxylic acids and their derivatives.

CO46: Describe the Classification, Nomenclature, structure, Methods of preparation and reactions of Amines and Diazonium Salts.

CO47: Compare the reducing and non-reducing sugars.CO-48.Discuss the Classification of carbohydrates.

CO49: Relate the Reactivity of Carbonyl group and categorize its reactions.

CO50: Outline of Representation of conformations of ethane by using Saw- Horse, Fischer (dotted line wedge) and Newmann's projection formulae and ethane andn-butane by Newmann's Projection formula.

B. Sc III Chemistry Semester-I

After completion of these courses students should be able to;

Paper XI Physical Chemistry

CO51: Describe Heisenberg Uncertainty Principle, concept of energy operator, particle in one dimensional box.

CO52: Define Quantum theory, explain Schrodinger wave equation, emf measurement and its application.

CO53: Analyze electromagnetic spectrum, Raman Spectra compare and contrast rotational spectra, vibrational spectra, vibrational Raman spectra and rotational Raman spectra of diatomic molecule.

CO54: Write Photochemical Law's, reactions and various Photochemical Phenomena.
CO55: Classify solutions, relation vapour pressure temperature relations.
CO56: Compare between electrodes and cells.

Paper IX Inorganic Chemistry
CO57: Find the meaning of various terms involved in Acids and Bases.
CO58: Describes the shapes of d-orbitals.
CO59: Discuss the Applications of Semiconductor and Superconductors.
CO60: Predict the mechanism involved in Organometallic Chemistry.
CO61: Explain the homogenous catalysis and heterogeneous catalysis.
CO62: Predict the degeneracy of d-orbitals.

Paper X Organic Chemistry
CO63: Describe the principle of UV Spectroscopy.
CO64: Impart the concept of vibrational Transitional region of IR Spectrum.
CO65: Illustrate the Structure of Unknown Organic compounds.
CO66: Compare between UV and NMR.
CO67: Explain the principle of mass spectroscopy.
CO68: Solve the problem based on UV, NMR and IR.

Paper XII Analytical Chemistry
CO69: Explain the Precipitation Techniques.
CO70: Discuss the applications of organic precipitants.
CO71: Explain the Principle of flame photometry.
CO72: Design the experimental set up for flame photometry.
CO73: Describe the theory of Colorimetry and spectrophotometry.
CO74: Identify the concept of Quality control.
CO75: Categorized the different functional group based on Chromatography.

B. Sc III Chemistry Semester-II
Paper XIII Inorganic Chemistry
CO75: Explain SN 1 and SN 2 reactions for inert and labile complexes.
CO76: Describe the Thermodynamic and Kinetic aspects of metal complexes.
CO77: Discuss the Nuclear reactions and energetic of nuclear reactions.
CO78: Use of Thorium, Uranium and Plutonium in atomic energy.
CO79: Compare between lanthanide and actinides.
CO80: Predict Biological role of alkali and alkaline earth metal ions with special reference to Na+, K+ and $Ca^{2+.}$

Paper No. XIV Organic Chemistry
CO81: Use and application Lithium aluminium hydride LiAlH4, Raney Nickel, Osmium tetraoxide, Selenium dioxide (SeO2),Dicyclohexyl Carbodiimide (DCC), Diazomethane.
CO82: Explain the Diels -Alder reaction, Meerwein –Pondorff-Verley reduction, Hofmann rearrangement, Wittig reaction,Wagner- Meerwein rearrangement,

Baeyer Villiger oxidation.

CO83: Discuss the Retrosynthesis of different Molecules.

CO84: Describe Electrophilic addition to >C=C< and −C≡C− bonds.

CO85: Solve the problem based on addition reaction.

CO86: Impact the concept of Anti-Markovnikoff's addition.

CO87: Explain Synthesis and uses of ethambutal, phenobarbitone, isoniazide, benzocaine, Chloramphenicol, paludrine.

CO88: Outline the biogenesis of Alkaloids, Terpenoids.

Chemistry Paper No. XV (Physical Chemistry)

CO89: Discuss Gibbs phase rule, Phase diagram, true and metastable equilibria.

CO90: Compare one component systems and two component systems.

CO91: Describe the concept of Thermodynamics and its applications

CO92: Explain the different State of solid, Laws of crystallography, Weiss indices andMiller indices.

CO93: Solve the Numerical problems based on Derivation of Bragg's equation.

CO94: Predict the Simultaneous reactions such as Opposing reaction, Sidereaction, Consecutive Reactions, Chain reaction, Explosive reaction.

Paper No. XVI (Industrial Chemistry)

CO95: Discuss Manufacture of cane sugar in India: Extraction of juice, Clarification, Concentration, crystallization, centrifugation and other details of industrial process.

CO96: Explain the Manufacture of Industrial Heavy Chemicals.

CO97: Describe the use, Classification and applications of Synthetic Polymers.

CO98: Categorized the different term involved in nanotechnology.

CO99: Impart the role of Petroleum industry and eco-friendly fuels.

CO100: Identify the concept of Nanotechnology.

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Programme Outcomes (POs)

After completing M.Sc. degree programme, the students will be able to:

PO1: Think creatively to propose novel ideas in explaining facts and figures or providing new solution to the problems in chemistry.

PO2: Realize how developments in any science subject helps in the development of other science .

PO2: Imbibe ethical, moral and social values in personal and social life leading to highly cultured, civilized personality and positive attitude.

PO4: Build a scientific temper, attitude and will be able to learn the necessary skills to succeed in research or industrial field.

PO5: Develop various communication skills such as reading, listening, speaking, etc., which we will help in expressing ideas and views clearly and effectively.

PO6: Understand the issues of environmental contexts and sustainable development.

Program Specific Outcomes (PSOs)

PSO1: Students will be able to prepare and qualify subject specific competitive exams like NET,SET and GATE and also other general public administration exams like M.P.S.C. and U.P.S.C.etc. exams.

PSO2: Student will be able to utilize the knowledge and analytical skills in QA-QC and R&D departments in almost all the industries enabling them to secure jobs where analytical chemistry is the core requirement to ensure and ascertain the quality of the product.

PSO3: Students will have opportunity for higher education leading to Ph.D. program.

PSO4: Students will be able to explore contemporary research in chemistry and allied fields of science and technology, collaborate in team projects, and communicate the results of scientific work in oral, written and electronic formats to both scientists and the public at large.

PSO5: Students can start their own laboratories/startups/ chemical industry/ business (entrepreneurship).

PSO6: Students will be able to interpret data from the state of art Analytical instruments for ascertaining the product/material.

Course Outcomes (COs)

Sem I CH-101: Inorganic Chemistry-Paper I

CO1: Understand wave nature of electron, wave equation, partical in one dimensional box.

CO2: Understand VSEPR theory, geometry and shape of the molecule

CO3: Study of transion elements their properties & Co-Ordination chemistry, Lern bioinorganic chemistry.

CO4: Understand electrical & optical behavior of inorganic material & their application.

CH -102 : Organic Chemistry Paper II

CO5: Understand structure ,generation , reactivity, &stability of reactive intermediate.

CO6: Understand SN1, SN2 and SN1 mechanism with respect to mechanism & stereochemistry.

CO7: Understand aromatic electrophilic & nucliophilic substitution reaction

CO8: Understand reaction ,mechanism &applications of E1,E2,E1Cb &some name reactions.

CO9: Understand stereo chemical principles, enantiomeric relationship R and S ,E and Z, stability reactivity of cyclohexene derivative

CO10: Compare the differ between types of addition, elimination and substitution reaction.

CO11: Learn and solve problem type of elimination

CH-1: 103: Physical Chemistry Paper III

CO12: Understand the thermodynamic of ideal & non ideal solution,Maxwell relation, thermodynamic equation of state,Gibbs-Duham equation & Its application to study of partial molar quantities.

CO13: Understand the statistical thermodynamics and various partition functions.

CO14: Study of basic terms related to surface phenomemon& its applications.

CO15: Understand the terminologyof biophysical chemistry its thermodyanamics & Michaelis-Menten equation,

CH-IV: Analytical Chemistry-I Paper IV

CO16: Know the different types errors, accuracy, precision treatments and different terms of analytical chemistry and types of sampling of matter.

CO17: Know terms, types, preparation, characterizations and applications of nanomaterials.

CO18: Know the different types of chromatographic techniques and its applications.

CO19: Know theory, instrumentation and applications of polarography and amperometry.

CO20: Know use of hardware and software, data representation, flow chart and witting simole programme like FORTRAN and C languages used in analytical chemistry

Practical M. Sc I Sem I (Practical-I)

CH-P-1 : Physical Chemistry Practical

CO21: Determination of binary mixture of weak acids and strong acid by potentiometry.

CO22: determine concentration of acid and their strength in given mixture of acid by conductometry.

CO23: Inversion of cane sugar by polarimetry

CO24: cpartial molar volume of solvent.

CO25: Study of catalyst in chemical kinetics.

Inorganic Chemistry

CO26: know Ore analysis – ‘2’ ores

CO27: know alloy analysis – '2' (Two and three components)
CO28: know Inorganic Preparations and purity of inorganic samples..

Oragnic Chemisty Practicals

CO29: Know One stage preparations involving various types of reactions Preparations, 1.Oxidation: Adipic acid by chromic acid oxidation of Cyclohexanol.

CO30: Aldol condensation: Dibenzal acetone from Benzaldehyde. 3.Sandmeyer reaction: p- Chlorotoulene from p-Toluidine. 4.Cannizzaro reaction: 4-chlorobenzyldehyde as a substrate.5.Aromatic Electrophilic substitutions: Synthesis of p-Nitroaniline and p- Bromoaniline. 6.Preparation of Cinnamic acid by Perkin's reaction.7.Knoevenagel condensation reaction 8.Coumarin Synthesis

CO31: know estimation of 1.Estimation of unsaturation. 2.Estimation of formalin. 3.Colorimetric Estimation of Dyes 4.Estimation of Amino acids

Practicals in Analytical Chemistry. (Practical-II)

CO32: know verify Beer-Lambert's Law for potassium permanganate solution and hence to determine the molar extinction coefficient and unknown concentration of given sample colorimetrically

CO33: know determination of the solubility of calcium oxalate in presence of KCl (Ionic Strength Effect)

CO34: know determination of the solubility of calciuum oxalate in presence of HCl (H+ ion Effect)

CO35: know of Analysis of Pharmaceutical tablets.

CO36: know verify the Beer-Lamberts Law and determine the concentration of given dye solution colorimetrically.

CO37: know estimation of the amount of D-glucose in given solution colorimetrically.

CO38: know determination of the acid value of given oil

CO39: Know determination of of sodium from the fertilizer sample using cation exchange chromatographically.

CO40: Know determination of calcium from given drug sample.

CO41: know determination of of hardness, alkalinity and salinity of water sample

CO42: know separation and estimation of chloride and bromide on anion exchanger.

M.Sc.I Sem II

CH:V-Inorganic chemistry Paper V

CO43: Learn mechanism in non transition metal complexes.

CO44: Learn of coordination chemistry of organometalic compounds & organic synthesis , **16 & 18** electron rule,factor affecting stability of metal complex

CO45: Understand the spectral magnetic properties& applications of lanthanide & actinides

CO46: Understand the nuclear reaction & chemical effect of nuclear transformation

.

CH-VI Organic Chemistry Paper VI

CO47: learn various name reaction with example.

CO48: Study of alkylation & acylation of active methylene compounds &applications.

CO49: study of oxidation and reduction for solving the example.

CO50: understand protection of various functional group. .

CO51: learn methodologies of organic synthesis &study of organometallic compound.

CH-P-VII: Physical Chemistry Paper VII

CO52: Understand the termanalogies of and postulates of quantum mechanics,application electronic spectra of conjugated linear organic molecules.

CO53: Understand mechanics of particle in one, two and three dimensional box.
CO54: Study of basic concepts,Jablonski diagram & photochemical process.
CO55: Understand the terms ionic strength, activity coefficient .DH limiting equation,Bjerrum Theory,acid & alkaline storage batteries.
CO56: Study of SSA & its applications,homogeneous & heterogenious catalysis & its kinetics Paper.

CH-VIII: Analytical Chemistry- Paper VIII
On completion of the course, M.Sc.I student will able to
CO57: Know basics terms, Woodward Fisher rule and calculation of λmax in UV spectroscopy.
CO58: Know basics terms, different types of vibrations, factor affecting on IR frequencies and frequencies of different functional groups in IR Spectroscopy
CO59: Know basics terminologies involved in NMR spectroscopy.
CO60: Know basics terms, and fragmentation of organic compounds involved in Mass spectroscopy.
CO61: Learn Physical methods of structure elucidation which includes IR, UV, NMR & Mass Spectroscopy
CO62: Understand theory, instrumentation, working and application of Nephelometry and turbidometry.
CO63: Know the radiochemical analysis using NAA, GM,and scintillation counter.

CH-P-1 : Physical Chemistry Practical III
CO64: Application of Onsagar equation by conductometry.
CO65: Determine concentration of acid and their strength in given mixture of acid by conductometry.
CO66: Determine of amount of halide in given mixture by conductometry.
CO67: Constriction of phage diagram of mixture of solvent.
CO68: Study of catalyst in chemical kinetics.
CO69: Decomposition of H_2O_2 and catalyst effect and rate constant.

CH:I & II: Practical Inorganic chemistry Practical III
CO70: Perform Ore analysis gravimetrically and volumetrically
CO72: Analyze alloy gravimetrically and volumetrically
CO73: Prepare various inorganic complexes and determination of its Percent purity

CH-IV Practical course IV
Organic Chemistry Practical
CO74: Know the technique of ternary organic mixture separation by using ether solvent..
CO75: Know the recovery of the separated organic compounds
CO76: Know the complete analysis of individual organic compound.
CO77: Know the confirmation of separated organic compound by preparing its derivatives.
CO78: Make use steam distillation assembly for Purification of organic compound.
CO79: know Ore analysis – '2' ores
CO80: know alloy analysis – '2' (Two and three components)
CO81: know Inorganic Preparations and purity of inorganic samples.

Organic Chemistry Practicles
CO82: Know qualitative analysis: Separation and identification of the two component mixtures using Chemical and physical methods.

CO83: Know Thin layer chromatography (TLC).
CO84: Know Column chromatography and steam distillation techniques.
CO85: Know Determination of percentage of Keto-enol form.
CO86: Know Estimation of pesticides
CO87: Application of Onsagar equation by conductometry.
CO88: determine concentration of acid and their strength in given mixture of acid by conductometry.
CO89: Determine of amount of halide in given mixture by conductometry.
CO90: constriction of phage diagram of mixture of solvent.
CO91: Study of catalyst in chemical kinetics.
CO92: Decompositation of H_2O_2 and catalyst effect and rate constant.

Practicals in Analytical Chemistry. Practical IV

Physical Chemistry Section

CO93: know the estimation of the amount of NH4Cl colorimetrically using Nesseler's Reagent.
CO94: know determination of the solubility of lead iodide in presence of varying concentration of salt KCl.
CO95: know determination of the solubility of lead iodide in presence of varying concentration of salt KNO_3 (Any other experiments may be added)

Organic Chemistry Section

On completion of the course, M.Sc. I student will able to
CO96: know analysis of pharmaceutical tablets: Ibrufen / INAH
CO97: know Colorimetric estimation of drugs.
CO98: know Preparation of pesticides.
CO99: know column and thin layer chromatography

Inorganic Chemistry Section

On completion of the course, M.Sc. I student will able to
CO100: know determination of the amount of copper in brass metal alloy colorimetrically.
CO101: Know the separation and estimation of Copper and Cobalt on cellulose Column.
CO102: know Separation and estimation of Nickel and Cobalt on a anion exchanger.
CO103: know Separation and estimation of Iron and aluminium on a cation exchanger.

Physical Chemistry Section

CO104: know the estimation of the amount of NH4Cl colorimetrically using Nesseler's Reagent.
CO105: know determination of the solubility of lead iodide in presence of varying concentration of salt KCl.
CO 206 know the determination of the solubility of lead iodide in presence of varying concentration of salt KNO3 (Any other experiments may be added)

Part-II Semester-III

ACH-3.1 (Advanced Analytical Techniques)

CO166: Develop knowledge of fundamental, instrumentation and working of state of art instrumental analytical techniques, effective use and choice of technique, written and/or oral communication of the concepts of analytical chemistry which will be useful as analytical chemist and R&D.

CO167: Acquire knowledge of mass spectrometry, type of MS, ionization types and specific Practical applications of MS.
CO168: Acquire knowledge of basics of nanochemistry, nanomaterials and nanotechnology and Application orientated synthesis and characterization of

nanomaterials.

CO169: This course gives wide understanding about the instrumental analytical techniques (SEM, TEM,EDS, STM, AFM, Raman, XFS, ESR, XPS, AES, SIMS etc.)employed for qualitative and quantitative Analysis for contemporary research

ACH-3.2 (Organic Analytical Chemistry)

CO170: Students will gain knowledge of the instruments used at the interface of Analytical-Organic Chemistry useful for R&D and structural elucidation using UV-Visible, IR, 1H & 13C NMR, Mass spectrometry data and interpretation of the same.

CO171: Students will acquire knowledge about the drug, their classification, sources of impurities(Chemical, atmospheric and microbial contamination) in pharmaceutical raw materials and analysis of the same.

CO172: Students will gain knowledge about the conventional and advanced analytical approaches For Analysis of drug, vitamin, body fluids and clinical samples.

CO173: Students will have an idea of commonly used pesticides and their analysis and also about Forensic Science and forensic sample analysis.

ACH- 3.3: (Electro analytical Techniques in Chemical Analysis)

CO174: Fundamental knowledge of electrochemistry, electrodes, types of electrodes, its construction Will Lay foundation for the course.

CO175: Students will gain knowledge and skill in electro analytical techniques like cyclic voltammetry And its types, polarography, coulometry and dynamic light scattering technique for qualitative and Quantitative analysis.

CO176: Students will be familiar with the advanced electrodes used for chemical analysis, liquid-liquid membrane electrodes, enzymes and gas electrodes.

CO177: Students will learn about electrophoretic techniques, advances in electrophoresis techniques and its analytical applications.

ACH-3. 4) (A) (Environmental Chemical Analysis and Control)

CO178: Students will acquire knowledge about sampling, criteria of good sampling, handling, Preservation and storage of the samples, pretreatment and post treatment of samples.

CO179: Students will acquire knowledge of conditions and strategies required during sampling and electrochemical and spectral methods for analysis of environmental samples.

CO180: Students will learn about the air and water pollution, sources of pollution, typical parameters and properties (physical, chemical and biological) to be measured in air and water pollution with relevance to specific case studies. Students will be acquainted with organic pollutants and their analysis with special reference to pesticide analysis.

ACH-3.4) (B) (Recent Advances in Analytical Chemistry)

CO181: Students will be acquainted with ultra purity and ultra trace analysis required in electronic and semiconductor processing.

CO182: Students will learn Radio-Analytical techniques for analysis.

CO183: Student will be well versed with C13, P15 and O17 NMR Spectroscopy applications.

CO184: Student will learn about ESR spectrometry and its applications quantitative

analysis. .

ACHP – V Practical -V

CO185: In-depth training on laboratory solution preparations on all concentration scales
CO186: Training on laboratory safety and lab ethics in scientific work
CO187: Training on planning, design and execution of experiments
CO188: Training on uncertainty estimations for experimentally measured and derived properties of solutions

ACHP – VI Practical-VI
CO189: Training on scientific literature search, defining the objective of the work, research skills, data representation in tabular and graphical form etc.
CO190: Training on experimental verification of fundamental theories, comparison of data with literature and scientific discussion on any deviation of data from expected theoretical values or reported literature.
CO191: Developing analytical skills
CO192: Training on qualitative and quantitative analysis of analyst.

Part-II semester-IV
ACH 4.1 (Modern Separation Method in Analysis)
CO193: Students will learn about modern separation and chromatographic used for analysis of different Type of samples.
CO194: The student will understand instrumentation and mechanism of various separation techniques.
CO195: Student will acquire knowledge regarding various choices of instrument and detectors to be used for analysis depending on the sample and matrix.
CO196: Student will learn fundamentals of extractive chromatography, types of extraction techniques, advances in extraction methods and their hyphenations with chromatography leading to addressing challenging problems in analytical chemistry.

ACH-4.2 (Organic Industrial Analysis)
CO197: Acquire knowledge of handling and investigating the characteristics of the oils, fats, detergents and soap samples and analysis of the same providing opportunity in cosmetic, pharmaceuticals, dyes and polymers industries.
CO198: Student will gain knowledge and importance of food quality, probe for food adulteration and adulterants, food preservative, food flavors and analysis of their components.

CO199: Students will also gain knowledge about the animal food stuff and the additives added in the animal food stuff as antibiotics, dietary supplements and growth promoting drugs, preservatives etc. and analysis of the same.

CO200: Student will learn about the analysis of cosmetics, face powder, hair dyes and hair care products, types of cosmetics, precautionary measures and composition of the cosmetics and specific roles of the ingredients. Will acquire knowledge about the paints, pigments and petroleum products, composition and analysis of the same using conventional and instrumental techniques.

ACH- 4.3 (Advanced Methods in Chemical Analysis

CO201: Students will be skilled in the techniques like fluorescence, phosphorescence, types of quenching, FRET and applications of the same in Analytical Chemistry and for addressing research problems.

CO202: Students will gain knowledge of the kinetic methods of analysis supporting the analysis and data procured in research.

CO203: The students will acquire the knowledge of advanced method of chemical analysis XPS, XRF, fluorescence and phosphorescence spectroscopy which will be beneficial in research.

CO204: Students will acquire knowledge of identifying types of plastic and will also be able to and determination of metallic impurities in plastics

ACH-4.4 (A) (Industrial Analytical Chemistry)

CO205: The students will acquire knowledge of analysis of metals, alloys, minerals and ores commonly Used in the industry.

CO206: The students will be acquainted with the analysis of real samples like cement, plaster of Paris, different commercial ores, soil composition, soil fertility, fertilizers etc using conventional and instrumental methods of analysis.

CO207: Students will also gain the knowledge of analysis of commercial materials, explosives, polymers, resins, rubber, luminescent paints, lubricants and adhesives.

CO208: These would offer opportunity to the students to get employment in industries for quality assurance and quality control (QA-QC) of the product.

ACH-4.4 (B) (Quality Assurance and Accreditation)

CO209: Students will acquire knowledge of QA-QC which in essential for analytical chemist, This covers a variety of chemical fields and this knowledge would help students working on various materials, understanding the basics of samples, sampling, sample storage, and pre-post treatment of samples.

CO210: Students will acquire knowledge of good laboratory practices, professional ethics, and instrumental analytical chemistry, awareness of health hazards, remedial measures, analytical method development and validation.

CO211: The students would be aware of the importance of documentation for raw materials and finished products, their monitoring, maintenance and management. World-wide agencies involved in regulating the analytical protocols and establishing standards.

CO212: Students will gain knowledge about the quality assurance and accreditation, evolution and significance of quality management, available accreditation agencies and advantages of accreditation.

ACHP – VIII Practical-VIII

CO213: The students will acquire hands on training for conducting the representative experiments for the analysis of wide variety of samples of inorganic, organic and physical approaches by qualitative and quantitative analysis. Demonstrate professional and ethical attitude to serve the society

CO214: Students will have knowledge of safety signs on container of chemicals, safety in handling of chemicals, MSDS sheets; learn sample preparation and

characterization for confirming the purity.

CO215: Students would acquire knowledge about the separation and estimation of amount of metal, metal ions, organic compounds etc. in given samples.

CO216: Based on the experience of project work, students will have ability to start their R & D laboratory