Shri Rawatpura Sarkar University, Raipur

Examination Scheme & Syllabus

for

Three Year Bachelor of Science (Hons.) in Chemistry Programme

B.Sc. (Hons.) Chemistry Semester-VI

(Effective from the session: 2022-23)

Shri Rawatpura Sarkar University

Raipur, Chhattisgarh

Department of Chemistry

Faculty of Science,

Three Year Bachelor of Science (Hons.) in Chemistry Programme

B.Sc. (Hons.) Chemistry Semester-VI

Scheme of Teaching and Examination

Outcome Based Education (OBC) and Choice Based Credit System (CBCS)

(Effective from the session: 2022-2023)

S. No.	Course Code	Course Title	Hours/ Week			Credit	Maximum Marks			Sem End Exam Duration (Hrs)
			L	T	P		Continuation Evaluation	Semester End Examination	Total	
1	SSH02601T	Inorganic Chemistry-IV	4	-	-	4	30	70	100	3.0
2	SSH02602T	Physical Chemistry-IV	4	-	-	4	30	70	100	3.0
3	SSH02603T	Organic Chemistry-IV	4	-	-	4	30	70	100	3.0
4	SSH02634T	Green Chemistry	4	-	-	4	30	70	100	3.0
5	SSH02635T	Polymer Chemistry								
6	SSH02636T	Industrial Chemistry	4	-	-	4	30	70	100	3.0
7	SSH02637T	Analytical Methods in Chemistry								
8	SSH02681P	Chemistry Lab Course: IX	-	-	4	2	15	35	50	5.0
9	SSH02682P	Chemistry Lab Course: X	-	-	4	2	15	35	50	5.0
10	SSH02683P	Chemistry Lab Course: XI	-	-	4	2	15	35	50	5.0
	Total teaching hrs/week: 32		**Total Credits**			**26**	**Total Marks**		**650**	

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Course Title	**Inorganic Chemistry-IV**				
Course Code	**SSH02601T**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**Inorganic chemistry III**				
Course Objectives	**To understand the basics of inorganic chemistry**				
Course Contents	**UNIT I** Theoretical Principles in Qualitative Analysis (H_2S Scheme) Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II. **UNIT II** Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands, Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT, acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding, Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls. **UNIT III** General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer &Bsworthdiagrams). Difference between the first, second and third transition series.Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkylaluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene. **UNIT IV** **Reaction Kinetics and Mechanism-**Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect,				

	theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes **UNIT V** **Catalysis by Organometallic Compounds-**Study of the following industrial processes and their mechanism: Alkene hydrogenation (Wilkinsons Catalyst), Hydroformylation (Co salts),Wacker Process, Synthetic gasoline (Fischer Tropsch reaction),Synthesis gas by metal carbonyl complexes
Course Outcomes	On the completion of this course successfully student will be able to CO 1 : Understand the Theoretical Principles in Qualitative Analysis CO 2 : Learn about the organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands, Metal carbonyls: 18 electron rule CO 3 : Gain the knowledge of electronic configuration, colour, variable valency, magnetic and catalytic properties of Grignard reagent and Ferrocene CO 4 : Understand about inorganic reaction mechanisms CO 5 : Study about the industrial processes and their mechanism:
Text Books	1. Svehla, G. Vogel's Qualitative Inorganic Analysis, 7th Edition, Prentice Hall, 1996. 2. Cotton, F.A.G.; Wilkinson &Gaus, P.L. Basic Inorganic Chemistry 3rd Ed.; Wiley India, 3. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson,2006. 4. Sharpe, A.G. Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005 5. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry3rd Ed., John Wiley and Sons, NY, 1994. 6. Greenwood, N.N. &Earnshaw, A. Chemistry of the Elements, Elsevier 2nd Ed, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution). 7. Lee, J.D. Concise Inorganic Chemistry 5th Ed., John Wiley and sons 2008. 8. Powell, P. Principles of Organometallic Chemistry, Chapman and Hall, 1988.

Reference Books	1. Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994. 2. Basolo, F. & Pearson, R. Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed., John Wiley & Sons Inc; NY. 3. Purcell, K.F. &Kotz, J.C., Inorganic Chemistry, W.B. Saunders Co. 1977 4. Miessler, G. L. &Tarr, D.A. Inorganic Chemistry 4th Ed., Pearson, 2010. 5. Collman, J. P. et al. Principles and Applications of Organotransition Metal Chemistry. Mill Valley, CA: University Science Books, 1987. 6. Crabtree, R. H. The Organometallic Chemistry of the Transition Metals. j New York, NY: John Wiley, 2000. 7. Spessard, G. O. &Miessler, G.L. Organometallic Chemistry. Upper Saddle River, NJ: Prentice-Hall, 1996.

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Course Title	**Physical Chemistry IV**				
Course Code	**SSH02602T**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**Physical Chemistry III**				
Course Objectives	• **To understand the importance of electrochemistry**				
Course Contents	**UNIT I** Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules.. **UNIT II** Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.. **UNIT III** Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. **UNIT IV** Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb_2O_3 electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation). **UNIT V** Electrical & Magnetic Properties of Atoms and Molecules,Basic ideas of				

	electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment and molecular polarizabilities and their measurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement, molecular interpretation.
Course Outcomes	On the completion of this course successfully student will be able to CO 1 : Understand the Kohlrausch law of independent migration of ions and Debye-Hückel-Onsager equation CO 2 : determine the transference numbers using Hittorf and Moving Boundary methods CO 3 : Learn about the Nernst equation and its application CO 4 : Understand the Application of EMF measurements CO 5 : Study the Clausius-Mosotti equation and Lorenz-Laurentz equation,
Text Books	1. Atkins, P.W & Paula, J.D. Physical Chemistry, 10th Ed., Oxford University Press (2014). 2. Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004). 3. Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier: NOIDA, UP (2009).
Reference Books	1. Barrow, G. M., Physical Chemistry 5th Ed., Tata McGraw Hill: New Delhi (2006). 2. Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012). 3. Rogers, D. W. Concise Physical Chemistry Wiley (2010).Silbey, R. J.; Alberty, R. A. &Bawendi, M. G. Physical Chemistry 4th Ed., John Wiley & Sons, Inc. (2005).

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Course Title	**Organic Chemistry IV**				
Course Code	**SSH02603T**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**Organic Chemistry III**				
Course Objectives	• **To understand the importance of hetrocyclic compoundand alkoloids**				
Course Contents	**UNIT I** **Nucleic Acids**-Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides. **UNIT II** Amino acids, Peptides and their classification, α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pK_a values, isoelectric point and electrophoresis, Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups -Solid-phase synthesis. **UNIT III** **Enzymes;** Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition), **Lipids :**Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenntion of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity. **UNIT IV** **Concept of Energy in Biosystems-** Cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism, anabolism).ATP: The universal currency of cellular energy, ATP hydrolysis and free energy change. Agents for transfer of electrons in biological redox systems: NAD^+, FAD. Conversion of food to energy: Outline of catabolic pathways of carbohydrate- glycolysis, fermentation, Krebs cycle, Overview of catabolic pathways of fat and protein. Interrelationship in the metabolic pathways of protein, fat and carbohydrate. Caloric value of food, standard caloric content of food types. **UNIT V**				

	Pharmaceutical Compounds: Structure and Importance-Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).
Course Outcomes	On the completion of this course successfully student will be able to understand CO 1 : Study the Synthesis and reaction of Nucleic acids CO 2 : determine the group analysis and synthesis of peptide CO 3 : Understand about the Enzymes and its Mechanism CO 4 : Gain the knowledge of Concept of Energy in Biosystems CO 5 : Preparation and reactions Paracetamol, Ibuprofen etc
Text Books	1. Berg, J.M., Tymoczko, J.L. &Stryer, L. (2006) Biochemistry. 6th Ed. W.H. Freeman and Co. 2. Nelson, D.L., Cox, M.M. &Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
References Books	1. Murray, R.K., Granner, D.K., Mayes, P.A. &Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill

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Course Title	**Green Chemistry**				
Course Code	**SSH02634T**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**Student must have the basic knowledge of traditional method of synthesis of molecules.**				
Course Objectives	• Understand the basic knowledge of basics of green chemistry				
Course Contents	**UNITI** Introduction to Green Chemistry Green chemistry - Anastas' twelve principles of green chemistry -Principle of atomeconomy. Examples of reactions following the principles of green chemistry and atomeconomy,A. Green Preparation of propene,B. Green synthesis of Ibuprofen **UNITII** Green Reactions Acetylation of primary amine, base catalyzedaldol condensation (synthesis of dibenzalpropanone)- halogen addition to C=C bond (bromination of trans-stilbene)-[4+2] cycloaddition reaction (Diels-Alder reaction between furan and maleic acid). Rearrangement reaction (benzyl-benzilic acid rearrangement)- coenzyme catalysed benzoin condensation (thiamine hydrochloride catalyzed synthesis of benzoin. **UNITIII** Green Solvents Introduction –classification of ionic liquids- synthesis of ionic liquids – Ionic liquids: simple preparation – types – properties and application – ionic liquids in organic reactions (Heck reaction, Suzuki reactions and epoxidation)- Analytical chemistry gas chromatography stationary phases – advantages and disadvantages. Reactions in water and supercritical water and carbon dioxide. **UNITIV** Green Catalyst Supported metal catalysts – mesoporous silica. Phase transfer catalyst - Synthesis –applications. Magnetically recoverable catalysts. **UNITV** Alternative Synthesis, Reagents and Reaction Conditions Photo reduction of benzophenone to benzopinacol using sunlight. Photochemical alternative to Friedel-Crafts reaction and use of dimethyl carbonate as a methylating agent. Reaction in water - furan and maleic acid. Supercritical liquids – water and CO2.Extraction of D-limonene from orange peel. Green chemistry examples based on sonochemistry and mechanochemistry and photochemical principles in				

	greenchemistry.
Course Outcomes	On the completion of this course successfully student will be able to understand CO1 : A functional understanding of the field of green chemistry. CO2 : A working understanding of the 12 principles of green chemistry. CO3 : a several real world examples where organizations used green chemistry to improve the sustainability performance of their products. CO4 : An appreciation of how the practice of green chemistry enhances competitiveness, innovation and faster time to market. CO5 : The significance of green chemistry in industries specially to provide cleaner energy.
Text Books	1. V.K. Ahluwalia, Green Chemistry – Environmentally benign reactions. Ane Books, India, 2006. 2. Paul T. Anastas& Tracy C.., Williamson, Green Chemistry – DesigningChemistry for the Environment, 2nd edition, 1998. 3. Paul T. Anastas& Tracy C.., Williamson Green Chemistry – Frontiers in benign chemical synthesis and processes, Oxford University Press, New York, 1998..
References Books	1. RashmiSanghi, & M. M. Srivastava, Green Chemistry – Environment friendly alternatives, Narosa Publishing House, 2003. 2. M.C. Cann& M. E Connelly, Real world cases in Green Chemistry, American Chemical Society, 2008. 3. P.Tundo, A. Perosa and F. Zechini , Methods and Reagents for Green Chemistry, John Wiley & Sons Inc. New Jersy, 2007

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Course Title	**Polymer chemistry**				
Course Code	**SSH02635T**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**Student must have the knowledge of polymers**				
Course Objectives	• **Upon completion of the course the student shall be able tounderstand the properties and techniques involved in the polymerization of polymers**				
Course Contents	**UNITI** Introduction to Polymer and its Synthesis,Definition – Monomer- polymer-polymerization and degree of polymerization,Classification of polymers based on architecture- structure- thermal behaviorsynthesisand tacticity. Synthesis of high polymers- step growth polymerization- chaingrowth polymerization - free radical- ionic- coordination polymerization. SpecialTopics in polymer synthesis – metathesis- group transfer polymerization andmacromers in polymer synthesis. **UNITII** Structure and Properties of Polymers,Molecular weight- structure- properties-physical properties- solubility- viscositydensity, crystallinity. Chemical properties, thermal properties- glass transitiontemperature, heat distortion temperature. Electrical properties- optical propertiesmechanicalproperties-rheological properties and magnetic properties. **UNITIII** Polymerization Techniques and Processing,Techniques of Polymerization – Bulk, solution, suspension, emulsion techniques,Other techniques – Interfacial polymerization technique and plasma polymerization technique. Processing of Polymers – principles of processing-melt- rubbery stagesolution- emulsion and suspension. Techniques for polymer processingcompression, extrusion-spinning- casting- transfer and injection **UNITIV** **Characterization of Polymers** Techniques for determination of molecular weight – Gel Permeation Chromatography. Techniques for determination of Morphology -X-Ray diffractometer- electron microscope- atomic force microscopy and scanning tunneling microscopy- scanningelectron microscopy and transmission electron microscope. Techniques for determination of thermal behavior of polymers – thermo gravimetric analysis differential thermal analysis-differential scanning calorimetry- dynamic mechanical analysis and thermo				

	mechanical analysis. **UNITV** Advances in Polymers,Biopolymers and biodegradable polymers in medical field- high temperature and fire resistant polymers- silicones. Application of polymers in solar cells- conducting polymers and composites (basic idea only).
Course Outcomes	On the completion of this course successfully student will be able to CO1 : learn about the Polymerization and its types. CO2: understand the Characterization Polymers with standard methods. CO3 : determine the physic-chemical properties of polymers CO4 : gain the knowledge about Polymer Processing CO5 : understand the Commercial use of Polymers
Text Books	1. Fred. W. Billmeyer, Textbook of Polymer Science, 3rd edition, Wiley India, Delhi, 2008. 2. Jeol R. Fried, Polymer Science and Technology, Prentice Hall of India Private Limited, New Delhi, 1999 3. PremamoyGhosh, Polymer Science and Technology: Plastics, Rubbers, Blends and Composites, 3rd edition, McGraw Hill Education (India) Private Limited, 2011.
References Books	1. NiranjanKarak, Fundamentals of Polymers Raw Materials to Finish Products, PHI Learning Private Limited, New Delhi, 2009. 2. M.G. Arora, M. Singh and M.S. YadavPolymer Chemistry, 2nd revised edition, Anmol Publications Private Ltd., New Delhi, 1989. 3. V. R. Gowariker, N.V. Viswanathan, JayadevSreedhar, Polymer Science, New Age International (P) Limited, Publishers, New Delhi, 2009.

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Course Title	**Industrial Chemistry**				
Course Code	**SSH02636T**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**Basic knowledge of industrial chemistry**				
Course Objectives	• **Upon completion of the course the student shall be able toindustrial chemistry**				
Course Contents	**UNITI** **Industrial Fuels**-Energy sources- Classification of fuels –solid- liquid and gaseous.Calorific value offuels and its determination.Solid fuels – coal- lignite-sub-bituminous coal- bituminouscoal and anthracite.Coking and non-coking coal. Liquid fuels – petroleum refining anduses. Hydrodesulphurisation and cracking (thermal and catalytic - fixed bed andfluidised bed).Octane number.Production and uses of tetraethyl lead- ETBE andMTBE. Gaseous fuels - natural gas and gobar gas –production- composition anduses-gobar electric cell. **UNITII** Chemistry in Agriculture Fertilizers- NPK- superphosphate- triple superphosphate- uses of mixed fertilizers. Micronutrients and their role, biofertilizers- plant growth harmones. Pesticides- classification of pesticides with examples. Insecticides - stomach poisonscontact insecticides- fumigants. Manufacture and uses of insecticides. DDT- BHC (gammaxane: Conformation of gamma isomer) pyrethrin, banned pesticides. Herbicides -manufacture of 2,4-D and 2,4,5-T. Fungicides -preparation of Bordeaux mixture-lime-sulphur creosote oil (formula only). Sugar industry - double sulphitation process. Refining and grading of sugar. Saccharin - use as a sugar substitute-aspartame. **.UNIT III** Water Treatment Introduction-sources of water. Hardness of water- temporary and permanenthardness - units of hardness disadvantages of hard water. Effect of iron andmanganese in water. Estimation of hardness – EDTA method and alkali titrationmethod. Water softening methods - Zeolite process- ion-exchange demineralisationmixed– bed deionisation. Domestic waste water treatment. Purification methods –chlorination- break point chlorination. Reverse osmosis - Desalination. **UNITIV** Pollution and Chemical Toxicology Pollution: Air pollution –causes and effects. Acid rain- Greenhouse effect (globalwarming)-ozone layer depletion-photochemical oxidants. Control measures of airpollution. Water pollution –					

	organic pollutants- chemical oxygen demand (COD)-biological oxygen demand (BOD) - total organic carbon and carbondioxide captureand sequestration.Chemical toxicology: Effect of toxic chemicals on enzymes. Lead-mercury andcyanide pollution and their biochemical effects. Carbon monoxide, sulfurdioxideoxidesof nitrogen- ozone - biochemical effects. **UNITV** Cement, Glass and CeramicsCement: Manufacturing – Wet Process and Dry process- types- analysis of major constituents- setting of cement- reinforced concrete. Cement industries in India.Glass: Composition and manufacture of glass. Types of glasses- optical glasscolouredglasses and lead glass. Ceramics: Types- raw materials-white waresmanufactureand uses.
Course Outcomes	On the completion of this course successfully student will be able to understand CO1 : the sources, classification and development of the fuel. CO2 : Chemistry in Agriculture.(Fertiliser, Bio Fertilizer, Insecticides, Pesticides) CO3 : Methods of water treatment and softening. CO4 : food analysis, food adulteration. Extraction , Purification and identification of pesticides in food. CO5 : Manufacturing and setting of cement. Composition and manufacture of glass.
Text Books	1. R.Norris Shreve and Joseph A. Brink, Jr., Chemical process industries, 4th edition, McGraw – Hill, Kogakusha, Ltd, New York, 1977. 2. T. George Austin, Shreve's Chemical Process industries, 5th edition, McGraw –Hill, New York, 1984.
References Books	1. P. C. Jain and M.C. Jain, Engineering Chemistry, 10th edition, DhanpatRai and Sons, New Delhi, 1993. 2. A. K.De, Environmental Chemistry, 2nd edition, Wiley Eastern Ltd., Delhi, 1986. 3. E. S Manahan, Fundamentals of Environmental Chemistry, 2nd edition, CRC Press, Florida, 2000. 4. N. S. SubbaRao, Biofertilizers in Agriculture, Oxford and IBH Publishing Co Pvt Ltd, New Delhi, 1982.

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Course Title	**Analytical methods in chemistry**				
Course Code	**SSH02637T**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**Knowledge of chemistry**				
Course Objectives	• **Upon completion of the course the student shall be able to analytical methods in chemistry**				
Course Contents	**UNITI** Qualitative and quantitative aspects of analysis: Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals. **UNITII** Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enoltautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method. **UNITIII** Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator& detector) for single and double beam instrument; sampling techniques.Structural illustration through interpretation of data, Effect and importance of isotope substitution,Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples. **UNIT IV** Thermal methods of analysis: Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture, Electroanalytical methods: Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.				

	UNITV Separation techniques: Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation.Technique of extraction: batch, continuous and counter current extractions.Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange.Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.
Course Outcomes	On the completion of this course successfully student will be able to understand CO1 : Qualitative and quantitative aspects of analysis CO2 : learn the UV-Visible Spectrometry: Basic principles of instrumentation for single and double beam instrument CO3 : gain the knowledge of Infrared Spectrometry: Basic principles of instrumentation for single and double beam instrument CO4 : Study on theory and instrumentation of thermogravimetry. CO5 : understand the principle and efficiency of the Separation techniques
Text Books	1. Mendham,J.,A.I.Vogel'sQuantitativeChemicalAnalysis6thEd.,Pearson, 2009. 2. Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA,1988. 3. Christian,G.D.AnalyticalChemistry,6thEd.JohnWiley&Sons,NewYork,2004. 4. Harris,D.C.:ExploringChemicalAnalysis,9thEd.NewYork,W.H.Freeman,2016.
References Books	1. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009. 2. Skoog, D.A. Holler F.J. &Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed. 3. Mikes, O. Laboratory Hand Book of Chromatographic & Allied Methods, EllesHarwood Series on Analytical Chemistry, John Wiley & Sons, 1979. 4. Ditts, R.V. Analytical Chemistry; Methods of separation, van Nostrand, 1974.

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<table>
<tr><td>Course Title</td><td colspan="5">Chemistry Lab Course: IX</td></tr>
<tr><td>Course Code</td><td colspan="5">SSH02681P</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>-</td><td>-</td><td>2</td><td>2</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Practical knowledge of chemistry VII</td></tr>
<tr><td>Course Objectives</td><td colspan="5">To enable the students to develop skills inorganic, physical and organic chemistry.</td></tr>
<tr><td>Course Contents</td><td colspan="5">Performed any 10 experiment
UV/Visible spectroscopy
1. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1},eV).
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of$K_2Cr_2O_7$.
3. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organiccompounds.
Colourimetry
1. Verify Lambert-Beer’s law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration
2. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in amixture.
3. Study the kinetics of iodination of propanone in acidic medium.
4. Determine the amount of iron present in a sample using1,10-phenathroline.
5. Determine the dissociation constant of an indicator (phenolphthalein).
6. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
7. Analysis of the given vibration-rotation spectrum ofHCl(g)
8. Any other experiment carried out related to physical chemistry.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">On the completion of this course successfully student will be able to</td></tr>
</table>

	CO 1 : Verification of Beer's Lambert Law. CO 2 : Determine the absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ CO 3 : Obtain the UV spectra of (acetone, acetaldehyde, 2-propanol, acetic acid) in water CO 4 : Determine the amount of iron present in a sample CO 5 : Study the pH-dependence of the UV-Vis spectrum
Text Books	1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G.,Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996. 2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960. 3. Khosla, B. D.; Garg, V. C. &Gulati, A. Senior Practical Physical Chemistry,R. Chand & Co.: New Delhi (2011). 4. Ahluwalia, V.K. &Aggarwal, R. Comprehensive Practical Organic Chemistry, UniversitiesPress.
Reference Books	1. Khosla, B. D.; Garg, V. C. &Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi(2011). 2. Garland,C.W.;Nibler,J.W.&Shoemaker,D.P.ExperimentsinPhysicalChemistry 8th Ed.; McGraw-Hill: New York(2003). 3. Halpern,A.M.&McBane,G.C.ExperimentalPhysicalChemistry3rdEd.; W.H. Freeman & Co.: New York(2003).

Course Title	**Chemistry Lab Course: X**				
Course Code	**SSH02682P**				
Course Credits	**L**	**T**	**P**	**TC**	
	-	**-**	**2**	**2**	
Prerequisites	**Practical knowledge of chemistry VII**				
Course Objectives	• **To enable the students to develop practical skills on organic chemistry experiments**				
Course Contents	**Performed any 10 experiment**				

	1. Extraction of caffeine from tea leaves. 2. Preparation of sodium polyacrylate. 3. Preparation of urea formaldehyde. 4. Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars. 5. Qualitative analysis of unknown organic compounds containing monofunctional groups (carbohydrates, arylhalides, aromatichydrocarbons, nitrocompounds, amines and amides) and simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols,etc. 6. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to beprovided). 7. Preparation of methyl orange. 8. Determination of cation exchange method 9. Determination of total difference of solids. 10. Synthesis of hydrogel by co-precipitation method. 11. Synthesis of silver and gold metal nanoparticles. Any other experiment carried out related to inorganic and organic chemistry
Course Outcomes	On the completion of this course successfully student will be able to CO 1 : Performed the Extraction of caffeine from tea leaves CO 2 : Synthesis of Inorganic preparations, Cuprous Chloride, MnPO4.H2O, Potash alum CO 3 : Prepare the methyl orange. CO 4 : Practically perform the Qualitative analysis of unknown organic compounds CO 5 : Analyze the Carbohydrate
Text Books	1. Mann,F.G.&Saunders,B.C.PracticalOrganicChemistry, PearsonEducation (2009) 2. Furniss,B.S.;Hannaford,A.J.;Smith,P.W.G.;Tatchell,A.R.Practical Organic Chemistry, 5th Ed., Pearson(2012)
Reference Book	1. Ahluwalia, V.K. &Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

Three year Bachelor of Science (Hons) in Chemistry programme
B.Sc. (Hons) Chemistry Semester-VI
2022-2023

Course Title	**Chemistry Lab Course: XI**				
Course Code	**SSH02683P**				
Course Credits	**L**	**T**	**P**	**TC**	
	-	**-**	**2**	**2**	
Prerequisites	**Basic Knowledge of chemistry practical**				
Course Objectives	• **To be familiar with the develop practical skills on green chemistry experiments**				

Course Contents

Five experiments from Elective II and III each

II A Green Chemistry

1. Preparation and characterization of nanoparticles of gold using tea leaves.
2. Preparation of biodiesel from vegetable/ waste cooking oil.
3. Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.
4. Preparation of propene by two methods can be studied
5. Triethylamine ion + OH^- → propene + trimethylpropene + water

$$\text{1-propanol} \xrightarrow{H_2SO_4/\square} \text{propene + water}$$

6.
7. Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.
8. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.
9. Extraction of D-limonene from orange peel using liquid CO_2 prepared form dry ice. Mechanochemical solvent free synthesis of azomethines
10. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).
11. Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

II B. Polymers chemistry

1. Determination of molecular weight by viscometry:

a. Polyacrylamide-aq.$NaNO_2$solution

b. (Poly vinyl proplylidine (PVP) inwater

	2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH)andthefractionof"head-to-head"monomerlinkagesinthepolymer. 3. Determinationofmolecularweightbyendgroupanalysis:Polyethyleneglycol(PEG) (OHgroup). 4. Testing of mechanical properties ofpolymers. 5. Determinationofhydroxylnumberofapolymerusingcolorimetricmethod. 6. EstimationoftheamountofHCHOinthegivensolutionbysodiumsulphitemethod 7. IR studies ofpolymers 8. DSC analysis ofpolymers 9. Preparation of polyacrylamide and itselectrophoresis 10. Preparation of urea-formaldehyderesin III A. Industrial chemistry 1. Determination of dissolved oxygen inwater. 2. Determination of Chemical Oxygen Demand(COD) 3. DeterminationofBiologicalOxygenDemand(BOD) 4. Percentageofavailablechlorineinbleachingpowder. 5. Measurementofchloride,sulphateandsalinity ofwatersamplesbysimpletitration method ($AgNO_3$ and potassiumchromate). 6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method. 7. Estimation of SPM in airsamples. 8. Determination of free acidity in ammonium sulphatefertilizer. 9. Estimation of Calcium in Calcium ammonium nitratefertilizer. 10. Estimation of phosphoric acid in superphosphatefertilizer. 11. Electroless metallic coatings on ceramic and plasticmaterial. 12. Determination of composition of dolomite 13. (by complexometrictitration). 14. Analysis of (Cu, Ni); (Cu, Zn) in alloy or syntheticsamples. 15. Analysis ofCement. 16. Preparation of pigment (zincoxide). 17. Determination of pH ofsoil,Total solublesalt

	18. Estimation of calcium, magnesium, phosphate,nitrate in soil III B. Analytical methods in chemistry 1. Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}. 2. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values. 3. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values. 4. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC 5. **T**o separate a mixture of Ni^{2+}& Fe^{2+} by complexation with DMG and extracting the Ni^{2+}- DMG complex in chloroform, and determine its concentration by spectrophotometry. 6. Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium 7. DeterminethepHofthegivenaerateddrinksfruitjuices,shampoosandsoaps. 8. Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques.
Course Outcomes	On the completion of this course successfully student will be able to CO 1 : Prepare of biodiesel from vegetable/ waste cooking oil. CO 2 : Synthesis of Inorganic preparations, Cuprous Chloride, MnPO4.H2O, Potash alum CO 3 : Understand the enthalpy of ionization of ethanoic acid. CO 4 : Practically perform the Estimation of calcium, magnesium, phosphate, nitrate in soil CO 5 : Preparation and characterization of nanoparticles of gold using tea leaves.
Text Books	1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK. 2. R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi. 3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi. 4. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi. 5. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009. 6. Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed.

	Wardsworth Publishing Company, Belmont, California, USA, 1988. 7. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004. 8. Harris, D.C. Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016. 9. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009. 10. M.P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed., Oxford University Press, 1999.
Reference Books	1. H.R. Allcock, F.W. Lampe & J.E. Mark, Contemporary Polymer Chemistry, 3rd ed. Prentice-Hall(2003) 2. F.W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley-Interscience(1984) 3. J.R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall(2003) 4. P. Munk& T.M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John Wiley & Sons(2002) 5. Ahluwalia, V.K. &Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers (2005). 6. Anastas, P.T. & Warner, J.K.: Green Chemistry - Theory and Practical, Oxford University Press (1998). 7. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001). 8. Cann, M.C. &Connely, M.E. Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).