

## ii. BSc Chemistry

### Programme Specific Outcomes

After the completion of the programme, a student will be able to:

1. Understand the basic principles of organic, inorganic, physical, analytical, pharmaceutical, polymer, pesticide, and green chemistry in the molecular level and their applications through various laboratory experiments.
2. Achieve the critical thinking ability in order to design, carry out, record, and analyse the results of chemical reactions performed in the laboratory.
3. Understand the concepts of practical techniques and different analytical procedures so that they can easily involve themselves in laboratory-based research activities.
4. Gain knowledge required for the safe handling of chemicals and apparatus in the laboratory.

### Course Outcomes

SL. NO.	SEMESTER	PAPER CODE & TITLE	COURSE OUTCOMES	UNIT/CHAPTER	BLOOM'S TAXONOMY LEVELS
<b>BSc (HONOURS) Chemistry</b>					
		CHE-HC-1016:	On successful completion, students would have clear	Atomic Structure	Understand and Remember
				Periodicity of Elements	Understand and Remember

1	I	INORGANIC CHEMISTRY-I LAB	understanding of the concepts related to atomic and molecular structure, chemical bonding, periodic properties and redox behavior of chemical species. Students will also have hands on experience of standard solution preparation in different concentration units and learn volumetric estimation through acid-base and redox reactions.	Chemical Bonding	Understand and Remember
				Oxidation-Reduction	Understand and Remember
				Titrimetric Analysis, Acid-Base Titrations and Oxidation-Reduction Titrimetry	Apply, Analyse and Evaluate
2	I	CHE-HC-1026: PHYSICAL CHEMISTRY I	In gaseous state unit the students will learn the kinetic theory of gases, ideal gas and real gases. In liquid state unit, the students are expected to learn the qualitative treatment of the structure of liquid along with the physical properties of liquid, viz, vapour pressure, surface tension and viscosity. In the molecular and crystal symmetry unit they will be introduced to the elementary idea of symmetry which will be useful to understand solid state chemistry and group theory in some higher courses. In solid state unit the students will learn the basic solid state chemistry application of x-ray crystallography for the determination of some very simple crystal structures. The students will also learn another	Gaseous State	Understand and Remember
				Liquid State	Understand and Remember
				Molecular and Crystal Symmetry	Understand and Remember
				Solid State	Understand and Remember

			important topic "ionic equilibria" in this course.	Ionic Equilibria	Understand and Remember
		LAB		Surface tension measurements, Viscosity measurement using Ostwald's viscometer, Indexing of a given powder diffraction pattern of a cubic crystalline system and pH metry	Apply, Analyse and Evaluate
3	II	CHE-HC-2016: ORGANIC CHEMISTRY I	Students will be able to identify different classes of organic compounds, describe their reactivity and explain/analyse their chemical and stereo chemical aspects.	Basics of Organic Chemistry	Understand and Remember
				Stereo chemistry	Understand, Remember and Apply
				Chemistry of Aliphatic Hydrocarbons a) Carbon-Carbon sigma bonds b) Carbon-Carbon Pi bonds c) Cycloalkanes and Conformational Analysis	Understand and Remember

		LAB		Aromatic Hydrocarbons	Understand and Remember
				Checking the calibration of the thermometer, Purification of organic compounds by crystallization, Determination of melting points and boiling points of unknown organic compounds, Effect of impurities on the melting point – mixed melting point of two unknown organic Compounds and chromatography	Apply, Analyse and Evaluate
		CHE-HC-2026: PHYSICAL CHEMISTRY II		Chemical Thermodynamics	Understand and Remember
			In this course the students are expected to learn laws of thermodynamics, thermochemistry, thermodynamic functions, relations between thermodynamic properties, Gibbs Helmholtz equation, Maxwell relations etc. Moreover, the students are expected to learn partial molar quantities, chemical equilibrium, solutions and colligative properties. After	System of variable compositions	Understand and Remember

			completion of this course, the students will be able to understand the chemical systems from thermodynamic point of view.		
				Chemical Equilibrium	Understand and Remember
				Solutions and Colligative properties	Understand and Remember
4	II	CHE-HC-2026: PHYSICAL CHEMISTRY II  LAB	In this course the students are expected to learn laws of thermodynamics, thermochemistry, thermodynamic functions, relations between thermodynamic properties, Gibbs Helmholtz equation, Maxwell relations etc. Moreover, the students are expected to learn partial molar quantities, chemical equilibrium, solutions and colligative properties. After completion of this course, the students will be able to understand the chemical systems from thermodynamic point of view.	Chemical Thermodynamics	Understand and Remember
				System of variable compositions	Understand and Remember
				Chemical Equilibrium	Understand and Remember
				Solutions and Colligative properties	Understand and Remember
				Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system,	

				<p>Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide, Calculation of the enthalpy of ionization of ethanoic acid, Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts, Determination of basicity/proticity of a polyprotic acid by the thermochemical method, Determination of enthalpy of hydration of copper sulphate and Study of the solubility of benzoic acid in water and determination of <math>\Delta H</math>.</p>	Apply, Analyse and Evaluate
5	III	CHE-HC-3016: INORGANIC CHEMISTRY-II	On successful completion of this course students would be able to apply theoretical principles of redox chemistry in the understanding of metallurgical processes. Students will be able to identify the variety of s and p block compounds and comprehend their preparation, structure, bonding, properties and uses. Experiments in this course will boost their quantitative estimation skills and	General Principles of Metallurgy	Understand and Remember
				Acids and Bases	Understand, Remember and Apply
				Chemistry of s and p Block Elements	Understand and Remember

			introduce the students to preparative methods in inorganic chemistry.	Noble Gases	Understand and Remember
				Inorganic polymers	Understand and Remember
		LAB		Iodo/Iodimetric Titrations and Inorganic preparations	Apply, Analyse and Evaluate
6	III	CHE-HC-3026: ORGANIC CHEMISTRY- II	Students will be able to describe and classify organic compounds in terms of their functional groups and reactivity.	Chemistry of Halogenated Hydrocarbons	Understand and Remember
				Alcohols, Phenols, Ethers and Epoxides	Understand and Remember
				Carbonyl compounds	Understand and Remember
				Carboxylic Acids and their Derivatives	Understand and Remember
				Sulphur containing compounds	Understand and Remember

		LAB		Test of functional groups like alcohols, phenols, carbonyl and carboxylic acid group and organic preparations	Apply, Analyse and Evaluate
7	III	CHE-HC-3036: PHYSICAL CHEMISTRY- III	The students are expected to learn phase rule and its application in some specific systems. They will also learn rate laws of chemical transformation, experimental methods of rate law determination, steady state approximation etc. in chemical kinetics unit. After attending this course the students will be able to understand different types of surface adsorption processes and basics of catalysis including enzyme catalysis, acid base catalysis and particle size effect on catalysis.	Phase Equilibria	Understand and Remember
				Chemical Kinetics	Understand and Remember
				Catalysis	Understand and Remember
				Surface Chemistry	Understand and Remember
		LAB		Determination of critical solution temperature and composition of the phenol- water system, Construction of the phase diagram using cooling curves or ignition	Apply, Analyse and Evaluate



				tube method, Distribution of acetic/ benzoic acid between water and cyclohexane, Equilibrium and Kinetics study of different reactions	
8	III	CHE-SE-3034: BASIC ANALYTICAL CHEMISTRY	Upon completion of this course, students shall be able to explain the basic principles of chemical analysis, design/implement microscale and semimicro experiments, record, interpret and analyze data following scientific methodology	Introduction	Understand and Remember
				Analysis of soil	Understand and Remember
				Analysis of water	Understand and Remember
				Analysis of food products	Understand and Remember
				Chromatography	Understand and Remember
				Ion-exchange	Understand and Remember

				Analysis of cosmetics	Understand and Remember
				To study the use of phenolphthalein in trap cases, To analyze arson accelerants, To carry out analysis of gasoline, Estimation of macro nutrients, Spectrophotometric determination of Iron in Vitamin /Dietary Tablets and Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink	Apply, Analyse and Evaluate
9	IV	CHE-HC-4016: INORGANIC CHEMISTRY-III	On successful completion, students will be able name coordination compounds according to IUPAC, explain bonding in this class of compounds, understand their various properties in terms of CFSE and predict reactivity. Students will be able to appreciate the general trends in the properties of transition elements in the periodic table and	Coordination Chemistry	Understand and Remember
				Transition Elements	Understand and Remember

			<p>identify differences among the rows.</p> <p>Through the experiments students not only will be able to prepare, estimate or separate metal complexes/compounds but also will be able to design experiments independently which they should be able to apply if and when required.</p>	Lanthanoids and Actinoids	Understand and Remember
				Bioinorganic Chemistry	Understand and Remember
		LAB		Gravimetric Analysis, Inorganic Preparations and Chromatography of metal ions	Apply, Analyse and Evaluate
10	IV	CHE-HC-4026: ORGANIC CHEMISTRY - III	<p>Students shall demonstrate the ability to identify and classify different types of N- based derivatives, alkaloids and hetrocyclic compounds/explain their structure mechanism and reactivity/critically examine their synthesis and reactions mechanism.</p>	Nitrogen Containing Functional Groups	Understand and Remember
				Polynuclear Hydrocarbons	Understand and Remember
				Heterocyclic compounds	Understand and Remember
				Alkaloids	Understand and Remember

				Terpenes	Understand and Remember
		LAB		Detection N, S, halogens in organic compounds, Functional group test for nitro, amine and amide groups and Qualitative analysis of unknown organic compounds containing simple functional groups	Apply, Analyse and Evaluate
11	IV	CHE-HC-4036: PHYSICAL CHEMISTRY- IV	In this course the students will learn theories of conductance and electrochemistry. Students will also understand some very important topics such as solubility and solubility products, ionic products of water, conductometric titrations etc. The students are also expected to understand the various parts of electrochemical cells along with Faraday's Laws of electrolysis. The students will also gain basic theoretical idea of electrical & magnetic properties of atoms and molecules.	Conductance	Understand and Remember
				Electrochemistry	Understand and Remember
				Electrical & Magnetic Properties of Atoms and Molecules	Understand and Remember
		LAB		Determination of cell constant, equivalent conductance, degree of dissociation and dissociation	Apply, Analyse and Evaluate

				constant of a weak acid and conductometric and potentiometric titrations	
12	IV	CHE-SE-4034: PHARMACEUTICAL CHEMISTRY	Students will be able to appreciate the drug development process, identify various small molecules used for treatments different ailments and other physiological processes.	Drugs & Pharmaceuticals	Understand and Remember
				Fermentation	Understand and Remember
		LAB		Preparation of Aspirin and its analysis, Preparation of magnesium bisilicate	Apply, Analyse and Evaluate
13	V	CHE-HC-5016: ORGANIC CHEMISTRY- IV	Students will be able to explain/describe the important features of nucleic acids, amino acids and enzymes and develop their ability to examine their properties and applications.	Nucleic Acids	Understand and Remember

				Amino Acids, Peptides and Proteins	Understand and Remember
				Enzyme	Understand and Remember
				Lipids	Understand and Remember
				Concept of Energy in Biosystems	Understand and Remember
				Pharmaceutical Compounds: Structure and Importance	Understand and Remember
				Estimation of glycine by Sorenson's formalin method, Study of the titration curve of glycine, Estimation of proteins by Lowry's method, Study of the action of salivary amylase on starch at optimum conditions, Effect of temperature on the action of salivary amylase Saponification value of an oil or a fat,	Apply, Analyse and Evaluate

				Determination of Iodine number of an oil/ fat and Isolation and characterization of DNA from onion/ cauliflower/peas.	
14	V	CHE-HC-5026: PHYSICAL CHEMISTRY V	After completion of this course the students are expected to understand the application of quantum mechanics in some simple chemical systems such as hydrogen atom or hydrogen like ions. The students will also learn chemical bonding in some simple molecular systems. They will be able to understand the basics of various kinds of spectroscopic techniques and photochemistry.	Quantum Chemistry	Understand and Remember
				Molecular Spectroscopy	Understand and Remember
				Photochemistry	Understand and Remember
		LAB		UV/Visible spectroscopy and Colourimetry	Apply, Analyse and Evaluate
15	V	CHE-HE-5026: ANALYTICAL METHODS IN CHEMISTRY	On successful completion students will be have theoretical understanding about choice of various analytical techniques used for qualitative and quantitative	Qualitative and quantitative aspects of analysis	Understand and Remember

		<p>characterization of samples. At the same time through the experiments students will gain hands on experience of the discussed techniques. This will enable students to take judicious decisions while analyzing different samples.</p>	Optical methods of analysis	Understand and Remember
			Thermal methods of analysis	Understand and Remember
			Electroanalytical methods	Understand and Remember
			Separation techniques	Understand and Remember
			<p>Chromatographic separations, solvent extractions, Determine the pH of the given aerated drinks fruit juices, shampoos and soaps, Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques, Analysis of soil, ion-exchange and spectrophotometry experiments</p>	Apply, Analyse and Evaluate



16	V	CHE-HE-5056: POLYMER CHEMISTRY	<p>After completion of this course the students will learn the definition and classifications of polymers, kinetics of polymerization, molecular weight of polymers, glass transition temperature, and polymer solutions etc. They also learn the brief introduction of preparation, structure and properties of some industrially important and technologically promising polymers.</p>	Introduction and history of polymeric materials	Understand and Remember
				Functionality and its importance	Understand and Remember
				Kinetics of Polymerization	Understand and Remember
				Crystallization and crystallinity	Understand and Remember
				Nature and structure of polymers	Understand and Remember
				Determination of molecular weight of polymers	Understand and Remember
				Glass transition temperature (T <sub>g</sub> ) and determination of T <sub>g</sub>	Understand and Remember
				Polymer Solution	Understand and Remember

				Properties of Polymers	Understand and Remember
		LAB		Polymer synthesis, Polymer characterization and Polymer analysis	Apply, Analyse and Evaluate
17	VI	CHE-HC-6016: INORGANIC CHEMISTRY-IV	<p>By studying this course the students will be expected to learn about how ligand substitution and redox reactions take place in coordination complexes. Students will also learn about organometallic compounds, comprehend their bonding, stability, reactivity and uses. They will be familiar with the variety of catalysts based on transition metals and their application in industry.</p> <p>On successful completion, students in general will be able to appreciate the use of concepts like solubility product, common ion effect, pH etc. in analysis of ions and how a clever design of reactions, it is possible to identify the components in a mixture. With the experiments related to coordination compound synthesis, calculation of <math>10Dq</math>,</p>	Mechanism of Inorganic Reactions	Understand and Remember
				Organometallic Compounds	Understand and Remember
				Transition Metals in Catalysis	Understand and Remember
				Theoretical Principles in Qualitative Inorganic Analysis (H <sub>2</sub> S Scheme)	Understand and Remember

			controlling factors etc. will make the students appreciate the concepts of theory in experiments		
				Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations, Synthesis of ammine complexes of Ni(II) and their ligand exchange reactions involving bidentate ligands like acetylacetone, dimethylglyoxime, glycine, Preparation of acetylacetonato complexes of $\text{Cu}^{2+}/\text{Fe}^{3+}$ , Controlled synthesis of two copper oxalate hydrate complexes, Determination of $\epsilon_{\text{max}}$ value from UV-visible spectra of complexes and Measurement of $10 Dq$ by spectrophotometric method	Apply, Analyse and Evaluate
18	VI	CHE-HC-6026: ORGANIC CHEMISTRY- V	Students will be able to explain/describe basic principles of different spectroscopic	Spectroscopy	Understand and Remember

			techniques and their importance in chemical/organic analysis. Students shall be able to classify/identify/critically examine carbohydrates, polymers and dye materials.	Carbohydrates	Understand and Remember
				Dyes	Understand and Remember
				Polymers	Understand and Remember
		LAB		Extraction of caffeine from tea leaves, Preparation of sodium polyacrylate and urea formaldehyde, Analysis of Carbohydrate, Qualitative analysis of unknown organic compounds containing monofunctional groups, Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy and preparation of methyl orange	Apply, Analyse and Evaluate
		CHE-HE-6016 : GREEN CHEMISTRY		Introduction to Green Chemistry	Understand and Remember

			<p>Apart from introducing learners to the principles of green chemistry, this course will make them conversant with applications of green chemistry to organic synthesis. Students will be prepared for taking up entry level jobs in the chemical industry. They also will have the option of studying further in the area.</p>		
		LAB		Principles of Green Chemistry and Designing a Chemical synthesis	Understand and Remember
				Examples of Green Synthesis/ Reactions	Understand and Remember
				<p>Future Trends in Green Chemistry dry ice, Mechanochemical solvent free synthesis of azomethines, Co-crystal controlled solid state synthesis (C2S3) of N-organophthalimide using phthalic anhydride and 3-aminobenzoic acid, Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II) and Photoreduction of</p>	Understand and Remember

				benzophenone to benzopinacol in the presence of sunlight	
20	VI	CHE-HE-6056 : DISSERTATION	Student will complete a project work and then prepare a report on that		Analyse, Evaluate and Create

SL NO.	SEMESTER	PAPER CODE & TITLE	COURSE OUTCOME	UNIT/CHAPTER	BLOOM'S TAXONOMY LEVELS
1	I	CHE-RC/HG-1016: CHEMISTRY-1	After completion of this course the students will learn the atomic structure through the basic concepts of quantum mechanics. They will understand the chemical bonding through VB and MO approaches. In organic part, the students	Atomic Structure	Understand and Remember
				Chemical Bonding and Molecular Structure	Understand and Remember
				Fundamentals of Organic Chemistry	Understand and Remember
				Stereochemistry	Understand and Remember
				Aliphatic Hydrocarbons Alkanes, Alkenes and Alkynes	Understand and Remember

		LAB	are expected to learn basic ideas used in organic chemistry, stereochemistry, functional groups, alkanes, alkenes, alkynes etc.	Estimation of Na <sub>2</sub> CO <sub>3</sub> , NaHCO <sub>3</sub> , oxalic acid, water of crystallization, Fe(II) and Cu(II) ions by volumetric analysis Detection of extra elements in organic compounds and Separation of mixtures by chromatography	Apply, Analyse and Evaluate
2	II	CHE-RC/HG-2016: CHEMISTRY-2	After completion of this course the students will learn periodic properties in main group elements, transition metals (3d series). They will also learn the crystal field theory in coordination chemistry unit. In physical chemistry part, the students are expected to learn kinetic theory of gases, ideal gas and real gases, surface tension, viscosity, basic solid state chemistry and chemical kinetics.	s- and p-Block Elements	Understand and Remember
				Transition Elements (3d series)	Understand and Remember
				Coordination Chemistry	Understand and Remember
				Kinetic Theory of Gases	Understand and Remember
				Liquids	Understand and Remember
				Solids	Understand and Remember
				Chemical Kinetics	Understand and Remember
		LAB		Semi-micro inorganic qualitative analysis, Estimation of Ni and Al gravimetrically, Determination of composition of Fe <sup>3+</sup> -salicylic acid complex solution by Job's method, Estimation of Mg <sup>2+</sup> , Zn <sup>2+</sup> and total hardness by complexometric titration, Determination of N <sup>+</sup> and K <sup>+</sup> using Flame Photometry, Surface tension measurement, Viscosity	Apply, Analyse and Evaluate

			measurement and Chemical Kinetics	
		<p>CHE-RC/HG-3016: CHEMISTRY-3 LAB</p> <p>After completion of this course the students will be able to understand the chemical system from thermodynamic points of view. They will also learn two very important topics in chemistry- chemical equilibrium and ionic equilibrium. In organic chemistry part, the students are expected to learn various classes of organic molecules- alkyl halides, aryl halides, alcohols, phenols, ethers, aldehydes and ketones.</p>	Chemical Energetics	Understand and Remember
			Chemical Equilibrium	Understand and Remember
			Ionic Equilibria	Understand and Remember
			Aromatic hydrocarbons	Understand and Remember
			Alkyl and Aryl Halides	Understand and Remember
			Alcohols, Phenols and Ethers	Understand and Remember
			Aldehydes and ketones (aliphatic and aromatic)	Understand and Remember



				<p>Determination of heat capacity of calorimeter for different volumes, enthalpy of neutralization of hydrochloric acid with sodium hydroxide, enthalpy of ionization of acetic acid, integral enthalpy of solution of salts and enthalpy of hydration of copper sulphate, Study of the solubility of benzoic acid in water and determination of <math>\Delta H</math>, Measurements of pH of different solutions and preparation of buffer solutions. Purification of organic compounds by crystallization, Determination of melting and boiling</p>	Apply, Analyse and Evaluate
				points and preparation of various organic compounds.	
			Upon completion of this course, students shall be able to explain the basic principles of chemical analysis, design/implement microscale and	Introduction	Understand and Remember
				Analysis of soil	Understand and Remember
				Analysis of water	Understand and Remember

4	III	CHE-SE-3034: BASIC ANALYTICAL CHEMISTRY	semimicro experiments, record, interpret and analyze data following scientific methodology.	Analysis of food products	Understand and Remember
				Chromatography	Understand and Remember
				Ion-exchange	Understand and Remember
				Analysis of cosmetics	Understand and Remember
5	IV	LAB  CHE- RC/HG- 4016: CHEMISTRY- 4	After completion of this course the students learn solutions, phase rule and its application in specific cases, basics of conductance and electrochemistry. Students will also learn some important topics of organic and biochemistry- carboxylic acids, amines, amino acids, peptides, proteins and carbohydrates.	To study the use of phenolphthalein in trap cases, To analyze arson accelerants, To carry out analysis of gasoline, Estimation of macro nutrients, Spectrophotometric determination of Iron in Vitamin /Dietary Tablets and Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink	Apply, Analyse and Evaluate
				Solutions	Understand and Remember
				Phase Equilibrium	Understand and Remember
				Conductance	Understand and Remember
				Electrochemistry	Understand and Remember
				Carboxylic acids and their derivatives	Understand and Remember
				Amines and Diazonium Salts	Understand and Remember

				Amino Acids, Peptides and Proteins	Understand and Remember
				Carbohydrates	Understand and Remember
		LAB		<p>Study of equilibrium by distribution method, Construction of the phase diagram of a binary system, Determination of the critical solution temperature and composition of the phenol water system, Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature, Determination of cell constant, equivalent conductance, degree of dissociation and dissociation constant of a weak acid and conductometric and potentiometric titrations of strong acid vs. strong base and weak acid vs. strong base Qualitative Organic Analysis of Organic Compounds,</p>	Apply, Analyse and Evaluate

				Separation of amino acids by paper chromatography, Determination of the concentration of glycine solution by formylation method, Titration curve of glycine, Action of salivary amylase on starch, Effect of temperature on the action of salivary amylase on starch, Determination of the saponification value of an oil/fat, Determination of the iodine value of an oil/fat, Differentiation between a reducing/nonreducing sugar, Extraction of DNA from onion/ cauliflower		
6	IV	CHE-SE-4034: PHARMACEU TICAL CHEMISTRY	Students will be able to appreciate the drug development process, identify various small molecules used for treatments different ailments and other physiological processes.	Drugs & Pharmaceuticals	Understand and Remember	
		LAB			Fermentation	Understand and Remember
					Preparation of Aspirin and its analysis, Preparation of magnesium bisilicate	Apply, Analyse and Evaluate
		CHE-RE-5026:	On successful completion students will be have theoretical understanding about choice of various analytical techniques used for qualitative and	Qualitative and quantitative aspects of analysis	Understand, Remember and Apply	

7	V	ANALYTICAL METHODS IN CHEMISTRY	quantitative characterization of samples. At the same time through the experiments students will gain hands on experience of the discussed techniques. This will enable students to take judicious decisions while analyzing different samples.		
				Optical methods of analysis	Understand and Remember
				Thermal methods of analysis	Understand and Remember
				Electroanalytical methods	Understand and Remember
		Separation techniques	Understand, Remember and Apply		
		LAB		Chromatographic separations, solvent extractions, Determine the pH of the given aerated drinks fruit juices, shampoos and soaps, Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques, Analysis of soil, ion-exchange and spectrophotometry experiments	Apply, Analyse and Evaluate
8	V	CHE-SE-5044: INTELLECTUAL PROPERTY RIGHTS	After completing this course, students will have in-depth understanding about the importance and types of IPR. This course will also provide the clarity on the legal and economic aspects of the	Introduction to Intellectual Property	Understand and Remember
				Copyrights	Understand and Remember
				Trademarks	Understand and Remember
				Patents	Understand and Remember
				Geographical Indications	Understand and Remember
				Industrial Designs	Understand and Remember
				Layout design of integrated circuits	Understand and Remember

			IP system.		
				Trade Secrets	Understand and Remember
				Different International agreements a) World Trade Organization (WTO) b) Paris Convention	Understand and Remember
9	VI	CHE-RE-6016: GREEN CHEMISTRY	Apart from introducing learners to the principles of green chemistry, this course will make them conversant with applications of green chemistry to organic synthesis. Students will be prepared for taking up entry level jobs in the chemical industry. They also will have the option of studying further in the area	Introduction to Green Chemistry	Understand and Remember
				Principles of Green Chemistry and Designing a Chemical synthesis	Understand and Remember
		LAB		Examples of Green Synthesis/ Reactions	Understand and Remember
				Future Trends in Green Chemistry	Understand and Remember
				Safer starting materials, Preparation of biodiesel from vegetable oil, Principle of atom economy, Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide, Reaction between furan and maleic acid in water and at room temperature rather than in benzene and reflux,	

				<p>Extraction of D-limonene from orange peel using liquid CO<sub>2</sub> prepared from dry ice, Mechanochemical solvent free synthesis of azomethines, Co-crystal controlled solid state synthesis (C2S3) of N-organophthalimide using phthalic anhydride and 3-aminobenzoic acid, Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II) and Photoreduction of benzophenone to benzopinacol in the presence of sunlight</p>	Apply, Analyse and Evaluate
10	VI	CHE-SE-6024: PESTICIDE CHEMISTRY	Students will be able to explain or describe and critically examine different types of pesticides, their activity/toxicity and their applications and the need for the	Definition of pesticides, general introduction to pesticides, benefits and adverse effects of pesticides.	Understand and Remember
				Classification, mode of action, toxicity and methods of pesticides residue analysis.	Understand and Remember
		<b>LAB</b>		Synthesis and technical manufacture and uses of representative	Understand and Remember

				pesticides	
				To calculate acidity/alkalinity in given sample of pesticides formulations as per BIS specifications	Apply, Analyse and Evaluate
				Preparation of simple organophosphates, phosphonates and thiophosphates	Apply, Analyse and Evaluate