

KTSP Mandal's
Hutatma Rajguru Mahavidyalaya, Rajgurunagar
Science Faculty

Program Outcome:

1. Students should be able understand basics of Physics, Chemistry, Botany, Zoology, Mathematics and Statistics.
2. Students should be able to understand theory behind the laboratory experiments of Physics, Chemistry, Botany, Zoology, Mathematics and Statistics.
3. Students should be able to communicate the scientific ideas effectively.
4. Students should be to develop the communication skills, personality development, and interview techniques.
5. Students should be able to preparation of application for job, presentation techniques.
6. Students should be able to develop the thinking power in scientific problems.
7. Students should be able to develop in such a way to handle unexpected situation.
8. Arrange the campus interview of national and multinational companies.
9. Arrange the program such that, How to face the interview in government and non government offices.
10. Training for MPSC/UPSC/Banking examination.
11. Develop the social awareness, environmental awareness.
12. Develop the ethical, moral and social values in personal.
13. Develop the innovation and development skill in science.
14. Students should be able to prepare the project and project writing skill.
15. Students should be able to develop business ideas and skill.

Department of Chemistry

B.Sc. Chemistry

Programme Outcomes (PO's)

After successful completion of three year degree program in chemistry a student should be able to;

1. Understand the central role of chemistry in our society and use as a basis for ethical behavior.
2. Provide foundation in the fundamentals & application of current chemical & scientific theories.
3. Impart skills in planning and conducting advanced chemical experiments & applying structural-chemical characterization.
4. Prepare laboratory reports that provide a description of the experiment & reasoning clearly.
5. Identify, formulate, analyze & solve problems in the analysis of chemical compounds.

Programme Specific Outcome (PSO's)

1. Student will have knowledge about fundamentals chemical and scientific theories and their applications.
2. Students familiar with the different branches of chemistry like Organic, Inorganic, Physical, Industrial, Medicinal, Analytical, Forensic, Environmental, Biochemistry.
3. Student able to prepare sample for solution preparation, prepare solution of various concentration for synthesis and analysis purpose
4. Students able to find procedure form literature to synthesize separate & purify compounds in laboratory and characterize using proper instrumentation techniques.
5. Understand the causes of environmental pollution and aware about steps to control Environmental Pollution.
6. Develops analytical and problem-solving skills among student.

7. Student able to use appropriate techniques for the qualitative and quantitative techniques for Chemical Analysis.

8. Use of Chemistry software's useful in future career such as Research, Industries & Academia.

Class	Semester	Paper no. & code	Subject	Course outcome
F. Y. B. Sc.	I st	1 and CH101	Physical Chemistry	At the end of course student, 1. Students will be able to apply thermodynamic principles to physical and chemical process Calculations of enthalpy, Bond energy, 2. Bond dissociation energy, resonance energy. 3. Variation of enthalpy with temperature – Kirchoff's equation. 4. Third law of thermodynamic and its applications. 5. Relation between Free energy and equilibrium and factors affecting on equilibrium constant. 6. Exergonic and endergonic reaction. 7. Gas equilibrium, equilibrium constant and molecular interpretation of equilibrium constant. 8. Van't Haff equation and its application. 9. Concept to ionization process occurred in acids, bases and pH scale. 10. Related concepts such as Common ion effect hydrolysis constant, ionic product, solubility product. 11. Degree of hydrolysis and pH for different salts, buffer solutions.
		2 and CH102	Organic Chemistry	At the end of course student, 1. The students are expected to understand the fundamentals, principles, and recent developments in the subject area. 2. It is expected to inspire and boost interest of the students towards chemistry as the main subject. 3. To familiarize with current and recent developments in Chemistry. 4. To create foundation for research and development in Chemistry.

		3 and CH103	Chemistry Practical Course I	At the end of course student, 1.Importance of chemical safety and Lab safety while performing experiments in laboratory 2.Determination of thermochemical parameters and related concepts 3.Techniques of pH measurements 4.Preparation of buffer solutions 5.Elemental analysis of organic compounds (non instrumental) 6.Chromatographic Techniques for separation of constituents of mixtures
F. Y. B.Sc.	II nd	1 and CH201	Inorganic Chemistry	At the end of course student, 1.Understand quantum mechanical approach to atomic structure 2. Know periodicity of elements 3.Understand theories for chemical bonding. 4. Know the various types of bonds 5. Types of hybridization 4. Discuss assumption and need of VSEPR theory.
		2 and CH202	Analytical Chemistry	At the end of course student, 1.Know about basics of analytical chemistry. 2.Know some analytical techniques of analysis. 3.Define term mole, milimole, molar concentration, molar equilibrium concentration and Percent Concentration. 4. Qualitative analysis of organic compounds-type determination, element detection, purification techniques 4.Understand theoretical background for Paper and Thin Layer Chromatography. 5. Application of pH meter
		3 and CH203	Chemistry Practical –II	At the end of course student, 1.Aware with Inorganic Estimations using volumetric analysis 2.Able to synthesize some Inorganic compounds by following given procedure 3.Analyze commercial products available in the market 4.Able to purify organic compounds.
S. Y. B.Sc.	III rd	1 and CH301	Physical and Analytical	At the end of course student, 1. Explain concept of kinetics, Rate of

			Chemistry	<p>reaction, rate laws, and order.</p> <p>2. Derive integrated rate laws, expression for half-life and examples of zero order, first order, and second order reactions, Graphical method, Energy of activation, Arrhenius equation</p> <p>3. Define adsorption, classification of given processes into physical and chemical adsorption, Classification of adsorption isotherms, Langmuir adsorption isotherm, Freundlich's adsorption, BET Theory.</p> <p>4. Discuss the types of volumetric analysis methods –Neutralisation titrations, complexometric titrations, Redox titrations, Precipitation titration</p> <p>5. Apply volumetric methods of analysis to real problem in analytical chemistry.</p> <p>6. Define and explain the meaning of accuracy and precision, solved problems based on standard deviation.</p>
		2 and CH302	Inorganic and Organic Chemistry	<p>At the end of course student,</p> <p>1. Explain molecular orbital theory, Werner's theory of coordination compounds</p> <p>2. Define different terms related to molecular orbital theory and coordination chemistry 147</p> <p>3. Explain synthesis of aromatic hydrocarbons, mechanism of reactions involved.</p> <p>4. Explain important reactions of aromatic hydrocarbon.</p> <p>5. Write / discuss the mechanism of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.</p> <p>6. Identify and draw the structures alcohols / phenols from their names or from structure name can be assigned.</p>

		3 and CH303	Practical Chemistry-III	<p>At the end of course student,</p> <ol style="list-style-type: none"> 1. Correlate theory to experiments. 2. Understand systematic methods of identification of substance by chemical methods. 3. Perform organic and inorganic synthesis and trace chemical reaction by suitable method i.e. (colour change, ppt. formation, TLC). 4. Set up the apparatus / prepare the solutions - properly for the designed experiments. 5. Perform the quantitative chemical analysis of substances explain principles behind it. 6. Systematic working skill in laboratory will be imparted in student.
	IV th	1 and CH401	Physical and Analytical Chemistry	<p>At the end of course student,</p> <ol style="list-style-type: none"> 1. Define the terms in phase equilibria such as- system, phase in system, components in system, degree of freedom, one / two component system, phase rule, etc. 2. Explain thermodynamic aspects of Ideal solutions-Gibbs free energy change, Volume change, Enthalpy change and entropy change of mixing of Ideal solution. 3. Explain solubility of partially miscible liquids- systems with upper critical. Solution temperature, lower critical solution temperature and having both UCST and LCST. 4. Define different terms in conductometry such as electrolytic conductance, resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, Kohlrausch's law, etc. 5. Apply conductometric methods of analysis to real problem in analytical laboratory. 6. Explain terms in Colorimetry such as radiant power, transmittance, absorbance, molar, Lambert's Law, Beer's Law, molar absorptivity 7. Apply colorimetric methods of analysis

				to real problem, analysis in analytical laboratory.
		2 and CH402	Inorganic and Organic Chemistry	At the end of course student, 1. Explain different types of isomerism in coordination complexes. 2. Apply principles of VBT to explain bonding in coordination compound of different geometries, limitation of VBT. 3. Explain principle of CFT. 4. Explain spectrochemical series, tetragonal distortion / Jahn-Teller effect in Cu (II) Oh complexes. 148 5. Explain structure, synthesis, mechanism reactions aldehydes and ketones, carboxylic acids and their derivatives, amines and cyclohexane. 6. Give synthesis diazonium salt from amines and reactions of diazonium salt.
		3 and CH403	Practical Chemistry-IV	At the end of course student, 1. Correlate the theory to the experiments. Understand / verify theoretical principles by experiment or explain practical output with the help of theory. 2. Understand systematic methods of identification of substance by chemical methods. 3. Write balanced equation for all the chemical reactions performed in the laboratory. 4. Perform organic and inorganic synthesis and able to follow the progress of the chemical reaction. 5. Set up the apparatus properly for the designed experiments. 6. Perform the quantitative chemical analysis of substances and able to explain principles behind it.
T. Y. B. Sc.	V th	1 and CH501	Physical Chemistry-1	At the end of course student, 1. Know historical of development of quantum mechanics in chemistry and understand terms involved in quantum chemistry. 2. Understand the term additive and constitutive properties. 3. Explain Raman spectra: Concept of polarizability, Pure rotational Raman spectra of diatomic molecules, Energy

				<p>Expression, Selection rule, Rotational energy level diagram, Rotational Raman spectrum and Problems</p> <p>4. Discuss difference between thermal and photochemical processes.</p> <p>5. Know photochemical reactions: photosynthesis, photolysis, photocatalysis, photosensitization, Various photochemical phenomena like fluorescence and phosphorescence, Chemiluminescence,</p> <p>6. Solve numerical Problems.</p>
		2 and CH502	Analytical Chemistry- I	<p>At the end of course student,</p> <ol style="list-style-type: none"> 1. Explain different principles involved in the gravimetry, spectrophotometry, parameters in instrumental analysis, qualitative analysis. 2. Perform quantitative calculations depending upon equations student has studied in the theory. Furthermore, student should able to solve problems on the basis of theory. 3. Design analytical procedure for given sample, discuss procedure for different types analyses included in the syllabus. 4. Select particular method of analysis if analyte sample is given to him. 5. Differentiate / distinguish / Compare among the different analytical terms, process and analytical methods. 6. Apply whatever theoretical principles he has studied in theory during practical session in laboratory.
		3 and CH503	Physical Chemistry Practical – I	<p>At the end of course student,</p> <ol style="list-style-type: none"> 1. Determine specific refractivity's of the given liquids 2. Calibrate and use pH meter for analysis. 3. Prepare of buffer solutions and measure its pH. 4. Determine the indicator constant of methyl red indicator by colorimetry 5. Determine the titration of a mixture of weak acid and strong acid with strong alkali. 6. Do qualitative analysis of vitamin by Photoflurometry.

		4 and CH504	Inorganic Chemistry – I	At the end of course student, 1. Explain electro-neutrality principle and Nephelauxetic effect towards covalent bonding, explain Charge Transfer Spectra 2. Explain MOT of Octahedral complexes with sigma bonding and compare the different approaches to bonding in Coordination compounds. 3. Understand Tran's effect and applications of Trans effect, Stereochemistry of mechanism 4. Gain the knowledge of inorganic reaction mechanisms available in the literature to solve chemical problems. 5. Explain metal, non-metal, insulator & semiconductor with intrinsic and extrinsic properties.
		5 and CH505	Industrial Chemistry – I	At the end of course student, 1. Know various industries, aspects and importance of chemical industry. 2. Explain manufacture of sugar, fruit juice, dye, soap and pigment 3. Aware of Fermentation Industry and manufacturing of ethyl alcohol by using molasses and fruit juice. 4. Understand chemistry of soap and different types of soap products, 5. Explain: Dyes its classification, synthesis, Structures, properties and applications of dyes.
		6 and CH506	Inorganic Chemistry Practical – I	At the end of course student, 1. Verify theoretical principles experimentally 2. Conceptual understanding of electrogravimetric principle, Numerical Problems 3. Principles of common ion effect and solubility product, Formation of complex ion 4. Factors affecting on solubility of precipitation 5. Prepare of inorganic complexes and spot tests for metal ions and ligands: 6. Qualitative and confirmatory tests of inorganic toxicants.
		7 and	Organic	At the end of course student,

		CH507	Chemistry – I	<p>1. Define and classify, draw structure, synthesis polynuclear and heteronuclear aromatic hydrocarbons & Understand their reactivity, meaning of active methylene group & its Reactivity</p> <p>2. To predict product with planning or supply the reagent/s for these reactions</p> <p>3. Learnt different types of rearrangement and intermediate formed</p> <p>4. Able to write the mechanism of rearrangement reactions and their applications</p> <p>5. Understand stereochemistry by using models and learn reactivity of geometrical isomers</p> <p>6. Orientation and reactivity in E1 and E2 elimination and factors affecting them</p> <p>7. Use of Hoffmann and Saytzeff's Orientation as per stereochemistry.</p>
		8 and CH508	Chemistry of Biomolecules	<p>At the end of course student,</p> <p>1. Understood the Cell types its Biological composition</p> <p>2. Award with different biomolecules and their stereochemistry</p> <p>3. Award with types of carbohydrates with examples their chemical and structural properties, their biochemical significance</p> <p>4. Know to the types of lipids with examples, structure of lipids, properties of lipids</p> <p>5. Learnt structure and types, properties & structure of amino acids & protein</p> <p>6. Known to enzymes with subclasses and examples and their industrial applications</p> <p>7. Learnt Basic concepts of Endocrinology,</p> <p>8. Student understood the different types of Endocrine glands with their hormones, biological nature and mechanism of action.</p>
		9 and CH509	Organic Chemistry Practical I	<p>At the end of course student,</p> <p>1. Separate, purify and analyse binary water-soluble and water insoluble mixture.</p> <p>2. Understand the techniques involving drying and recrystallization by various method.</p> <p>3. Learn the confirmatory test for various functional groups, special elements.</p>

				<p>4. Systematic working skill in laboratory will be imparted in student.</p> <p>5. Learn the basic principles of green and sustainable chemistry.</p> <p>6. Learn the preparations of derivative various functional groups aspects of electrical experiments.</p> <p>7. Use of Chromatographic techniques in chemical analysis.</p>
		10 and CH510A	Introduction to Medicinal Chemistry	<p>At the end of course student,</p> <ol style="list-style-type: none"> 1. Award with fundamentals of medicinal chemistry and its importance 2. Understood concept of Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics, metabolites, antimetabolites and therapeutic index 3. Understood overall process of drug discovery & drug mechanism of action 4. Importance of stereochemistry of drugs and receptors for biological effect. 5. Know mechanism of action of drugs belonging to the classes of infectious and noninfectious diseases.
		11 and CH511A	Environmental Chemistry	<p>At the end of course student,</p> <ol style="list-style-type: none"> 1. Understand importance and conservation of environment, biogeochemical cycles, Hydrological Cycle. 2. Know water resources and water quality parameters 3. Aware of organic and inorganic pollutants, surfactants, toxic chemicals causing water pollution 4. Understand water parameters monitoring techniques and methodology.
	VI th	1 and CH601	Physical Chemistry-II	<p>At the end of course student,</p> <ol style="list-style-type: none"> 1. Understand concepts in electrochemistry, electrochemical series, electrodes, Primary Batteries, Secondary Batteries, etc. 2. Explain diagram, Construction, representation, working and limitation of primary reference electrode, calomel electrode, glass electrode, silver-silver chloride electrode. 3. Know types of Reversible electrodes with respect to examples, diagram, representation, construction, working

				<p>(electrode reactions) and electrode potential.</p> <p>4.Explain the term crystallography and laws of crystallography.</p> <p>5.Understand Radioactivity, types of radioactive decay types and properties of radiations, detectors and application of radioisotopes</p> <p>6. Solve the problems.</p>
		2 and CH602	Physical Chemistry-III	<p>At the end of course student,</p> <p>1.Understand meaning of the terms- Solution, electrolytes, non electrolytes and colligative properties,</p> <p>2.Know application of colligative properties to determine molecular weight of non electrolyte, abnormal molecular weight,</p> <p>3. Factors affecting on solid state reactions,</p> <p>4.Explain phenomena of photoconductivity, conductors and insulators, semiconductors</p> <p>5. Numerical based on cohesive energy.</p>
		3 and CH603	Physical Chemistry Practical –II	<p>At the end of course student,</p> <p>1.Understand method of analysis by potentiometric titration, pH-metric titration, turbidometry</p> <p>2.Explain colligative properties of material like polymer.</p> <p>3.Determine the molecular weight of solute by depression in freezing point method</p> <p>4.Prepare buffer solutions and measure its pH by pH-metry.</p> <p>5.Analyze of crystal structure from X-ray diffraction spectra.</p>
		4 and CH604	Inorganic Chemistry –II	<p>At the end of course student,</p> <p>1. Understand organometallic chemistry, method of synthesis of compounds</p> <p>2. Know the phenomenon of catalysis, its basic principles and terminologies.</p> <p>3. Understand the role of metals in non-enzymatic processes.</p> <p>4. Explain the functions of hemoglobin and myoglobin in O₂ transport and storage.</p> <p>5. Know thy types of Inorganic polymers, comparison with organic polymers, synthesis, structural aspects of Inorganic</p>

				polymers.
		5 and CH605	Inorganic Chemistry –III	At the end of course student, 1. Learn the concept of acid, base and their theories. 2. Know the crystal structures of solids, simple cubic, BCC and FCC structures 3. Know the defects in Ionic solids, differentiate between the defects. 4. Synthesize Zeolite and their structure, Know application of zeolites 5. Learn various methods of nanoparticle synthesis 6. Know toxic chemical in the environment, explain biological methylation.
		6 and CH606	Inorganic Chemistry Practical –II	At the end of course student, 1. Volumetric Estimations of Calcium, Cu, Phosphate, Iodine from products 2. Estimation of Na, K by flame photometry by calibration curve method and regression method. 3. Purification of water using cation/anion exchange resin and analysis by qualitative analysis 4. Synthesize nanoparticles of silver, ZnO. 5. Explain UV spectra of nanomaterial.
		7 and CH607	Organic Chemistry –II	At the end of course student, 1. Award with principle & instrumentation in UV, Mass, IR & NMR Spectroscopy. 2. Determine the structure of simple organic compounds on the basis of spectral data such as λ max values, IR frequencies, chemical shift (δ values). 3. Determine λ max value from structure of compound. 4. Read UV, Mass, IR & NMR Spectrum interpret them to determine structure of organic compound 5. Explain stereochemistry of cyclohexane and decalin.
		8 and CH608	Organic Chemistry –III	At the end of course student, 1. Use retrosynthesis for synthesis of target molecule from commercially available synthetic equivalents 2. Aware with the Terms - Disconnection, Synthons, Synthetic equivalence, FGI, TM.

				<p>3. Apply knowledge of Organic Reaction Mechanism in Synthetic of organic compounds</p> <p>4. Know oxidizing reagents and reducing reagents for synthesis of organic compound.</p> <p>5. Explain natural products like terpenoids, Alkaloids and their importance.</p>
		9 and CH609	Organic Chemistry Practical –II	<p>At the end of course student,</p> <ol style="list-style-type: none"> 1. Handling of chemicals & Glassware with safety 2. Able to read infrared spectrum Identify the functional group or groups present in a compound. Interpret IR and NMR spectra 3. Apply learnt Chemistry principles in practical 4. Trained with hands-on experience of modern extraction methods. 5. Able to determine and use chromatography techniques for purification, separation of organic compounds.
		10 and CH610A	Chemistry of Soils and Agrochemicals	<p>At the end of course student,</p> <ol style="list-style-type: none"> 1. Understood various components of soil and soil properties and their impact on plant growth. 2. Understood the classification of the soil. 3. Explores the problems and potentials of soil and decide the most appropriate treatment for land use. 4. Understood the Reclamation and management of soil physical and chemical constraints. 5. Useful in making decisions on nutrient dose, choice of fertilizers and method of application etc. practiced in crop production. 6. Got experience on advanced analytical and instrumentation methods in the estimation of soil. 7. Understood various Nutrient management concepts and Nutrient use efficiencies of major and micronutrients and enhancement techniques. 8. Proper understanding of chemistry of

				<p>pesticides will be inculcated among the students.</p> <p>9. Imparts knowledge on different pesticides, their nature and, mode of action and their fate in soil so as to monitor their effect on the environment.</p>
		11 and CH611A	Analytical Chemistry-II	<p>At the end of course student,</p> <ol style="list-style-type: none"> 1. Define basic terms in solvent extraction, basics of chromatography, HPLC, GC, and AAS and AES. Some important terms are: solvent extraction, aqueous and organic phase, distribution ratio and coefficient, solute remain unextracted, percent extraction, ion association complex, theoretical plate, HETP, retention time, selectivity, resolution, stationary phase, normal and reverse phase, ion exchange, column efficiency, carrier gas, split and splitless injection, packed column, tubular column, atomic absorption and emission spectroscopy, electronic excitation in atoms, nebulization, atomization, reduction of metal ions in flame, absorbance by atoms in flame, flame atomizers, furnace atomizers, interference in AES and FES, HCL, hydride generator, etc. 2. Identify important parameters in analytical processes or estimations. Example: minimum analyte concentration in particular method, reagent concentration for particular analysis, reagent for particular analysis, reaction condition to convert analyte into measurable form, wavelength selection in HPLC with spectrophotometric and fluorometric detector, solvent or carrier gas in HPLC and GC, choice method for the sample preparation in atomic spectroscopic methods, choice of filter and HCL in atomic spectroscopic methods, etc. 3. Explain different principles involved in the analyses using solvent extraction, basics of instrumental chromatography, HPLC, GC, and atomic

				<p>spectroscopic techniques.</p> <p>4. Perform quantitative calculations depending upon equations students has studied in the theory. Furthermore, student should able to solve problems on the basis of theory.</p> <p>5. Discuss / Describe procedure for different types analyses included in the syllabus.</p> <p>6. Select particular method of analysis if analyte sample is given to him.</p> <p>7. Differentiate / distinguish / compare among the different analytical terms, process and analytical methods.</p> <p>8. Demonstrate / explain theoretical principles with help of practical.</p> <p>9. Design analytical procedure for given sample.</p>
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