

		The Maharaja Sayajirao University of Baroda		ACADEMIC YEAR	
		Faculty of Science		2023-2024	
		Department of Chemistry			
Bachelor of Science					
YEAR	1	IKS2121C		CREDIT	2
Semester	I	Ayurveda and Ancient Indian Metallurgy		HOURS	30
OBJECTIVES:		Study of Traditional Indian Knowledge in context to Chemistry/Science in the development of metallurgy and Ayurveda (Health Science)			
COURSE CONTENT / SYLLABUS					
UNIT-I		INDIAN METALLURGY:			15 hrs.
		Vedic references to metals and metal working. Mining and manufacture in India of Zinc, Iron, Copper, Gold, etc., from ancient times. Indian texts which refer to metallurgy. Important specimens of metal workmanship preserved/found in different parts of India. The significance and wide prevalence of ironsmith and other metal workers n the pre-modern era. European observers on the high quality and quantity of Indian iron and steel in the 18/19 th centuries.			
UNIT-II		INDIAN HEALTH SCIENCES			15 hrs.
		Vedic foundations of Ayurveda. Ayurveda is concerned both with maintenance of good health and treatment of diseases. Basic concepts of Ayurveda. The three Gunas and Three Doshas, Pancha-mahabhuta and Sapta-dhatu. The importance of Agni (digestion). Six Rasas and their relation to Doshas. Ayurvedic view of the cause of diseases. Dinacharya or daily regimen for the maintenance of good health. Ritucharya or seasonal regimen. Important texts of Ayurveda. Selected extracts from Astāngahrdaya (selections form Sutrasthana) and Susruta-Samhita (section on plastic surgery, cataract surgery and anal fistula). The large pharmacopeia of Ayurveda. Natural products of native Indian origin in the context of Ayurvedic medicine.			
REFERENCES					
1	Dharampal, Indian Science and Technology in the Eighteenth Century: Some Contemporary European Accounts, Dharampal Classics Series, Rashtrothana Sahitya, Bengaluru, 2021.				
2	D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2 nd Ed., Universities Press, Hyderabad, 2010.				
3	Ashoka K. Mishra, Ancient Indian Metallurgy: Theory and Practice, Agam Kala Prakashan, 2009				
4	A. Dandekar, A. Joshi and I . Dandekar, Vedic Metallurgy: Unveiling the ancient Technology, Notion Press, 2020.				
3	Astāngahrdaya, Vol. 1, Sūtrasthāna and Śārīrasthāna, Translated by K. R. Srikantha Murthy, Vol. I, Krishnadas Academy, Varanasi, 1991.				
4.	V. Lad, Complete Ayurvedic Home remedies, Little Brown Book Group, 2006				
5.	P. C. Ray, History of Chemistry in Ancient and Medieval India, Chowkhamba Krishnadas Academy, 1 st Ed. 2014				
6.	B.V. Subbarayappa, Indian Alchemy: its origin and Ramifications, Centre for studies in Civilisations, New Delhi, 1999				
7.	M. Sabnis, Chemistry and Pharmacology of Ayurvedic Medicinal plants, C A Prakashan, 2006				

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry The Maharaja Sayajirao University of Baroda, Vadodara			ACADEMIC YEAR 2023-2024	
Bachelor of Science						
YEAR	1	<u>IKS2111C</u>			CREDIT	2
Semester	I	Ancient Methods of Identification of Chemicals			HOURS	40
OBJECTIVES:		Practical Training in Qualitative and Quantitative analysis				
COURSE CONTENT / SYLLABUS						
I	Volumetric analysis:					20 hrs.
	Acidimetry – Alkalimetry Oxidation – Reduction Iodometry – Iodimetry					
II	Organic Spotting					
	Systematic analysis of mono-functional organic compounds.					
	Minimum Eight Samples to be Analyzed.					
REFERENCES						
1.	Shah R C, (2005) Inorganic Analysis Part I Qualitative, Baroda Book Depot, Vadodara					
2.	Shah R C, (2005) Inorganic Analysis Part II Quantitative, Baroda Book Depot, Vadodara					
3.	Shah R C, (2001) Organic Analysis Part I Qualitative Analysis Baroda Book Depot, Vadodara					

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry The Maharaja Sayajirao University of Baroda, Vadodara		ACADEMIC YEAR 2023-2024	
Bachelor of Science					
YEAR	1	CHM2001C		CREDIT	4
Semester	I	Basics of Chemistry-I		HOURS	60
OBJECTIVES:		Study of Some fundamental aspects in chemistry.			
COURSE CONTENT / SYLLABUS					
UNIT-I		<i>Metallic and electrolytic conductors:</i> <i>Metallic and electrolytic conductors:</i> Conduction of electricity by metals and solutions. Arrhenius theory of electrolytic dissociation. Specific, equivalent and molar conductance - measurement of conductance - variation of conductance with dilution for strong and weak electrolytes, Molar conductivity at infinite dilution. Debye-Huckel- Onsager (D-H-O) theory of electrolytic conductance. Wien effect, Debye-Falkenhagen effect, Walden's rule. Ionic velocities, mobilities, and their determinations, Transport number and its determination by Hittorff's and moving boundary method. Effect of temperature and concentration: ionic mobility and ionic conductance - Kohlrausch's law and its applications, conductometric titrations.			15 hrs.
UNIT-II		<i>Chemistry of Alkanes and Alkyl Halides</i> <i>Chemistry of Alkanes:</i> Introduction, Preparation of alkanes: catalytic hydrogenation of alkenes and alkynes; reduction of alkyl halide using metal & mineral acid; hydrolysis of Grignard reagent, Corey-House synthesis, Wurtz reaction, Wurtz-Fittig reaction. <i>Reactions of alkanes:</i> combustion; efficiency of fuels; octane and cetane numbers.; halogenations of alkanes; free radical mechanism (orientation, reactivity, selectivity, transition state and reaction intermediates, stability and relative energy of free radicals). <i>Alkyl halides:</i> Synthesis from alcohols; alkanes; alkenes; alkynes; Hunsdiecker reaction. Reactions of alkyl halides: S _N ¹ and S _N ² reactions (kinetics, stereochemistry, solvent effects); reactions of alkyl halides with ⁻ OH, H ₂ O, RC≡C-, CN ⁻ , NH ₃ , R-M, I ⁻ , RCOO ⁻ ; E1 and E2 mechanism of dehydrohalogenation, orientation and reactivity. Generation of carbocation; structure; stability; hyperconjugation; energy diagram; 1,2 hydride shift; 1,2 alkyl shift; 1,2 aryl shift and reactions of carbocations.			15 hrs.
UNIT-III		<i>Atomic Structure</i> : Dual nature of radiation and matter, de Broglie's principle, Heisenberg's Uncertainty principle, Schrödinger wave equation and its interpretation, origin of quantum numbers and symbols for orbitals, shapes of orbitals - s, p, d. Radial and angular probabilities. Electronic configuration and Periodic properties – atomic size, ionization energy, electron affinity, electronegativity. Trends in the metallic character. <i>Chemical Bonding:</i> Introduction to types of bonds. <i>Ionic compounds:</i> Lattice energy and factors affecting it, Madelung constants, Born-Haber Cycle. Applications of lattice energetics. Solvation energy. Effect of lattice energy and solvation on the solubility of ionic compounds. <i>Covalent bonding:</i> Valence Shell Electron Pair Repulsion (VSEPR) theory and shapes of simple covalent molecules like H ₂ O, NH ₃ , BF ₃ , CH ₄ , PCl ₅ , SF ₆ , IF ₇ .			15 hrs.

	<i>Valence Bond Theory (VBT)</i> - assumptions, linear combination of atomic orbitals and properties of hybrid orbitals. hybridization involving s, p and d orbitals (dsp^2 , sp^3d , dsp^3 , d^2sp^3 , sp^3d^2 , sp^3d^3) and shapes of simple molecules like SF_6 , IF_5 , PCl_5 , IF_7 . Concept of resonance (including examples of various oxyanions).	
UNIT-IV	<i>Volumetric Analysis:</i>	15 hrs.
	Acidimetry – Alkalimetry Oxidation – Reduction Iodometry – Iodimetry	
REFERENCES		
1	Atkins P. and Paula J. D. (2006), Physical Chemistry, 8 th Edition (International Student Edition) Oxford Univ. Press, New Delhi.	
2	Puri, B. R., Sharma, L.R. and Pathania, M. S. (2005), 41 st Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar	
3	Bahl, B.S., Bahl A. and Tuli, G.D. (2007), Essentials of Physical Chemistry, 25 th Edition, S. Chand, New Delhi.	
4	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York.	
5	Pine S.H; (1993) Organic Chemistry, McGraw Hill, New Delhi.	
6	Loudon G M; (2002) Organic Chemistry, Oxford, New York.	
7	Roberts J.D. and Caserio M.C., (1992) Basic Principles of Organic Chemistry, 2 nd Edition, W.A. Benjamin Inc., California	
8	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York.	
9	Singh S.P. and Mukherjee S.M; (1984) Organic Chemistry, McMillan India.	
10	Tewari K. S. and Vishnoi N. K.; (2006) A Textbook of Organic Chemistry, Vikas Publishing House, New Delhi.	
11	Sharma B.K.(2006) Industrial Chemistry, Goel Publishing House,	
12.	Shah R C, (2005) Inorganic Analysis Part II Quantitative, Baroda Book Depot, Vadodara	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry The Maharaja Sayajirao University of Baroda, Vadodara		ACADEMIC YEAR 2023-2024	
Bachelor of Science					
YEAR	1	CHM2011C		CREDIT	4
Semester	I	Basic of Chemistry-II		HOURS	60
OBJECTIVES:		Basics of chemical properties and Unsaturated Organic Compounds Identification of organic monofunctional compounds			
COURSE CONTENT / SYLLABUS					
UNIT-I	<i>Electronic configuration and chemical properties</i> <i>Electronic configuration and chemical properties:</i> Origin of quantum numbers and their relation to the symbols and energy of atomic orbitals, radial and angular probabilities. <i>Electronic configuration and Periodic properties</i> –atomic size, ionization energy, electron affinity, electronegativity. Trends in the metallic character. Ionization of elements and stabilization of various oxidation states. Characteristic and distinctive properties of elements. <i>Chemistry of s-Block elements:</i> Hydrogen. Hydrides-Classification and Chemistry. Alkali Metals: Li, Na, K, Rb and Cs–occurrence, comparative study of elements, oxides, halides, hydroxides and carbonates. Exceptional property of Lithium. <i>Alkaline Earth Metals:</i> Be, Mg, Ca, Sr and Ba –occurrence, and comparative study of the elements, oxides, hydroxides, halides, sulphates and carbonates. Exceptional property of Beryllium. Chemistry of Nobel Gases: Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.				15 hrs.
UNIT-II	<i>Chemistry of Alkenes and Alkynes.</i> <i>Alkenes:</i> Nomenclature, geometric isomerism, preparation of alkenes from halides elimination reactions, E1, E2 and E1cb mechanisms, dehydration of alcohols and dehalogenation of vicinal dihalides, Saytzeff and Hofmann elimination. Electrophilic addition reactions and orientation; mechanism of addition of H ₂ , X ₂ , HX, H ₂ SO ₄ , H ₂ O and X ₂ /H ₂ O, addition of alkenes, oxymercuration-demercuration, hydroboration, hydroxylation (syn. And anti), Structure, reactivity and stability of allyl and vinyl radicals, ozonolysis and its use in structure determination. <i>Alkynes:</i> Introduction, Preparation from CaC ₂ and alkyl halides, acidity of alkynes and formation of acetylides with Na, Ag, Cu and Grignard reagents. Reactions of alkynes with H ₂ , X ₂ , HX and H ₂ O. tautomerism.				15 hrs.
UNIT-III	<i>Introduction to Analytical Science</i> <i>Introduction to Analytical Science.</i> Basic Tools of Analytical Chemistry. Vocabulary of Analytical Chemistry- Analysis, Determination, Measurement, Techniques, Methods, Procedures, Protocols, Sample, Analyte. Different methods of expressing concentration- Weight by weight and Weight by volume methods. Qualitative and Quantitative Analysis, comparison. Principles of Qualitative Analysis – Solubility product, common ion effect and Ph – effects on solubility. Systematic Qualitative analysis scheme based on the above principles <i>Evaluating Analytical Data</i> -Significant figures, Types of Errors involved during analysis-determinate and indeterminate, detection of errors and correction, rejection of data				15 hrs.

	(based on standard deviation, coefficient of variation and Q- test). Numerical problems based on all the above topics mentioned in the unit. Thermochemistry: Standard states, standard enthalpy of formation-Hess's law of heat summation and its application. Kirchoff's equation.	
UNIT-IV	Organic Spotting	15 hrs.
	Systematic analysis of mono-functional organic compounds. Minimum Eight Samples to be Analyzed.	
REFERENCES		
1.	Lee J.D., (1991) Concise Inorganic Chemistry, 4th Edition, Chapman and Hall,	
2.	Puri B.R., Sharma L.R. and Kalia K.C., (2006). Principles of Inorganic Chemistry, 29th Edition, Milestone Publ., Delhi	
3.	Cotton F.A. and Wilkinson G., (2009) Basic Principles of Inorganic Chemistry, 3rd Edition, Wiley Eastern	
4.	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi	
5.	Pine S.H; (1993) Organic Chemistry, McGraw Hill, New Delhi.	
6.	Loudon G M; (2002) Organic Chemistry, Oxford, New York.	
7.	Roberts J.D. and Caserio M.C., (1992) Basic Principles of Organic Chemistry, 2 nd Edition, W.A. Benjamin Inc., California.	
8.	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York.	
9	Singh S.P. and Mukherjee S.M; (1984) Organic Chemistry, McMillan India.	
10	Tewari K. S. and Vishnoi N. K.; (2006) A Textbook of Organic Chemistry, Vikas Publishing House, New Delhi.	
11	Christian Gary, (2004) Analytical Chemistry, 6th Edition, John Wiley and Sons, Inc. New York.	
12	Khopkar, S.M.(2009) Basic Concepts of Analytical Chemistry New Age, International Publisher	
13	John Bassett (Editor) Vogel's Textbook of Quantitative Inorganic Analysis, Including Elementary Instrumental Analysis, 4th edition, Longman Science and Tech	
14.	Shah R C, (2001) Organic Analysis Part I Qualitative Analysis Baroda Book Depot, Vadodara	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry The Maharaja Sayajirao University of Baroda, Vadodara		ACADEMIC YEAR 2023-2024	
Bachelor of Science					
YEAR	1	CHE2001C (MINOR)		CREDIT	4
Semester	I	Basics of Chemistry-I		HOURS	60
OBJECTIVES:		Study of Some fundamental aspects in chemistry.			
COURSE CONTENT / SYLLABUS					
UNIT-I		<i>Metallic and electrolytic conductors:</i> <i>Metallic and electrolytic conductors:</i> Conduction of electricity by metals and solutions. Arrhenius theory of electrolytic dissociation. Specific, equivalent and molar conductance - measurement of conductance - variation of conductance with dilution for strong and weak electrolytes, Molar conductivity at infinite dilution. Debye-Huckel- Onsager (D-H-O) theory of electrolytic conductance. Wien effect, Debye-Falkenhagen effect, Walden's rule. Ionic velocities, mobilities, and their determinations, Transport number and its determination by Hittorff's and moving boundary method. Effect of temperature and concentration: ionic mobility and ionic conductance - Kohlrausch's law and its applications, conductometric titrations.			15 hrs.
UNIT-II		<i>Alkanes, Alkene and Alkyl Halides</i> <i>Alkanes:</i> Introduction, Preparation of alkanes: catalytic hydrogenation of alkenes and alkynes; reduction of alkyl halide using metal & mineral acid; hydrolysis of Grignard reagent, Corey-House synthesis. <i>Reactions of alkanes:</i> halogenations of alkanes; free radical mechanism . <i>Alkenes:</i> Nomenclature, geometric isomerism, preparation of alkenes from halides elimination reactions, E1, E2 mechanisms, dehydration of alcohols Saytzeff rule. Electrophilic addition reactions: mechanism of addition of H ₂ , X ₂ , HX, H ₂ SO ₄ , H ₂ O and X ₂ /H ₂ O, addition of alkenes, oxymercuration-demercuration, hydroboration, hydroxylation (syn. and anti). <i>Alkyl halides:</i> Synthesis from alcohols; alkanes; alkenes; alkynes;. Reactions of alkyl halides: S _N ¹ and S _N ² reactions (kinetics, stereochemistry); reactions of alkyl halides with ⁻ OH, H ₂ O, RC≡C ⁻ , CN ⁻ , NH ₃ , R-M, I ⁻ , RCOO ⁻ .			15 hrs.
UNIT-III		<i>Electronic configuration and chemical properties</i> <i>Electronic configuration and chemical properties:</i> Origin of quantum numbers and their relation to the symbols and energy of atomic orbitals, radial and angular probabilities. <i>Electronic configuration and Periodic properties</i> –atomic size, ionization energy, electron affinity, electronegativity. Trends in the metallic character. Ionization of elements and stabilization of various oxidation states. Characteristic and distinctive properties of elements. <i>Chemistry of s-Block elements:</i> Hydrogen. Hydrides-Classification and Chemistry. Alkali Metals: Li, Na, K, Rb and Cs–occurrence, comparative study of elements, oxides, halides, hydroxides and carbonates. Exceptional property of Lithium. <i>Alkaline Earth Metals:</i> Be, Mg, Ca,Sr and Ba -occurrence, and comparative study of the elements, oxides, hydroxides, halides, sulphates and carbonates. Exceptional property of Beryllium.			15 hrs.

	Chemistry of Nobel Gases: Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.	
UNIT-IV	Introduction to Analytical Science	15 hrs.
	<i>Introduction to Analytical Science.</i> Basic Tools of Analytical Chemistry. Vocabulary of Analytical Chemistry- Analysis, Determination, Measurement, Techniques, Methods, Procedures, Protocols, Sample, Analyte. Different methods of expressing concentration- Weight by weight and Weight by volume methods. Qualitative and Quantitative Analysis, comparison. Principles of Qualitative Analysis - Solubility product, common ion effect and pH - effects on solubility. Systematic Qualitative analysis scheme based on the above principles <i>Evaluating Analytical Data</i> -Significant figures, Types of Errors involved during analysis-determinate and indeterminate, detection of errors and correction, rejection of data (based on standard deviation, coefficient of variation and Q- test). Numerical problems based on all the above topics mentioned in the unit.	
REFERENCES		
1	Atkins P. and Paula J. D. (2006), Physical Chemistry, 8th Edition (International Student Edition) Oxford Univ. Press, New Delhi.	
2	Puri, B. R., Sharma, L.R. and Pathania, M. S. (2005), 41st Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar	
3	Bahl, B.S., Bahl A. and Tuli, G.D. (2007), Essentials of Physical Chemistry, 25th Edition, S. Chand, New Delhi.	
4	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York.	
5	Pine S.H; (1993) Organic Chemistry, McGraw Hill, New Delhi.	
6	Loudon G M; (2002) Organic Chemistry, Oxford, New York.	
7	Roberts J.D. and Caserio M.C., (1992) Basic Principles of Organic Chemistry, 2nd Edition, W.A. Benjamin Inc., California	
8	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York.	
9	Singh S.P. and Mukherjee S.M; (1984) Organic Chemistry, McMillan India.	
10	Tewari K. S. and Vishnoi N. K.; (2006) A Textbook of Organic Chemistry, Vikas Publishing House, New Delhi.	
11.	Lee J.D., (1991) Concise Inorganic Chemistry, 4th Edition, Chapman and Hall,	
12.	Puri B.R., Sharma L.R. and Kalia K.C., (2006). Principles of Inorganic Chemistry, 29th Edition, Milestone Publ., Delhi	
13.	Cotton F.A. and Wilkinson G., (2009) Basic Principles of Inorganic Chemistry, 3rd Edition, Wiley Eastern	
14	Christian Gary, (2004) Analytical Chemistry, 6th Edition, John Wiley and Sons, Inc. New York.	
15	Khopkar, S.M.(2009) Basic Concepts of Analytical Chemistry New Age, International Publisher	
16	John Bassett (Editor) Vogel's Textbook of Quantitative Inorganic Analysis, Including Elementary Instrumental Analysis, 4th edition, Longman Science and Tech	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry The Maharaja Sayajirao University of Baroda, Vadodara		ACADEMIC YEAR 2023-2024	
Bachelor of Science					
YEAR	1	MDC2201C		CREDIT	4
Semester	I	Basics of Chemistry-I		HOURS	60
OBJECTIVES:		Study of Some fundamental aspects in chemistry.			
COURSE CONTENT / SYLLABUS					
UNIT-I	<i>Metallic and electrolytic conductors:</i>				15 hrs.
	<i>Metallic and electrolytic conductors:</i> Conduction of electricity by metals and solutions. Arrhenius theory of electrolytic dissociation. Specific, equivalent and molar conductance - measurement of conductance - variation of conductance with dilution for strong and weak electrolytes, Molar conductivity at infinite dilution. Debye-Huckel- Onsager (D-H-O) theory of electrolytic conductance. Wien effect, Debye-Falkenhagen effect, Walden's rule. Ionic velocities, mobilities, and their determinations, Transport number and its determination by Hittorff's and moving boundary method. Effect of temperature and concentration: ionic mobility and ionic conductance - Kohlrausch's law and its applications, conductometric titrations.				
UNIT-II	<i>Alkanes, Alkene and Alkyl Halides</i>				15 hrs.
	<i>Alkanes:</i> Introduction, Preparation of alkanes: catalytic hydrogenation of alkenes and alkynes; reduction of alkyl halide using metal & mineral acid; hydrolysis of Grignard reagent, Corey-House synthesis. <i>Reactions of alkanes:</i> halogenations of alkanes; free radical mechanism . <i>Alkenes:</i> Nomenclature, geometric isomerism, preparation of alkenes from halides elimination reactions, E1, E2 mechanisms, dehydration of alcohols Saytzeff rule. Electrophilic addition reactions: mechanism of addition of H ₂ , X ₂ , HX, H ₂ SO ₄ , H ₂ O and X ₂ /H ₂ O, addition of alkenes, oxymercuration-demercuration, hydroboration, hydroxylation (syn. and anti). <i>Alkyl halides:</i> Synthesis from alcohols; alkanes; alkenes; alkynes;. Reactions of alkyl halides: S _N ¹ and S _N ² reactions (kinetics, stereochemistry); reactions of alkyl halides with ⁻ OH, H ₂ O, RC≡C ⁻ , CN ⁻ , NH ₃ , R-M, I ⁻ , RCOO ⁻ .				
UNIT-III	<i>Electronic configuration and chemical properties</i>				15 hrs.
	<i>Electronic configuration and chemical properties:</i> Origin of quantum numbers and their relation to the symbols and energy of atomic orbitals, radial and angular probabilities. <i>Electronic configuration and Periodic properties</i> –atomic size, ionization energy, electron affinity, electronegativity. Trends in the metallic character. Ionization of elements and stabilization of various oxidation states. Characteristic and distinctive properties of elements. <i>Chemistry of s-Block elements:</i> Hydrogen. Hydrides-Classification and Chemistry. Alkali Metals: Li, Na, K, Rb and Cs–occurrence, comparative study of elements, oxides, halides, hydroxides and carbonates. Exceptional property of Lithium. <i>Alkaline Earth Metals:</i> Be, Mg, Ca, Sr and Ba -occurrence, and comparative study of the elements, oxides, hydroxides, halides, sulphates and carbonates. Exceptional property of Beryllium.				

	Chemistry of Nobel Gases: Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.	
UNIT-IV	Introduction to Analytical Science	15 hrs.
	<i>Introduction to Analytical Science.</i> Basic Tools of Analytical Chemistry. Vocabulary of Analytical Chemistry- Analysis, Determination, Measurement, Techniques, Methods, Procedures, Protocols, Sample, Analyte. Different methods of expressing concentration- Weight by weight and Weight by volume methods. Qualitative and Quantitative Analysis, comparison. Principles of Qualitative Analysis - Solubility product, common ion effect and pH - effects on solubility. Systematic Qualitative analysis scheme based on the above principles <i>Evaluating Analytical Data</i> -Significant figures, Types of Errors involved during analysis-determinate and indeterminate, detection of errors and correction, rejection of data (based on standard deviation, coefficient of variation and Q- test). Numerical problems based on all the above topics mentioned in the unit.	
REFERENCES		
1	Atkins P. and Paula J. D. (2006), Physical Chemistry, 8th Edition (International Student Edition) Oxford Univ. Press, New Delhi.	
2	Puri, B. R., Sharma, L.R. and Pathania, M. S. (2005), 41st Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar	
3	Bahl, B.S., Bahl A. and Tuli, G.D. (2007), Essentials of Physical Chemistry, 25th Edition, S. Chand, New Delhi.	
4	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York.	
5	Pine S.H; (1993) Organic Chemistry, McGraw Hill, New Delhi.	
6	Loudon G M; (2002) Organic Chemistry, Oxford, New York.	
7	Roberts J.D. and Caserio M.C., (1992) Basic Principles of Organic Chemistry, 2nd Edition, W.A. Benjamin Inc., California	
8	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York.	
9	Singh S.P. and Mukherjee S.M; (1984) Organic Chemistry, McMillan India.	
10	Tewari K. S. and Vishnoi N. K.; (2006) A Textbook of Organic Chemistry, Vikas Publishing House, New Delhi.	
11.	Lee J.D., (1991) Concise Inorganic Chemistry, 4th Edition, Chapman and Hall,	
12.	Puri B.R., Sharma L.R. and Kalia K.C., (2006). Principles of Inorganic Chemistry, 29th Edition, Milestone Publ., Delhi	
13.	Cotton F.A. and Wilkinson G., (2009) Basic Principles of Inorganic Chemistry, 3rd Edition, Wiley Eastern	
14	Christian Gary, (2004) Analytical Chemistry, 6th Edition, John Wiley and Sons, Inc. New York.	
15	Khopkar, S.M.(2009) Basic Concepts of Analytical Chemistry New Age, International Publisher	
16	John Bassett (Editor) Vogel's Textbook of Quantitative Inorganic Analysis, Including Elementary Instrumental Analysis, 4th edition, Longman Science and Tech	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry The Maharaja Sayajirao University of Baroda, Vadodara		ACADEMIC YEAR 2023-2024	
Bachelor of Science					
YEAR	1	<u>SEC2141C</u>		CREDIT	2
Semester	I	Chemistry Lab-I		HOURS	40
OBJECTIVES:		Practical Training in Qualitative and Quantitative analysis			
COURSE CONTENT / SYLLABUS					
I	Volumetric analysis:				20 hrs.
	Acidimetry – Alkalimetry Oxidation – Reduction Iodometry – Iodimetry				
II	Organic Spotting				20 hrs.
	Systematic analysis of mono-functional organic compounds. Minimum Eight Samples to be Analyzed.				
REFERENCES					
1.	Shah R C, (2005) Inorganic Analysis Part I Qualitative, Baroda Book Depot, Vadodara				
2.	Shah R C, (2005) Inorganic Analysis Part II Quantitative, Baroda Book Depot, Vadodara				
3.	Shah R C, (2001) Organic Analysis Part I Qualitative Analysis Baroda Book Depot, Vadodara				

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry The Maharaja Sayajirao University of Baroda, Vadodara		ACADEMIC YEAR 2023-2024	
Bachelor of Science					
YEAR	1	<u>CHM2002C</u> Basics of Chemistry-III		CREDIT	4
Semester	II			HOURS	60
OBJECTIVES:					
Study of some fundamental aspect in chemistry Understanding of aromaticity of organic molecule Learning of qualitative analysis of inorganic salts					
COURSE CONTENT / SYLLABUS					
UNIT-I	Chemical Bonding Covalent Bond: Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH ₃ , H ₃ O ⁺ , SF ₄ , ClF ₃ , ICl ₂ ⁻ and H ₂ O. MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductor, lattice energy and Born-Haber cycle, salivation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond-free electron, valence bond and band theories. Weak interactions: hydrogen bonding and van der Waals forces.				15 hrs.
UNIT-II	Dilute solutions Dilute solutions: lowering of vapor pressure, Raoult's law and Henry's law and their applications, Colligative Properties, Lowering of Vapour Pressure, Raoult's Law, Derivation of Raoult's Law, Measurement of Lowering of Vapour Pressure, Boiling Point Elevation Determination of Molecular Mass from Elevation of Boiling Point, Measurement of Boiling Point Elevation, Freezing-point Depression, Determination of Molecular Weight from Depression of Freezing Point, Colligative Properties of Electrolytes, dissociation and association of solute and its determination (von't Hoff factor).				15 hrs.
UNIT-III	Benzene and Aromatic Compounds Benzene: Structure, Huckel rule. Aromaticity in tropylium ion and cyclopentadienyl anion. Electrophillic substitution reactions of benzene with mechanism: Nitration, Sulphonation, Halogenation, Friedel-Craft's alkylation and acylation, Reactivity and orientation, Arenes: Synthesis, substitution reactions, side chain and ring halogenation and side chain oxidation. Structure and stability of benzyl cation, Alkenyl and alkynylbenzenes: Nomenclature, synthesis and reactions. Polynuclear Aromatic Hydrocarbons: Preparation and reactions of naphthalene, anthracene, phenanthrene.				15 hrs.
UNIT-IV	Inorganic Qualitative Analysis				

	Qualitative analysis of Inorganic Salts (single salts with one cation and one anion) 1. Lead Nitrate $Pb(NO_3)_2$ 2 Ferrous Sulphate $FeSO_4$ 3 Strontium Nitrate $Sr(NO_3)_2$ 4 Potassium Chromate K_2CrO_4 5 Cobalt Sulphate $CoSO_4$ 6 Sodium Sulphite Na_2SO_3 7 Manganese Chloride $MnCl_2$ 8 Aluminium Sulphate $Al_2(SO_4)_3$ 9 Ammonium Phosphate $(NH_4)_3 PO_4$ 10 Ammonium Bromide NH_4Br 11 Copper Chloride $CuCl_2$ 12 Aluminium Sulphate $Al_2 (SO_4)_3$	15 hrs
REFERENCES		
1.	Lee J.D., (1991) Concise Inorganic Chemistry, 4th Edition, Chapman and Hall	
2.	Puri B.R., Sharma L.R. and Kalia K.C., (2006). Principles of Inorganic Chemistry, 29th Edition, Milestone Publ., Delhi	
3.	Cotton F.A. and Wilkinson G., (2009) Basic Principles of Inorganic Chemistry, 3rd Edition, Wiley Eastern	
4.	Mahan B.H., (2009) University Chemistry, 3rd Edition, Narosa Publ House, New Delhi	
5.	Gilreath E. S., (1985) Fundamental Concepts of Inorganic Chemistry, 2nd Edition, McGraw Hill Int.	
6	Atkins P. and Paula J. D. (2006), Physical Chemistry, 8th Edition (International Student Edition) Oxford Univ. Press, New Delhi.	
7	Glasstone, S. (1990), Text Book of Physical Chemistry, 2nd Edition Reprint, Macmillan and Co. Ltd., NY.	
8	Puri, B. R., Sharma, L.R. and Pathania, M. S. (2009), 44th Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar	
9	Engel T. and Reid P. (2007), Physical Chemistry, Pearson Prentice Hall, Noida.	
10	Mahan B. H. (2009), University Chemistry, 3rd Edition, Narosa Publishing House, New Delhi.	
11	Arnikar. H. J., (1995), Essential of Nuclear Chemistry, 4th Edition, New Age International Publishers, Delhi.	
12	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi	
13	Pine S.H; (1993) Organic Chemistry, McGraw Hill, New Delhi.	
14	Loudon G M; (2002) Organic Chemistry, Oxford, New York.	
15	Roberts J.D. and Caserio M.C., (1992) Basic Principles of Organic Chemistry, 2nd Ed., W.A. Benjamin Inc., California	
16	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York	
15	Singh S.P. and Mukherjee S.M; (1984) Organic Chemistry, McMillan India.	
16	Tewari K. S. and Vishnoi N. K.; (2006) A Textbook of Organic Chemistry, Vikas Publishing House, N.Delhi.	
17	Finar I L Organic Chemistry Vol 1 & 2 ELBS/ Pearson 1982	
18	Shah R C, (2005) Inorganic Analysis Part I Qualitative, Baroda Book Depot, Vadodara	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry The Maharaja Sayajirao University of Baroda, Vadodara		ACADEMIC YEAR 2023-2024	
Bachelor of Science					
YEAR	1	<u>CHM2012C</u> Basics of Chemistry- IV		CREDIT	4
Semester	II			HOURS	60
OBJECTIVES:		Study of some fundamental aspect in chemistry Understanding of stereochemistry of organic molecule Learning of qualitative analysis of inorganic salts			
COURSE CONTENT / SYLLABUS					
UNIT-I		Chemistry of p-block and d-block elements Chemistry of p-block elements: Comparative study of the p-Block elements- Groups 13-18 with special reference to electronic configuration, structure of elements and trends in atomic and ionic radii, ionization potential, electron affinity, electronegativity and oxidation states. Inert pair effect. Occurrence, extraction and important uses of p-Block elements. Chemistry of Transition elements: Characteristic properties of d-block elements. Electronic configuration. Comparative account of atomic and ionic radii, density, M.P., B.P., metallic character, reactivity of metals, ionization energies. Difference between the properties of the elements of first and the other two transition Series. Application of coordination compounds in analysis and industry.			15 hrs.
UNIT-II		Alcohol, ethers and introductory stereochemistry Alcohols: Introduction. Preparation: oxymercuration-demercuration, hydroboration-oxidation, hydroxylation of alkenes, Grignard reaction, hydrolysis of alkyl halides. Reactions with HX, PX ₃ , dehydration and oxidation. Esterification. 1,2-Glycols, glycerol, preparations and reactions, periodic acid oxidation, pinacol – pinacolone rearrangement. Ethers: Nomenclature, preparations, reactions, cleavage, auto oxidation, Ziesel’s method. Cyclic ethers: epoxides, synthesis, acid and base catalyzed opening. Orientation, reaction with Grignard and organolithium reagents. Crown ethers. Stereochemistry: Isomerism, conformation of butane, optical activity, specific rotation, Newman and Fischer Projection, chirality, enantiomers, diastereoisomers, meso compounds.			15 hrs.
UNIT-III		Gravimetric Analysis Principles of gravimetric analysis, apparatus used for gravimetric analysis (balance – care and use of analytical balance, crucible, desiccator, burner, oven), preparation of solutions and reagents, precipitation conditions, impurities in precipitates, digestion, filtration, washing, drying, incineration, ignition, weighing of precipitate, gravimetric calculations. Precipitation titrations – precipitation reactions, determining end points in precipitation titrations. Volhard’s method, Mohr’s method and Fajan’s method, Determination of Cl ⁻ .			15 hrs.
UNIT-IV		Inorganic Qualitative Analysis Qualitative analysis of Inorganic Salts (single salts with one cation and one anion) 1 Copper Carbonate CuCO₃ 2 Potassium Iodide KI			15 hrs.

	3 Ammonium Dichromate $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ 4 Nickel Sulphate NiSO_4 5 Zinc Sulphide ZnS 6 Sodium Carbonate Na_2CO_3 7 Barium Nitrate $\text{Ba}(\text{NO}_3)_2$ 8 Cadmium Sulphate CdSO_4 9 Sodium Nitrite NaNO_2 10 Magnesium Carbonate MgCO_3 11 Calcium Carbonate CaCO_3 12 Cadmium Phosphate $\text{Cd}_3(\text{PO}_4)_2$	
--	--	--

REFERENCES

1.	Lee J.D., (1991) Concise Inorganic Chemistry, 4th Edition, Chapman and Hall
2.	Puri B.R., Sharma L.R. and Kalia K.C., (2006). Principles of Inorganic Chemistry, 29th Edition, Milestone Publ., Delhi
3.	Cotton F.A. and Wilkinson G., (2009) Basic Principles of Inorganic Chemistry, 3rd Edition, Wiley Eastern
4.	Mahan B.H., (2009) University Chemistry, 3rd Edition, Narosa Publ House, New Delhi
5.	Gilreath E. S., (1985) Fundamental Concepts of Inorganic Chemistry, 2nd Edition, McGraw Hill Int.
6	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi
7	Pine S.H; (1993) Organic Chemistry, McGraw Hill, New Delhi.
8	Loudon G M; (2002) Organic Chemistry, Oxford, New York.
9	Roberts J.D. and Caserio M.C., (1992) Basic Principles of Organic Chemistry, 2nd Ed., W.A. Benjamin Inc., California
10	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York
11	Singh S.P. and Mukherjee S.M; (1984) Organic Chemistry, McMillan India.
12	Tewari K. S. and Vishnoi N. K.; (2006) A Textbook of Organic Chemistry, Vikas Publishing House, N.Delhi.
13	Finar I L Organic Chemistry Vol 1 & 2 ELBS/ Pearson 1982
14	John Bassett (Editor) Vogel's Textbook of Quantitative Inorganic Analysis, Including Elementary Instrumental Analysis, 4th edition, Longman Science and Tech
15	Shah R C, (2005) Inorganic Analysis Part I Qualitative, Baroda Book Depot, Vadodara

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry The Maharaja Sayajirao University of Baroda, Vadodara		ACADEMIC YEAR 2023-2024	
Bachelor of Science					
YEAR	1	CHE2002C (MINOR) Basics of Chemistry-II		CREDIT	4
Semester	II			HOURS	30
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
UNIT-I	Chemical Bonding				15 hrs.
	Covalent Bond: Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH ₃ , H ₃ O ⁺ , SF ₄ , ClF ₃ , ICl ₂ ⁻ and H ₂ O. MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductor, lattice energy and Born-Haber cycle, salvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond-free electron, valence bond and band theories. Weak interactions: hydrogen bonding and van der Waals forces.				
UNIT-II	Benzene and Aromatic Compounds				15 hrs.
	Benzene: Structure, Huckel rule. Aromaticity in tropylium ion and cyclopentadienyl anion. Electrophillic substitution reactions of benzene with mechanism: Nitration, Sulphonation, Halogenation, Friedel-Craft's alkylation and acylation, Reactivity and orientation, Arenes: Synthesis, substitution reactions, side chain and ring halogenation and side chain oxidation. Structure and stability of benzyl cation, Alkenyl and alkynylbenzenes: Nomenclature, synthesis and reactions. Polynuclear Aromatic Hydrocarbons: Preparation and reactions of naphthalene, anthracene, phenanthrene.				
UNIT-III	Chemistry of p-block and d-block elements				15 hrs.
	Chemistry of p-block elements: Comparative study of the p-Block elements- Groups 13-18 with special reference to electronic configuration, structure of elements and trends in atomic and ionic radii, ionization potential, electron affinity, electronegativity and oxidation states. Inert pair effect. Occurrence, extraction and important uses of p-Block elements. Chemistry of Transition elements: Characteristic properties of d-block elements. Electronic configuration. Comparative account of atomic and ionic radii, density, M.P., B.P., metallic character, reactivity of metals, ionization energies. Difference between the properties of the elements of first and the other two transition Series. Application of coordination compounds in analysis and industry.				
UNIT-IV	Alcohol, ethers and introductory stereochemistry				15 hrs.

	<i>Alcohols:</i> Introduction. Preparation: oxymercuration-demercuration, hydroboration-oxidation, hydroxylation of alkenes, Grignard reaction, hydrolysis of alkyl halides. Reactions with HX, PX₃, dehydration and oxidation. Esterification. 1,2-Glycols, glycerol, preparations and reactions, periodic acid oxidation, pinacol – pinacolone rearrangement. <i>Ethers:</i> Nomenclature, preparations, reactions, cleavage, auto oxidation, Ziesel's method. <i>Cyclic ethers:</i> epoxides, synthesis, acid and base catalysed opening. Orientation, reaction with Grignard and organolithium reagents. Crown ethers. <i>Stereochemistry:</i> Isomerism, conformation of butane, optical activity, specific rotation, Newman and Fischer Projection, chirality, enantiomers, diastereoisomers, meso compounds.	
--	--	--

REFERENCES

1.	Lee J.D., (1991) Concise Inorganic Chemistry, 4th Edition, Chapman and Hall
2.	Puri B.R., Sharma L.R. and Kalia K.C., (2006). Principles of Inorganic Chemistry, 29th Edition, Milestone Publ., Delhi
3.	Cotton F.A. and Wilkinson G., (2009) Basic Principles of Inorganic Chemistry, 3rd Edition, Wiley Eastern
4.	Mahan B.H., (2009) University Chemistry, 3rd Edition, Narosa Publ House, New Delhi
5.	Gilreath E. S., (1985) Fundamental Concepts of Inorganic Chemistry, 2nd Edition, McGraw Hill Int.
6.	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi
7.	Pine S.H; (1993) Organic Chemistry, McGraw Hill, New Delhi.
8.	Loudon G M; (2002) Organic Chemistry, Oxford, New York.
9.	Roberts J.D. and Caserio M.C., (1992) Basic Principles of Organic Chemistry, 2nd Ed., W.A. Benjamin Inc., California
10.	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York
11.	Singh S.P. and Mukherjee S.M; (1984) Organic Chemistry, McMillan India.
12.	Tewari K. S. and Vishnoi N. K.; (2006) A Textbook of Organic Chemistry, Vikas Publishing House, N.Delhi.
13.	Finar I L Organic Chemistry Vol 1 & 2 ELBS/ Pearson 1982
14.	Lee J.D., (1991) Concise Inorganic Chemistry, 4th Edition, Chapman and Hall
15.	Puri B.R., Sharma L.R. and Kalia K.C., (2006). Principles of Inorganic Chemistry, 29th Edition, Milestone Publ., Delhi
16.	Cotton F.A. and Wilkinson G., (2009) Basic Principles of Inorganic Chemistry, 3rd Edition, Wiley Eastern
17.	Mahan B.H., (2009) University Chemistry, 3rd Edition, Narosa Publ House, New Delhi
18.	Gilreath E. S., (1985) Fundamental Concepts of Inorganic Chemistry, 2nd Edition, McGraw Hill Int.
19.	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi
20.	Pine S.H; (1993) Organic Chemistry, McGraw Hill, New Delhi.
21.	Loudon G M; (2002) Organic Chemistry, Oxford, New York.
22..	Roberts J.D. and Caserio M.C., (1992) Basic Principles of Organic Chemistry, 2nd Ed., W.A. Benjamin Inc., California
23.	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York
24.	Singh S.P. and Mukherjee S.M; (1984) Organic Chemistry, McMillan India.
25.	Tewari K. S. and Vishnoi N. K.; (2006) A Textbook of Organic Chemistry, Vikas Publishing House, N.Delhi.
26.	Finar I L Organic Chemistry Vol 1 & 2 ELBS/ Pearson 1982

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry The Maharaja Sayajirao University of Baroda, Vadodara		ACADEMIC YEAR 2023-2024	
Bachelor of Science					
YEAR	1	MDC2202C		CREDIT	4
Semester	II	Basics of Chemistry-II		HOURS	30
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
UNIT-I	Chemical Bonding				15 hrs.
	Covalent Bond: Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH ₃ , H ₃ O ⁺ , SF ₄ , ClF ₃ , ICl ₂ ⁻ and H ₂ O. MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductor, lattice energy and Born-Haber cycle, salvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond-free electron, valence bond and band theories. Weak interactions: hydrogen bonding and van der Waals forces.				
UNIT-II	Benzene and Aromatic Compounds				15 hrs.
	Benzene: Structure, Huckel rule. Aromaticity in tropylium ion and cyclopentadienyl anion. Electrophilic substitution reactions of benzene with mechanism: Nitration, Sulphonation, Halogenation, Friedel-Craft's alkylation and acylation, Reactivity and orientation, Arenes: Synthesis, substitution reactions, side chain and ring halogenation and side chain oxidation. Structure and stability of benzyl cation, Alkenyl and alkynylbenzenes: Nomenclature, synthesis and reactions. Polynuclear Aromatic Hydrocarbons: Preparation and reactions of naphthalene, anthracene, phenanthrene.				
UNIT-III	Chemistry of p-block and d-block elements				15 hrs.
	Chemistry of p-block elements: Comparative study of the p-Block elements- Groups 13-18 with special reference to electronic configuration, structure of elements and trends in atomic and ionic radii, ionization potential, electron affinity, electronegativity and oxidation states. Inert pair effect. Occurrence, extraction and important uses of p-Block elements. Chemistry of Transition elements: Characteristic properties of d-block elements. Electronic configuration. Comparative account of atomic and ionic radii, density, M.P., B.P., metallic character, reactivity of metals, ionization energies. Difference between the properties of the elements of first and the other two transition Series. Application of coordination compounds in analysis and industry.				
UNIT-IV	Alcohol, ethers and introductory stereochemistry				15 hrs.

	<i>Alcohols:</i> Introduction. Preparation: oxymercuration-demercuration, hydroboration-oxidation, hydroxylation of alkenes, Grignard reaction, hydrolysis of alkyl halides. Reactions with HX, PX₃, dehydration and oxidation. Esterification. 1,2-Glycols, glycerol, preparations and reactions, periodic acid oxidation, pinacol – pinacolone rearrangement. <i>Ethers:</i> Nomenclature, preparations, reactions, cleavage, auto oxidation, Ziesel's method. <i>Cyclic ethers:</i> epoxides, synthesis, acid and base catalysed opening. Orientation, reaction with Grignard and organolithium reagents. Crown ethers. <i>Stereochemistry:</i> Isomerism, conformation of butane, optical activity, specific rotation, Newman and Fischer Projection, chirality, enantiomers, diastereoisomers, meso compounds.	
--	--	--

REFERENCES

1.	Lee J.D., (1991) Concise Inorganic Chemistry, 4th Edition, Chapman and Hall
2.	Puri B.R., Sharma L.R. and Kalia K.C., (2006). Principles of Inorganic Chemistry, 29th Edition, Milestone Publ., Delhi
3.	Cotton F.A. and Wilkinson G., (2009) Basic Principles of Inorganic Chemistry, 3rd Edition, Wiley Eastern
4.	Mahan B.H., (2009) University Chemistry, 3rd Edition, Narosa Publ House, New Delhi
5.	Gilreath E. S., (1985) Fundamental Concepts of Inorganic Chemistry, 2nd Edition, McGraw Hill Int.
6.	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi
7.	Pine S.H; (1993) Organic Chemistry, McGraw Hill, New Delhi.
8.	Loudon G M; (2002) Organic Chemistry, Oxford, New York.
9.	Roberts J.D. and Caserio M.C., (1992) Basic Principles of Organic Chemistry, 2nd Ed., W.A. Benjamin Inc., California
10.	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York
11.	Singh S.P. and Mukherjee S.M; (1984) Organic Chemistry, McMillan India.
12.	Tewari K. S. and Vishnoi N. K.; (2006) A Textbook of Organic Chemistry, Vikas Publishing House, N.Delhi.
13.	Finar I L Organic Chemistry Vol 1 & 2 ELBS/ Pearson 1982
14.	Lee J.D., (1991) Concise Inorganic Chemistry, 4th Edition, Chapman and Hall
15.	Puri B.R., Sharma L.R. and Kalia K.C., (2006). Principles of Inorganic Chemistry, 29th Edition, Milestone Publ., Delhi
16.	Cotton F.A. and Wilkinson G., (2009) Basic Principles of Inorganic Chemistry, 3rd Edition, Wiley Eastern
17.	Mahan B.H., (2009) University Chemistry, 3rd Edition, Narosa Publ House, New Delhi
18.	Gilreath E. S., (1985) Fundamental Concepts of Inorganic Chemistry, 2nd Edition, McGraw Hill Int.
19.	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi
20.	Pine S.H; (1993) Organic Chemistry, McGraw Hill, New Delhi.
21.	Loudon G M; (2002) Organic Chemistry, Oxford, New York.
22..	Roberts J.D. and Caserio M.C., (1992) Basic Principles of Organic Chemistry, 2nd Ed., W.A. Benjamin Inc., California
23.	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York
24.	Singh S.P. and Mukherjee S.M; (1984) Organic Chemistry, McMillan India.
25.	Tewari K. S. and Vishnoi N. K.; (2006) A Textbook of Organic Chemistry, Vikas Publishing House, N.Delhi.
26.	Finar I L Organic Chemistry Vol 1 & 2 ELBS/ Pearson 1982

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry The Maharaja Sayajirao University of Baroda, Vadodara		ACADEMIC YEAR 2023-2024	
Bachelor of Science					
YEAR	1	SEC2142C Chemistry Lab-II		CREDIT	2
Semester	II			HOURS	40
OBJECTIVES:					
		Practical Training			
COURSE CONTENT / SYLLABUS					
I	<i>Inorganic Qualitative Analysis</i>				40 hrs.
	Qualitative analysis of Inorganic Salts (single salts with one cation and one anion)				
REFERENCES					
1.	Shah R C, (2005) Inorganic Analysis Part I Qualitative, Baroda Book Depot, Vadodara				
2.	Shah R C, (2005) Inorganic Analysis Part II Quantitative, Baroda Book Depot, Vadodara				
3.	Shah R C, (2001) Organic Analysis Part I Qualitative Analysis Baroda Book Depot,				

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry The Maharaja Sayajirao University of Baroda, Vadodara		ACADEMIC YEAR 2023-2024	
Bachelor of Science					
YEAR	1	VAC2132C Qualitative Analysis of Inorganic Salts		CREDIT	2
Semester	II			HOURS	40
OBJECTIVES:					
		Practical Training			
COURSE CONTENT / SYLLABUS					
I	<i>Inorganic Qualitative Analysis</i>				40 hrs.
	Qualitative analysis of Inorganic Salts (single salts with one cation and one anion)				
REFERENCES					
1.	Shah R C, (2005) Inorganic Analysis Part I Qualitative, Baroda Book Depot, Vadodara				
2.	Shah R C, (2005) Inorganic Analysis Part II Quantitative, Baroda Book Depot, Vadodara				
3.	Shah R C, (2001) Organic Analysis Part I Qualitative Analysis Baroda Book Depot,				

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2024-2025		
Bachelor of Science						
YEAR	II	MAJOR		CREDIT	4 [3(T)+1(P)]	
Semester	I	Thermodynamics, Catalysis and Photochemistry CHM2003C		HOURS	75 (45+30)	
OBJECTIVES:						
		i)	Study fundamental of Chemical Thermodynamics and its applications.			
		ii)	To understand the basics of adsorption and its potential applications in catalysis.			
		iii)	To understand the photochemical and photophysical process and its application in Chemical and biological process.			
		iv)	To determined constants and parameters using Physical Chemistry experiments.			
COURSE CONTENT / SYLLABUS						
UNIT-I		Classical Thermodynamics and Thermochemistry:			15 hrs.	
		Definition and explanation of terms - types of systems, intensive and extensive properties, thermodynamic process - cyclic, reversible, irreversible, isothermal and adiabatic processes. Zeroth law of thermodynamics: concept of heat and work. Internal energy and enthalpy. First law of thermodynamics: Statement and equation, Cp and Cv relationship - calculation of W, E and H for the expansion of ideal gases and real gas under reversible, isothermal and adiabatic conditions. Joule-Thomson effect, inversion temperature and its significance. Thermochemistry: Standard states, standard enthalpy of formation-Hess's law of heat summation and its application. Kirchoff's equation.				
UNIT-II		Adsorption and Catalysis			15 hrs.	
		Adsorption Physisorption and Chemisorption and factors affecting adsorption, Freundlich and Langmuir Adsorption Isotherms. BET isotherm (No derivation), applications. Catalysis: Catalyst, inhibitor, autocatalysis. Catalytic activity, selectivity and stability. Homogeneous and heterogeneous catalysis, General characteristics of catalytic reactions. Theories of catalysis (Chemical theory and adsorption theory), active sites, role of active sites in catalysis, turn over number, Acid - base catalysis, Enzyme catalysis, catalysis in atmospheric pollution control. Applications of catalysts in industries.				
UNIT-III		Photochemistry			15 hrs	
		Photophysical and photochemical processes, Grothus-Draper law, Stark-Einstein's law of photochemical equivalence and quantum yield. Electronic excitation of molecules, Frank-Condon principle. Examples of low and high quantum yields. Photo-stationary equilibrium. Photosensitization, Photochemical formation of HCl, HBr and HI and rate of photochemical reactions. Actinometry. Luminescence phenomenon: Timescales of photophysical processes, phosphorescence, fluorescence, chemiluminescence. Quenching of fluorescence, Stern-Volmer equation. Photochemistry of stratospheric ozone, harvesting of light during plant photosynthesis, photochemistry of vision. Solar energy conversion.				

UNIT-IV	<i>Physical Chemistry Experiments 1</i> i) To determine the surface tension of the given liquid by drop number method at room temperature and to calculate parachor of methyl functional group using homologous series of alcohols. ii) To study the adsorption of oxalic acid on charcoal and verify Freundlich Adsorption isotherm. iii) To determine the % composition of the given liquid mixture by viscometric method iv) To determine the rate constant of acid catalyzed hydrolysis of ester (First Order Kinetics). v) To determine the rate constant of base catalyzed hydrolysis of ester (Second Order Kinetics). vi) To determine the rate constant of reaction between KI and K₂S₂O₈.	30 hrs
REFERENCES		
1	Atkins P. and Paula J. D. (2006), Physical Chemistry, 8th Edition (International Student Edition) Oxford Univ. Press, New Delhi.	
2	Glasstone, S. (1990), Text Book of Physical Chemistry, 2nd Edition Reprint, Macmillan and Co. Ltd., New York	
3	Puri, B. R., Sharma, L.R. and Pathania, M. S. (2020), 48 th Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar	
4	Bahl, B.S., Bahl A. and Tuli, G.D. (2022), Essentials of Physical Chemistry, 28 th Edition, S. Chand, Delhi.	
3	Engel T. and Reid P. (2007), Physical Chemistry, Pearson Prentice Hall, Noida.	
4.	Mahan B. H. (2009), University Chemistry, 3rd Edition, Narosa Publishing House, New Delhi.	
5.	Rastogi, K. K. and Mukherjee (1978), Fundamental of Photochemistry, New Age International Pvt. Ltd, New Delhi.	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2024-2025	
The Maharaja Sayajirao University of Baroda, Vadodara					
Bachelor of Science					
YEAR	II	MAJOR		CREDIT	4 [3(T)+1(P)]
Semester	I	CHM2013C Inorganic Chemistry		HOURS	75 (45 +30)
OBJECTIVES:					
i) Study of Some fundamental aspects of Inorganic chemistry. ii) Understanding of the basics of Coordination Chemistry iii) Understanding of the basics of commercially important Inorganic chemicals iv) To get hands-on training on qualitative analysis of inorganic salts.					
COURSE CONTENT / SYLLABUS					
UNIT-I		Coordination Compounds Introduction to basic terminologies (primary and secondary coordination spheres, ligands and their types, CN, chelation), Effective Atomic Number (EAN) and 18 electron rules. Bonding in complexes with coordination number 4 & 6 in terms of VBT, high and low spin complexes. Capability and limitations of VBT. Electrostatic concept of complex formation: Crystal field theory, (CFT), energy of d orbitals in spherical, octahedral, tetrahedral and square planar fields. Weak field and strong field complexes. Color and magnetism of complexes on the basis of CFT.			15 hrs.
UNIT-II		Chemistry of lanthanide and actinide compounds Lanthanides: Properties, electronic configuration, oxidation states, ionic radii, lanthanide contraction, color and magnetic properties, extraction, separation of lanthanide. Actinides: Transuranic elements, properties of actinides, oxidation states, ionic radii, color of ions, companion with lanthanide Higher coordination number and complex formation, color and absorption spectra, magnetic properties and their important applications. Application of radioactive elements and radioisotopes in agriculture, industries and clinical diagnosis.			15 hrs.
UNIT-III		Heavy chemicals in industries Special methodology used in the manufacture (including the physicochemical principles involved), properties and uses of sulphuric acid, nitric acid and ammonia. Cement: Types of cement and their manufacturing processes, reactions involved in the setting of cement. Role of lime and gypsum. Glass: Glassy state. manufacturing of glass, structure of glass, network formers and network modifiers, coloring and decolorization in glass making, change in physical properties of glass with variation in additives. Various types of glass and their use.			15 hrs.
UNIT-IV		Inorganic Chemistry Experiments Inorganic Qualitative analysis: Analysis of binary mixture of Inorganic Salts involving standard dry tests and wet tests for acidic and basic radicals.			30 hrs

REFERENCES

1	Puri, B. R., Sharma, L.R. and Pathania, M. S. (2005), 41st Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar
2	Lee J.D. Concise Inorganic Chemistry, ELBS, 1991.
3	Cotton F. A. and Wilkinson G. (1988), Basic Inorganic Chemistry, Wiley Eastern.
4	Huheey J. E., Keiter E. A. and Keiter R. L., (1993) Inorganic Chemistry: Principles of Inorganic Chemistry, 4th Edition, Addison-Wesley International.
5	Sanderson R. T. (1971) Inorganic Chemistry, East-West Press
6	Sharma B.K.(2006) Industrial Chemistry, Goel Publishing House,
7	Analytical Chemistry, G.D. Christian, John Willey & Sons. 6th Edition.2004
8	Shah R C, (2005) Inorganic Analysis Part I Qualitative, Baroda Book Depot, Vadodara
9	Modern Analytical Chemistry, D. Harvey, McGraw Hill Higher Education, New York, 2000.
10	G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denny, Vogel's Text Book of Qualitative Chemical Analysis, 5th Edn., ELBS, 1991.
11	Douglas A. Skoog and Donald M..West: Fundamentals of Analytical Chemistry

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2024-2025	
Bachelor of Science					
YEAR	II	MAJOR		CREDIT	4 [3(T)+1(P)]
Semester	I	Fundamental of Organic and Analytical Chemistry CHM2023C		HOURS	75 (45+30)
OBJECTIVES:					
		i) To study chemistry of carbonyl compounds. ii) To understand the basics of aromatic halides and phenols. iii) To study the basics of acid-base, redox and complexometric titration. iv) To study the chemical separation of a mixture and identification of separated substances.			
COURSE CONTENT / SYLLABUS					
UNIT-I		Carbonyl Compounds: Aldehydes and Ketones: Introduction, preparation: oxidation of alcohols, Reimer–Tiemann reaction, Friedel–Crafts acylation, application of lithium dialkylcuprates. Reactivity, nucleophilic addition reactions, oxidation, reduction, aldol and benzoin condensations, Cannizzaro reaction, iodoform reaction, Beckmann and benzil-benzilic acid rearrangements. Carboxylic acids: Introduction, acidity, Preparation: oxidation of alcohols and alkylbenzenes, carbonation of Grignard reagents, hydrolysis of nitriles. Reactions: Hell-Volhard-Zelinsky reaction, reduction, conversion into acid chlorides, anhydrides, esters and amides, mechanism of esterification. Hoffmann degradation, Claisen condensation, Curtius rearrangement.			15 hrs.
UNIT-II		Aromatic halides and Phenols Aromatic halides: Introduction, preparation, electrophilic aromatic substitution, nucleophilic aromatic substitution, bimolecular displacement, elimination-addition (benzyne) mechanism, evidence for benzyne mechanism. Application of aryl halides in C-C forming reactions with example of Mizoroki-Heck reaction with mechanism. Phenols: Introduction, acidity, preparation, Reactions, ether and ester formation, nitration, nitrosation, sulphonation, halogenation, coupling with diazonium salt, Fries rearrangement, Reimer-Tiemann Reaction, Lederer-Manasse and Kolbe reactions with mechanism. Synthesis of Phenolphthalein and Eosin			15 hrs.
UNIT-III		Titrimetric Analysis Common apparatus and general considerations. Concepts of primary and secondary standards. Classification of titrimetric methods based on chemical reactions involved. Neutralization titrations – determination of end point, choice of indicators, titration curves and applications. Complexometric titrations – types of EDTA titrations, metal ion indicators, applications in water analysis. Oxidation reduction titrations – indicators for			15 hrs.

	redox titration, oxidation with potassium permanganate, oxidation with potassium dichromate, iodometric and iodimetric titrations.	
UNIT-IV	Qualitative Analysis of Organic Compounds Separation of binary mixtures (solid mixtures) of Organic Compounds and Identification.	30 hrs.

REFERENCES

1	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi.
2	Pine S.H; (1993) Organic Chemistry, McGraw Hill, New Delhi.
3	Loudon G M; (2002) Organic Chemistry, Oxford, New York.
4	Roberts J.D. and Caserio M.C., (1992) Basic Principles of Organic Chemistry, 2nd Edition, W.A. Benjamin Inc., California.
5	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York.
6	Singh S.P. and Mukherjee S.M; (1984) Organic Chemistry, McMillan India.
7	Tewari K. S. and Vishnoi N. K.; (2006) A Textbook of Organic Chemistry, Vikas Publishing House, New Delhi.
8	Finar I L Organic Chemistry Vol 1 & 2 ELBS/ Pearson 1982
9	Analytical Chemistry, G.D. Christian, John Willey & Sons. 6th Edition.2004
10	Vogel's Textbook of Inorganic Quantitative Analysis; Pearson Education Ltd
11	Douglas A. Skoog and Donald M..West: Fundamentals of Analytical Chemistry
12	G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denny, Vogel's Text Book of Qualitative Chemical Analysis,5th Edn. , ELBS, 1991.
13	Modern Analytical Chemistry, D. Harvey, McGraw Hill Higher Education, New York, 2000.
14	Shah R C, (2001) Organic Analysis Part I Qualitative Analysis Baroda Book Depot.
15	V K Ahluwalia and Sunita Dhingra, (2000), Comprehensive Practical Organic Chemistry Qualitative Analysis, University Press Publishers

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2024-2025	
Bachelor of Science					
YEAR	II	Multidisciplinary Course Chemistry of Biomolecules <u>MDC2503C</u>		CREDIT	4
Semester	I			HOURS	60
OBJECTIVES:		i) To study structure and function of amino acids and proteins. ii) To understand structure and function of enzymes and nucleic acid. iii)To know importance and structure of drugs and vitamins. iv) To learn separation and purification of aminoacids and proteins.			
COURSE CONTENT / SYLLABUS					
UNIT-I	Amino Acid, Peptides and Proteins			15 hrs.	
	Amino Acids: Introduction, Classification, Isoelectric point, Preparation: malonic acid synthesis, Gabriel phthalimide synthesis, Reactions. Peptides and proteins: Structure of peptides and proteins, nomenclature of peptides, Classification of proteins, peptide structure determination, end group analysis, selective hydrolysis of peptides, classical peptide synthesis, solid phase peptide synthesis, protein denaturation.				
UNIT-II	Enzymes			15 hrs.	
	Introduction, Classification, Characteristics and salient features of enzymes, Factors affecting enzyme actions, Mechanism of Chymotripsin, Coenzymes and Cofactors-their role in biological reactions, Specificity and Stereospecificity of enzymes, Enzyme inhibitors and their importance. Nucleic acids: Introduction, structure of nucleic acids, ribonucleosides and ribonucleotides, the double helical structure of DNA, structure of RNA, genetic code. Types of RNA and their importance. Replication, Transcription and Translation processes.				
UNIT-III	Drugs and Vitamins			15 hrs	
	Drugs: Introduction, Characteristic of drugs, Terminology, Classification of drugs Antimalarials: Malaria cycle, classification, Synthesis and uses of Chloroquine and Primaquine Antipyretics & Analgesics: Classification, Synthesis and uses of Paracetamol, Phenacetin, Ibuprofen. Vitamins: Structure and synthesis of Vitamin A1 (retinol)and Vitamin K1 (phyllloquinone). Structure and synthesis (Gorlich and Bakke) of Vitamin C (ascorbic acid).				

UNIT-IV	Separation and determination of biomolecules	15 hrs
	Amino acids: general methods of separation – chromatography of underivatized and derivatized amino acids – paper and thin layer chromatography, high performance liquid chromatography, capillary electrophoresis, amino acid analyzers, sample preparation for amino acid determination. Proteins: sample processing for protein purification, separation methods – centrifugation, precipitation and differential solubilisation, chromatography – size exclusion, ion exchange, affinity, hydrophobic interaction. Big biomolecules: Chromatography – size exclusion, affinity.	
REFERENCES		
1	Biochemistry by Donald Voet, Judith G. Voet, J. Wiley & Sons, 2004	
2	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi	
3	Fundamentals of Analytical Chemistry, Skoog, West, Holler, Crouch, 10 th Edition, Cengage Learning. 2022	
4	Analytical Chemistry, G.D. Christian, John Wiley & Sons. 6 th Edition, 2004	
5	Medical Chemistry by Ashutosh Kar New Age International Publishers	
6	Principles and Practice of Analytical Chemistry, F.W. Fifeild, 5th Ed. (2000) Blackwell science.	

		The Maharaja Sayajirao University of Baroda		ACADEMIC YEAR	
		Faculty of Science		2024-2025	
		Department of Chemistry			
Bachelor of Science					
YEAR		II		CREDIT	4
Semester	I	Multidisciplinary Course Materials and Sustainable Chemistry <u>MDC2513C</u>		HOURS	60
OBJECTIVES:					
i) To understand the novel inorganic materials and its potential applications. ii) To study the materials used in electronics. iii) To understand the design, synthesis and applications of nanomaterials. iv) To understand the principles of green chemistry. v) To study the basic chemistry of renewable energy.					
COURSE CONTENT / SYLLABUS					
UNIT-I	Novel Inorganic Solids				15 hrs.
	Synthesis and modification of inorganic solids: Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods. Inorganic solids of technological importance: Solid electrolytes – Cationic, anionic, mixed Molecular material and fullerenes, molecular materials & chemistry – one-dimensional metals, molecular magnets, inorganic liquid crystals.				
UNIT-II	Materials for electronics and Nanomaterials				15 hrs.
	Preparation of high purity Silicon, silicon-based semiconductors and devices. Introduction, Limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal matrix composites, polymer matrix composites, fiber reinforced composites, environmental effects on composites, applications of composites. Nano-materials: Overview of nano-structures and nano-materials; classification. Preparation of gold and silver metallic nano particles, self-assembled nano structures, control of nano architecture. Carbon nano tube and nano wires, Bio inorganic nanomaterials				
UNIT-III	Environmental Green Chemistry				15 hrs
	What is Green Chemistry?. Need for Green Chemistry. Twelve principles of Green Chemistry with their explanations and special emphasis on Designing a Green Synthesis using these principles; waste or pollution prevention hierarchy; .Limitations/Obstacles in the pursuit of the goals of Green Chemistry.				

	Elimination of hazardous substances and pollution, renewable feedstocks, sustainable processes, energy. The metrics of Green Chemistry: Determination of whether a process is green or not, atom economy Calculation of atom economy of the rearrangement, addition, substitution and elimination reactions , reaction mass efficiency, environmental (E) factor Prevention of Waste/by products; maximum incorporation of the materials used in the process into the final products, Atom Economy, use of 12 principles to measure sustainability of process, full life cycle, cradle to cradle, Green solvents- super critical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solvent less processes, immobilized solvents and how to compare greenness of solvents; Microwave assisted reactions in water and organic solvents. Microwave assisted solid state reactions; Sonochemistry	
UNIT-IV	Chemistry of Renewable Energy	15 hrs
	Fuel cell, solar cell and battery. Fuel cell basic chemistry. Solar cells: Principle, Classification of Solar Cells, Working principle of solar cells, Comparison of Inorganic Solar Cells and Organic Solar Cells. Applications of Solar Cells. Direct methanol fuel cell; microbial and enzymatic fuel cell, hydrogen generation and storage, Hydrogen fuel cells, lithium batteries, Hydrogen vs lithium.	
REFERENCES		
1	Sharma, B. K., Industrial Chemistry including chemical engineering, Goel Publ. House, Meerut.	
2	Thompson D. (Ed.), Insights into speciality Inorganic chemicals, RSC, Cambridge, U.K.	
3	Poole, C. P. and Owens, F.J. Introduction to nanotechnology, John Wiley & Sons.	
4	Rodger, G.E., Inorganic and solid state chemistry, Cengage Learning India Edition	
5	P Wurfel , Physics of Solar Cells: From Basic Principles to Advanced Concept, 2009.	
6	Solar Cells. Chemistryexplained.com	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2024-2025	
Bachelor of Science					
YEAR		II Skill Enhancement Qualitative Analysis <u>SEC2423C</u>		CREDIT	2
Semester	I			HOURS	60
OBJECTIVES:		i) To get hands-on training on qualitative analysis of inorganic salts. ii) To study the chemical separation of a mixture and identification of separated substances.			
COURSE CONTENT / SYLLABUS					
UNIT-I	Inorganic Qualitative Analysis				30 hrs.
	Qualitative analysis of Inorganic Salts (mixture of two salts or three salts with two cations and two anions or three cations and three anions).				
UNIT-II	Organic Qualitative Analysis				30 hrs.
	Separation of binary mixtures (solid and Liquid mixtures) of Organic Compounds and Identification of separated substances.				
REFERENCES too many references					
1	Vogel's Textbook of Inorganic Qualitative Analysis; Pearson Education Ltd (2004)				
2	Shah R C, (2001) Inorganic Analysis Part I Qualitative Analysis Baroda Book Depot.				
3	Shah R C, (2001) Organic Analysis Part I Qualitative Analysis Baroda Book Depot.				
4	V K Ahluwalia and Sunita Dhingra, (2000), Comprehensive Practical Organic Chemistry Qualitative Analysis, University Press Publishers				

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2024-2025	
Bachelor of Science					
YEAR	II	MAJOR		CREDIT	4 [3(T)+1(P)]
Semester	II	Chemical Kinetics and States of Matter <u>CHM2004C</u>		HOURS	75 (45+30)
OBJECTIVES:		i) To study basic and advance topics of chemical kinetics ii) To understand physicochemical aspect of various states of matter such gas, liquid and solid. iii) To know the colloidal and mesomorphic state and its potential applications. iv) To determine various parameters and constant using various physicochemical techniques			
COURSE CONTENT / SYLLABUS					
UNIT-I		Chemical Kinetics Rates of chemical reactions, Rate laws, Order of reaction and Molecularity, factors affecting rate of reaction. Derivation of integrated rate law expression for zero, first and second order reactions. Methods of determination of order of chemical reactions. Arrhenius equation. Elementary and complex reactions, Examples of parallel, opposing and consecutive reactions, rate determining step, steady state approximation. Derivation of rate laws of complex reactions (only first order). Arrhenius equation and concept of energy of activation. Collision theory and transition state theory (elementary treatment of reaction rates). Mechanism of unimolecular reactions.			15 hrs.
UNIT-II		Gaseous State Recapitulations of Ideal gas/Real gas, Heat capacity (molecular basis), Heat capacity ratio. Mean Free Path, Collision frequency, Transport properties of gases- Viscosity, Diffusion and Thermal Conductivity. Deviation from ideal gas behavior - Boyle temperature, Compressibility Factor. Derivation of van der Waals gas equation. Liquefaction of gases, Critical phenomenon and critical constants, Law of corresponding states, Reduced equation of state, Joule-Thomson effect and Inversion temperature (definition). Methods of liquefaction of gases: Faraday's, Linde's method and Claude's method. Liquid State: Intermolecular forces and structure of liquids (qualitative description) Definition and determination of Vapour Pressure, Surface tension, Viscosity and its variation with temperature. Parachor and its importance.			15 hrs.
UNIT-III		Solid, Colloidal and Mesomorphic states <i>Solid State:</i> Recapitulations, Symmetry elements in crystals. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. X-ray diffraction by crystals. Derivation of Bragg's law, Structure of few metallic elements, ionic solids (NaCl and KCl) radius ratios, defects in solids. <i>Colloidal State:</i>			15 hrs

	Classification of colloids, Preparation and purification of sols, Stability of sols, Schulze-Hardy rule, Gold Number. Emulsions, gel and foam. Association colloids, Surfactants, Micelle formation and critical micelle concentration, Action of soap. Applications. <i>Mesomorphic state</i> : Difference between liquid crystal, liquid and solid. Classification and structure of nematic, smectic and cholesteric phases. Non-conventional liquid crystals.	
UNIT IV	Physical Chemistry Practical's 2 (i) Conductometric Titrations: a) Weak acid/ strong base b) weak acid/weak base c) Strong Acid/strong base d) Strong acid/weak base (ii) Potentiometric Titrations: a) strong acid and strong base b) weak acid and Strong base (iii) To determine the pH and the dissociation constant of the given weak acid potentiometrically (iv) To determine equivalent conductance, degree of dissociation and the dissociation constant of weak acid using conductometer (v) To determine the rate constant of acid catalyzed hydrolysis of sucrose using polarimeter (vi) To determine equivalent conductance at infinite dilution ((λ_{∞}) for NaCl and KCl and verify Debye, Huckel and Onsager's limiting law. (vii) To determine the rate constant for decomposition of hydrogen peroxide using Copper ion adsorbed on alumina as a catalyst.	30 hrs
REFERENCES		
1	Atkins P. and Paula J. D. (2006), Physical Chemistry, 8th Edition (International Student Edition) Oxford Univ. Press, New Delhi.	
2	Glasstone, S. (1990), Text Book of Physical Chemistry, 2nd Edition Reprint, Macmillan and Co. Ltd., New York	
3	Puri, B. R., Sharma, L.R. and Pathania, M. S. (2020), 48 th Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar	
4	Bahl, B.S., Bahl A. and Tuli, G.D. (2022), Essentials of Physical Chemistry, 28 th Edition, S. Chand, Delhi.	
3	Engel T. and Reid P. (2007), Physical Chemistry, Pearson Prentice Hall, Noida.	
4.	Mahan B. H. (2009), University Chemistry, 3 rd Edition, Narosa Publishing House, New Delhi.	
5.	Laidler K. J. (2003), Chemical Kinetics, 3 rd Edition, Pearson Education India.	
6.	West, A. R. (2022), Solid State Chemistry, 2 nd Edition, Wiley Publication	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry			ACADEMIC YEAR 2023-2024	
The Maharaja Sayajirao University of Baroda, Vadodara						
Bachelor of Science						
YEAR	II	MAJOR			CREDIT	4 [3(T)+1(P)]
Semester	II	Inorganic Chemistry-II CHM2014C			HOURS	75 (45 + 30)
OBJECTIVES:						
i) Study of Some fundamental aspects of Organometallic chemistry.						
ii) Understanding of the basics of Metals and Metallurgy.						
iii) Understanding of the basics of non-aqueous solvents and their applications.						
COURSE CONTENT / SYLLABUS						
UNIT-I		ORGANOMETALLIC CHEMISTRY AND BIOINORGANIC CHEMISTRY				15 hrs.
		Definitions, Classification of ligands in organometallic compounds, 18-electron rule, Effective atomic number rule, Nomenclature of Organometallic compounds. Ionic and covalent organometallic compounds, Synthesis, structure, properties and applications of some commercially important organometallic compounds such as RM, R2M, R3M, R4M, R4M, RMX, Li[AlR4]. Bioinorganic Chemistry: Metal ions present in biological systems, geochemical effect on the distribution of metal ions, bulk and trace metal ions in biological systems. Excess and deficiency of essential metal ions, toxicity of metal ions (Hg, Pb, Cd and As), chelation therapy for the removal of excess and toxic metal ions. Role of alkali metal ions (Sodium / K-pump). Zinc in biological systems - carbonic anhydrase and carboxypeptidases. Iron and its application in bio-systems, Hemoglobin and Myoglobin.				
UNIT-II		Metals and Metallurgy				15 hrs.
		Occurrence's of metals, extraction of metals- silver and gold. various steps involved in metallurgist processes with few examples, concentration of ores, calcination, roasting, reduction to free metal, electrometallurgy, hydro-metallurgy, refining or purification, thermodynamics of the oxidation of the metals to metal oxides, Ellingham diagram.				
UNIT-III		Non-aqueous Solvents				15 hrs.
		Acids and bases leveling effect, Lux-Flood concept, solvent system concept and Lewis's concept. Classification of solvents, characteristic properties of solvents, liquid ammonia, solutions of alkali metals in liquid ammonia, liquid hydrogen fluoride, sulfuric acid, liquid di-nitrogen tetroxide, liquid sulfur dioxide, reactions in liquid sulfur dioxides. Molten salts as non-aqueous solvents. Introduction to HSAB concept and its applications.				
UNIT-IV		Inorganic Chemistry Experiments Inorganic Preparations: Laboratory scale preparation of commercially important inorganic compounds such as double salts (FeSO4(NH4)2SO4.6H2O and K2SO4.Al2(SO4)3.24H2O), Na2S2O3, CuSO4.nH2O, Cu2Cl2, Mn(acac)3, Cu(Salen)2 etc.				30 hrs.

REFERENCES	
1.	Lee J.D., (1991) Concise Inorganic Chemistry, 4th Edition, Chapman and Hall,
2.	Puri B.R., Sharma L.R. and Kalia K.C., (2006). Principles of Inorganic Chemistry, 29th Edition, Milestone Publ., Delhi
3.	Cotton F.A. and Wilkinson G., (2009) Basic Principles of Inorganic Chemistry, 3rd Edition, Wiley Eastern
4.	Huheey J. E., Keiter E. A. and Keiter R. L., (1993) Inorganic Chemistry: Principles of Inorganic Chemistry, 4th Edition, Addison-Wesley International.
5.	G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denny, Vogel's Text Book of Qualitative Chemical Analysis, 5th Edn. , ELBS, 1991.
6.	Analytical Chemistry, G.D. Christian, John Willey & Sons. 6th Edition.2004
7	Synthesis and Technique in Inorganic Chemistry: A Laboratory Manual, By Gregory S. Girolami, Thomas B. Rauchfuss, Robert J. Angelici, University Science Books, 1999
8	Advanced Practical Inorganic Chemistry, Gurdeep Raj, Krishna Prakashan Media (P) Ltd (1 January 2013).

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2024-2025	
Bachelor of Science					
YEAR	II	MAJOR Organic Chemistry - I <u>CHM2024C</u>		CREDIT	4 [3(T)+1(P)]
Semester	II			HOURS	75 (45+30)
OBJECTIVES:		i) To study chemistry of nitro compounds. ii) To understand the basics of amines. iii) To understand the basics of carbohydrates. iv) To study the chemistry of drugs and dyes. v) To study the synthetic methodology of organic synthesis.			
COURSE CONTENT / SYLLABUS					
UNIT-I	Nitro compounds and Amines				15 hrs.
	Nitro compounds: Preparation of nitroalkanes and nitroarenes. Reactions: reduction, Alkylation at α-carbon, Henry reaction, nucleophilic substitution reactions in nitroarenes, Picric acid, NEF reaction. Amines: Nomenclature and physical properties, effect of substituent on basicity, preparation: reduction of nitro and nitrile compounds, reductive amination of aldehydes and ketones. Hofmann rearrangement, Hinsberg's test, Hofmann exhaustive methylation, Hofmann elimination and orientation. Mannich reaction, Diazonium salts: diazotization and its mechanism, Reactions of diazonium salts.				
UNIT-II	Carbohydrates				15 hrs.
	Classification and nomenclature, open chain and cyclic structure of glucose, determination of ring size, mutarotation and its mechanism, epimers, chain shortening and chain lengthening of aldose, conversion of glucose to fructose and Mannose, conversion of fructose to glucose, formation of glycosides, ethers and esters, erythro and threo diastereoisomers. Disaccharides and polysaccharides: Introduction to maltose, sucrose and lactose, starch and cellulose. Energy production in biological systems, biological oxidation of alcohols and carbohydrates.				
UNIT-III	Drugs and Dyes				15 hrs.
	Drugs: Classification, methods of preparation and uses of Aspirin, mode of action, salol principle, true and partial salol, sulphanilamide, sulphathiazole, succinoyl sulphathiazole, mechanism of action of sulpha drugs. Synthetic Dyes: Introduction, classification of dyes, colour and constitution, methods of preparation and uses of methyl orange, congo red, malachite green, crystal violet, phenolphthalein and fluorescein.				

UNIT-IV	Organic Preparation (Single Step)	30 hrs.
	i) 7-Hydroxy-4-methyl coumarin from resorcinol ii) p-Bromo acetanilide from acetanilide iii) Acetyl salicylic acid (aspirin) from salicylic acid iv) Cinnamic acid from benzaldehyde v) 1,4-Diacetoxy benzene from hydroquinone vi) m-Nitroaniline from m-dinitrobenzene vii) 1-Phenylazonaphthol from β -naphthol	
REFERENCES		
1	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi.	
2	Pine S.H; (1993) Organic Chemistry, McGraw Hill, New Delhi.	
3	Loudon G M; (2002) Organic Chemistry, Oxford, New York.	
4	Roberts J.D. and Caserio M.C., (1992) Basic Principles of Organic Chemistry, 2nd Edition, W.A. Benjamin Inc., California.	
5	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York.	
6	Singh S.P. and Mukherjee S.M; (1984) Organic Chemistry, McMillan India.	
7	Tewari K. S. and Vishnoi N. K.; (2006) A Textbook of Organic Chemistry, Vikas Publishing House, New Delhi.	
8	Finar I. L Organic Chemistry Vol 1 & 2 ELBS/ Pearson 1982	
9	Chatwal G; (1985) Synthetic Dyes, Himalaya Publication.	
10	V K Ahluwalia and Renu Agrawal; (2000), Practical Organic Chemistry Preparation and Quantitative Analysis.	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2024-2025	
Bachelor of Science					
YEAR	II	MINOR Fundamental of Chemistry - I <u>CHE2004C</u>		CREDIT	4
Semester	II			HOURS	60
OBJECTIVES:					
i) Study of Some fundamental aspects of Inorganic chemistry. ii) Understanding of the basics of Coordination Chemistry. iii) To study basic and advance topics of chemical kinetics. iv) To study chemistry of carbonyl compounds. v) To study the basics of acid-base, redox and complexometric titration.					
COURSE CONTENT / SYLLABUS					
UNIT-I	Coordination Compounds				15 hrs.
	Introduction to basic terminologies (primary and secondary coordination spheres, ligands and their types, CN, chelation), Effective Atomic Number (EAN) and 18 electron rule. Bonding in complexes with coordination number 4 & 6 in terms of VBT, high and low spin complexes. Capability and limitations of VBT. Electrostatic concept of complex formation: Crystal field theory, (CFT), energy of d orbitals in spherical, octahedral, tetrahedral and square planar fields. Weak field and strong field complexes. Colour and magnetism of complexes on the basis of CFT.				
UNIT-II	Chemical Kinetics				15 hrs.
	Rates of chemical reactions, Rate laws, Order of reaction and Molecularity, factors affecting rate of reaction. Derivation of integrated rate law expression for zero, first and second order reactions. Methods of determination of order of chemical reactions. Arrhenius equation. Elementary and complex reactions, Examples of parallel, opposing and consecutive reactions, rate determining step, steady state approximation. Derivation of rate laws of complex reactions (only first order). Arrhenius equation and concept of energy of activation. Collision theory and transition state theory (elementary treatment of reaction rates). Mechanism of unimolecular reactions.				
UNIT-III	Carbonyl Compounds				15 hrs
	Aldehydes and Ketones: Introduction, preparation: oxidation of alcohols, Reimer–Tiemann reaction, Friedel–Crafts acylation, application of lithium dialkylcuprates. Reactivity, nucleophilic addition reactions, oxidation, reduction, aldol and benzoin condensations, Cannizzaro reaction, iodoform reaction, Beckmann and benzil-benzilic acid rearrangements. Carboxylic acids: Introduction, acidity, Preparation: oxidation of alcohols and alkylbenzenes, carbonation of Grignard reagents, hydrolysis of nitriles. Reactions: Hell-Volhard-Zelinsky reaction, reduction, conversion into acid chlorides, anhydrides, esters and amides,				

	mechanism of esterification. Hoffmann degradation, Claisen condensation, Curtius rearrangement.	
UNIT-IV	Titrimetric Analysis	15 hrs
	Common apparatus and general considerations. Concepts of primary and secondary standards. Classification of titrimetric methods based on chemical reactions involved. Neutralization titrations – determination of end point, choice of indicators, titration curves and applications. Complexometric titrations – types of EDTA titrations, metal ion indicators, applications in water analysis. Oxidation reduction titrations – indicators for redox titration, oxidation with potassium permanganate, oxidation with potassium dichromate, iodometric and iodimetric titrations.	
REFERENCES		
1	Atkins P. and Paula J. D. (2006), Physical Chemistry, 8th Edition (International Student Edition) Oxford Univ. Press, New Delhi.	
2	Puri, B. R., Sharma, L.R. and Pathania, M. S. (2020), 48 th Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar	
3	Bahl, B.S., Bahl A. and Tuli, G.D. (2022), Essentials of Physical Chemistry, 28 th Edition, S. Chand, Delhi.	
4	Lee J.D., (1991) Concise Inorganic Chemistry, 4th Edition, Chapman and Hall,	
5	Puri B.R., Sharma L.R. and Kalia K.C., (2006). Principles of Inorganic Chemistry, 29th Edition, Milestone Publ., Delhi	
6	Cotton F.A. and Wilkinson G., (2009) Basic Principles of Inorganic Chemistry, 3rd Edition, Wiley Eastern	
7	Morrison R.T. and Boyd R.N; (1994) Organic Chemistry, Prentice Hall of India, New Delhi.	
8	Loudon G M; (2002) Organic Chemistry, Oxford, New York.	
9	Graham Solomons T.W. and Fryhle C., (2002) Organic Chemistry, John Wiley, New York.	
10	Analytical Chemistry, G.D. Christian, John Willey & Sons. 6th Edition.2004	
11	Vogel’s Textbook of Inorganic Quantitative Analysis; Pearson Education Ltd	
12	Douglas A. Skoog and Donald M. West: Fundamentals of Analytical Chemistry	
13	G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denny, Vogel’s Text Book of Qualitative Chemical Analysis,5th Edn. , ELBS, 1991.	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2024-2025	
Bachelor of Science					
YEAR	II	Value Added Course Natural Product Chemistry and Chromatographic Separation <u>VAC2364C</u>		CREDIT	2
Semester	II			HOURS	60
OBJECTIVES:					
i) To study extraction and separation procedures of natural products. ii) To study purification of isolated natural products. iii) To study fundamentals of various chromatographic techniques.					
COURSE CONTENT / SYLLABUS					
UNIT-I		Natural product chemistry		30 hrs.	
		Principles of separations, purification methods, simple and vacuum distillations, steam volatile compounds, steam distillation and its use in perfume industries, extraction of essential oils. Isolation of essential components from mint, tulsi and various flowers,			
UNIT-II		Chromatographic Separations:		30 hrs.	
		Principles of chromatographic separations, distribution law, stationary and mobile phase, R _f values, factors affecting separations, Adsorption and Partition chromatography, Ascending and descending chromatography, Theory and applications of TLC and column chromatography for various components of the mixtures, fundamental concepts of chromatography involved in GC and HPLC.			
REFERENCES					
1	V K Ahluwalia and Sunita Dhingra, (2000), Comprehensive Practical Organic Chemistry Qualitative Analysis, University Press Publishers				
2	Vogel's Textbook of Inorganic Quantitative Analysis; Pearson Education Ltd				

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2024-2025	
Bachelor of Science					
YEAR	II	Skill Enhancement Course Qualitative and Qunatitative Analysis <u>SEC2414C</u>		CREDIT	2
Semester	II			HOURS	60
OBJECTIVES:					
i) To get hands-on training on qualitative analysis of inorganic salts. ii) To study the chemical separation of a mixture and identification of separated substances.					
COURSE CONTENT / SYLLABUS					
UNIT-I	Inorganic Qualitative/Quantitative Analysis				30 hrs.
	Qualitative analysis of Inorganic Salts (mixture of two salts or three salts with two cations and two anions or three cations and three anions)				
UNIT-II	Organic Quantitative Analysis				30 hrs.
	Estimation of organic compounds: Amide, Ester, Aniline, Phenol, Glucose, Nitro Compound, etc.				
REFERENCES					
1	Vogel's Textbook of Inorganic Qualitative Analysis; Pearson Education Ltd (2004).				
2	Shah R C, (2001) Inorganic Analysis Part I Qualitative Analysis Baroda Book Depot.				
3	Shah R C, (2001) Organic Analysis Part I Qualitative Analysis Baroda Book Depot.				
4	V K Ahluwalia and Sunita Dhingra, (2000), Comprehensive Practical Organic Chemistry Qualitative Analysis, University Press Publishers				

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	MAJOR (PAPER I) Basic Phase equilibrium, Electrochemistry, Thermodynamics and Instrumental Methods of Chemical Analysis <u>CHM3005C</u>		CREDIT	4 [3(T)+1(P)]
Semester	I			HOURS	75 (45+30)
OBJECTIVES :	i) To study basic of Phase equilibria ii) To understand basic of Electrochemistry and electrochemical processes iii) To study classical thermodynamic and its potential applications iv) To understand the classical and instrumental method of analysis.				
COURSE CONTENT / SYLLABUS					
UNIT-I	Phase equilibria I				15 hrs.
	Phases, components, degrees of freedom, equilibrium between phases, phase boundaries, phase stability and phase transitions, Ehrenfest classification of phase transitions, phase diagrams. Derivation of phase rule and Experimental procedures for phase studies. One component systems (Water, sulphur, carbon dioxide, carbon, helium), supercritical fluid. Two-component systems involving eutectics, congruent and incongruent melting points.				
UNIT-II	Electrochemistry I				15 hrs.
	Electrolytic and galvanic cells, reversible and irreversible cells. EMF of a Cell and its measurement. Nernst's equation. Determination of E ⁰ and equilibrium constant of cell reaction. Standard electrodes (including reference electrodes). Electrochemical series of electrode potentials. Convention for half-cell potential. Applications of EMF measurements: Determination of solubility product, mean activity coefficient, transport number. Weston-Cadmium cell				
UNIT-III	Thermodynamics I				15 hrs
	Second law of thermodynamics: Need for the II law, statements of the second law. Spontaneous process, Carnot's cycle and efficiency of heat engine. Concept of entropy, definition, entropy of an ideal gas, entropy changes in cyclic, reversible and irreversible processes and physical transformations. Calculation of entropy changes with changes in T, V and P, entropy of mixing. Gibbs free energy, Helmholtz work functions, their variations with temperature, pressure and volume. Criteria for spontaneity, Gibbs Helmholtz equations- derivation and its applications. Third law of Thermodynamics: Nernst heat theorem, statement of third law of thermodynamics. Evaluation				

	and absolute entropy from heat capacity measurements. Exception to third law.	
UNIT IV	Classical and Instrumental methods of chemical analysis - I	30 hrs
	Quantitative chemical analysis using classical and / or instrumental methods for commercial substances like ascorbic acid, boric acid, calibration of analytical equipment etc.	
REFERENCES		
1	Atkins, P. and Paula, J. D., Physical Chemistry, 8th Edition (International Student Edition) Oxford Univ. Press, New Delhi, 2006.	
2	Glasstone, S., Text Book of Physical Chemistry, 2nd Edition Reprint, Macmillan and Co. Ltd., New York, 1990.	
3	Puri, B. R., Sharma, L.R. and Pathania, M. S., 48 th Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar, 2020.	
4	Bahl, B.S., Bahl A. and Tuli, G.D., Essentials of Physical Chemistry, 28 th Edition, S. Chand, Delhi, 2022.	
3	Engel, T. and Reid, P., Physical Chemistry, Pearson Prentice Hall, Noida, 2007.	
4.	Mahan, B. H., University Chemistry,3 rd Edition, Narosa Publishing House, New Delhi, 2009.	
5.	Bockris, John O'M. and Reddy, Amulya K. N., Modern Electrochemistry, Springer, NY, 2012.	
6.	Christian, G. D., Analytical Chemistry, John Willey & Sons. 6th Edition, 2004	
7.	Skoog, D. A., West, D. M., Holler, F. J. and Crouch, S. R., Fundamentals of Analytical Chemistry, Cengage Learning. 9th Edition, 2014.	
8	Jeffery, G. H., Bassett, J., Mendham, J. and Denny, R. C., Vogel's Text Book of Quantitative Chemical Analysis, 5th Edn. , ELBS, 1991.	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	MAJOR (PAPER II) Main Group Elements, Separation Methods and Organic Preparation <u>CHM3015C</u>		CREDIT	4 [3(T)+1(P)]
Semester	I			HOURS	75 (45+30)
OBJECTIVES :					
i) To understand the chemistry of main group elements ii) To understand the basic principles of separation iii) To learn the synthetic methodology					
COURSE CONTENT / SYLLABUS					
UNIT-I		Main Group Elements-I			15 hrs.
		Chemistry of Boron family: Electron deficiency and acceptor behavior, Oxides, hydroxides and halides, boronnitride and borazole. Structure, bonding and important applications. Boranes, borohydrides and carboranes. Chemistry of Carbon family: Allotropy, trends in metallic properties and conduction, structure, bonding and properties of oxides. Carbides, graphitic compounds, silicates, zeolites, feldspars, ultramarines and clay minerals. Synthetic zeolites and clays.			
UNIT-II		Main Group Elements-II			15 hrs.
		Nitrogen family: hydrazine, hydroxylamine and hydrazoic acid, hydrides of other elements, oxides and halides, oxyacids of nitrogen and phosphorous. Chemistry of Oxygen family: Ozone, oxides, peroxides and superoxides. Oxyacids and halides of sulphur, peracids and persalts of sulphur, Chemistry and applications of lead compounds, toxicity and biological role of selenium and tellurium. Chemistry of Halogens: Oxides and oxyacids of halogens, peracids and persalts, interhalogen compounds, pseudohalogens and polyhalides, basic properties of Iodine, Chemistry of Astatine. Chemistry of Noble Gases: Oxides, fluorides and oxyfluorides of xenon.			
UNIT-III		Separation Methods			15 hrs
		Separation methods: Introduction, Need for separation, types of separation, different methods of separation Solvent extraction: Batch, continuous and counter current methods of solvent extraction, solvent extraction systems for organic and inorganic species, effect of pH on such systems, important analytical and industrial applications. Chromatography: Principle of separation, terminology (stationary and mobile phases, retention time, retention volume, resolution, number of theoretical plates (N and HETP), Column theory (qualitative approach), mechanism of separation.			

UNIT IV	Two stage organic preparations – I		30 hrs
	1. Preparation of benzanilide from benzophenone via benzophenone oxime.		
	2. Preparation of 7-acetoxy-4-methyl coumarin from resorcinol via 7-hydroxy-4-methyl coumarin.		
	3. Preparation of p-bromoaniline from acetanilide via p-bromoacetanilide.		
REFERENCES			
1	Lee, J. D., Concise Inorganic Chemistry, 4th Edition, Chapman and Hall, 1991.		
2	Huheey, J. E., Inorganic Chemistry: Principles of Inorganic Chemistry, 4 th , 1983.		
3	Cotton, F. A. and Wilkinson, G., Basic Inorganic Chemistry, Wiley Eastern, 1988.		
4	Rodgers, Glen E., Introduction to Coordination, Solid State & Descriptive Inorganic Chemistry, McGraw Hill Inc., 1994.		
5	Cotton, F. A. & Wilkinson G, Advanced Inorganic Chemistry, 6th Ed., Wiley Interscience, 1999.		
6	Sanderson, R. T., Inorganic Chemistry, East-West Press, 1971.		
7	Purcell, K. F. & Kotz J.C., Inorganic Chemistry, Holt-Saunders, 1980.		
8	Willard, H. H., Merritt, L. L., Dean, J. N. and Settle, F. A., Instrumental methods of analysis I.B.H. Publishing House, New Delhi. 7 th Ed. 1988.		
9	Christian, G. D., Analytical Chemistry, John Willey & Sons. 6 th Edition,		
10	Skoog, D. A., West, D. M., Holler, F. J., and Crouch, S. R., Fundamentals of Analytical Chemistry, Cengage Learning. 9th Edition, 2014.		
11	Bauer, H. R., Bauer, H. H., Christian, G. D., O' Reilly, J. E., Instrumental Analysis, Ed. Allyn and Bacon, Inc. USA, 1978		
12	Braun, R. D., Introduction to Instrumental Analysis, McGraw-Hill Book Company, 1987.		
13	Fifield, F. W., Principles and Practice of Analytical Chemistry, 5th Ed. Blackwell Science, 2000.		
14	Furniss, B. S., Hannaford, A. J., Smith, P. W. G., and Tatchel, A. R., Vogel's Textbook of Practical Organic Chemistry, 5 th addition, Pearson, 2020.		
15	Ahluwalia, V. K., Agarwal R., Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, Universities Press, 2001.		

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry			ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	MAJOR (PAPER III) Stereochemistry, Heterocyclic Compound, Optical Methods and Organic Preparations <u>CHM3025C</u>		CREDIT	4 [3(T)+1(P)]
Semester	I			HOURS	75 (45+30)
OBJECTIVES:	i) Study fundamentals of stereochemistry of organic compounds. ii) To study the chemistry of heterocyclic compounds. iii) To understand the basics of optical methods. iv) To learn basic spectroscopic techniques and its applications.				
COURSE CONTENT / SYLLABUS					
UNIT-I	Stereochemistry of Organic Compounds				15 hrs.
	Stereochemistry of organic compounds: Conformation, energy of conformers, conformation of cyclohexane, Conformation of mono- and di-substituted cyclohexanes, 1,2-, 1, 3- and 1,4- disubstituted cyclohexanes and their relative energies, chair form of α - and β -D- glucose. Chirality in organic compounds: Concept of chirality, generation of chiral centre, reactions remote from chiral centre, correlating stereochemistry of chiral compounds, generation of another chiral centre, reaction of chiral compounds with chiral compounds, resolution, stereochemical outcome of addition of halogens to alkenes. Chirality in absence of stereogenic centre, chiral biphenyls, atropisomerism, chiral allenes and spiro compounds.				
UNIT-II	Heterocyclic Compounds				15 hrs.
	Heterocyclic compounds: Introduction, structure, molecular orbitals and aromaticity in pyrrole, furan and thiophene, methods of preparation, electrophilic and nucleophilic substitution reactions with mechanism; relative basicity of pyridine, piperidine and pyrrole. Condensed five and six member heterocycles: Introduction and nomenclature, preparation and reactions of indole, quinoline and isoquinoline, Fischer indole synthesis, Skraup synthesis, Bischler-Napieralski synthesis, electrophilic and nucleophilic substitution reactions of indole, quinoline and isoquinoline.				
UNIT-III	Optical Methods				15 hrs
	Interaction of radiation with matter, fundamental laws of spectroscopy and selection rules.				

	UV-visible Spectrometry: Basic principles of instrumentation (Choice of source, monochromator and detector), single and double beam instrument; basic principles of quantitative analysis: validity of Beer-Lambert’s law, estimation of metal ions in aqueous solution, Infrared spectroscopy: Basic principle of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; sampling techniques. 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, techniques for the quantitative estimation of trace level of metal ions from metal samples.	
UNIT IV	Two stage organic preparations – II	30 hrs
	1. Preparation of Quinacetophenone from hydroquinone via hydroquinone diacetate. 2. Preparation of 1,3,5-tribromobenzene from aniline via 2,4,6-tribromoaniline. 3. Preparation of methyl orange from aniline via sulphanilic acid.	
REFERENCES		
1	Morrison, R. T., Boyd, R. N., Organic Chemistry, Prentice Hall of India, New Delhi (VI Ed).	
2	Pine, S. H., Organic Chemistry, McGraw Hill, New Delhi, 1993.	
3	Loudon, G. M., Organic Chemistry, Oxford, New York, 2002.	
4	Roberts, J. D. and Caserio, M. C., Basic Principles of Organic Chemistry, 2 nd Edition, W A Benjamin Inc., California, USA, 1992.	
5	Graham, Solomons T W and Fryhle, C, Organic Chemistry, John Wiley, 2002.	
6	Singh, S. P. and Mukherjee, S. M., Organic Chemistry, McMillan India, 1984.	
7	Finar, I. L., Organic Chemistry, Vol 1 & 2, Pearson Edu. Ltd., 2013	
8	Arora, M. G., Stereochemistry in Organic Compounds, Anmol Publishers, New Delhi, 1997.	
9	Willard, H. H., Merritt, L. L., Dean, J. N. and Settle, F. A., Instrumental methods of analysis, I B H Publishing House, New Delhi. 7th Ed. 1988.	
10	Christian, G. D., Analytical Chemistry, John Willey & Sons. 6 th Edition, 2004.	
11	Skoog, D. A., West, D. M., Holler, F. J. and Crouch, S. R., Fundamentals of Analytical Chemistry, Cengage Learning. 9 th Edition, 2014.	
12	Bauer, H. H., Christian, G. D., Reilly J E O’, Instrumental Analysis, Ed. Allyn and Bacon, Inc. USA, 1978.	
13	Braun, R. D., Introduction to Instrumental Analysis, McGraw-Hill Book Company, 1987. Fifield, F. W., Principles and Practice of Analytical Chemistry, 5 th Ed., Blackwell Science, 2000.	
14	Bauer H H, Christian G D, Reilly J E O’, Instrumental Analysis, Ed. Allyn and Bacon, Inc. USA, 1978.	
15	Furniss, B. S., Hannaford, A. J., Smith, P. W. G. and Tatchel, A. R., Vogel’s Textbook of Practical Organic Chemistry, 5th addition, Pearson, 2020.	
16	Ahluwalia, V. K., Agarwal, R., Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, Universities Press, 2001.	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	MINOR (PAPER I)		CREDIT	4
Semester	I	<u>Advanced phase Equilibrium, IR and UV Spectroscopy, Environmental Chemistry and Novel Inorganic Solids</u> <u>CHE3005C</u>		HOURS	60
OBJECTIVES :					
i) To study advanced topics of Phase equilibrium and its application. ii) To study the basic principles of Infrared spectroscopy and UV-Visible spectroscopy. iii) To understand the basics of water pollution and remediations. iv) To study novel inorganic solids and its applications.					
COURSE CONTENT / SYLLABUS					
UNIT-I	Phase equilibria II: Liquid-gas and liquid-liquid systems, Ideal/non-ideal liquids, Raoult’s Law, Henry’s Law, Fractional distillation of binary miscible liquids. Column efficiency, Azeotropes, Breaking of azeotropes, Lever rule, partial miscibility of liquids, lower and upper critical solution temperature, Immiscible liquid pairs, steam distillation. Three component systems, triangular plots: Partially miscible three liquid systems. (Formation of one, two and three immiscible pairs). Nernst Distribution law: Definition, Thermodynamic derivation, Association and dissociation of solute in one solvent, Applications, study of complex ions, solvent extraction.				15 hrs.
	UNIT-II				
UNIT-II	Infrared Spectroscopy and UV-Visible spectroscopy				15 hrs.
	Infrared Spectroscopy Introduction, characteristic vibrational frequencies for alkanes, alkenes, alkynes, aromatics, alcohols, ethers, phenols, amines and nitro compounds, carbonyl compounds, aldehydes, ketones, esters, amides, acids, anhydride, lactones, lactams and conjugated carbonyl compounds, Effect of hydrogen bonding, ring size and solvent.				
	UV-Visible spectroscopy Electronic excitations, UV absorption by dienes, carbonyl, conjugated and extended conjugated and unsaturated alkenes and carbonyl compounds, aromatic systems, polyynes, biphenyls, Woodward–Fieser rules for conjugated dienes and enones. Optical rotatory dispersion and circular dichroism.				

UNIT-III	Environmental Chemistry -I	
	Introduction. Water pollution: Quality of water, types of pollutants, their sources, methods of sampling, BOD, COD, TOC determination. Determination of some important water pollutants.	15 hrs
UNIT IV	Novel Inorganic Solids-II	
	Metallic Properties: Properties of metals, crystal structure of metals, electron gas theory and Pauling's theory of metals, Band theory, Alloys, Hume-Rothery rules. Simple idea of conduction, Semiconductors and insulators. Magnetic and electrical properties of solids. Introduction to superconductivity. Introduction to inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones. Inorganic Pigments: Types of pigment, physical and chemical properties, choice of pigment, synthetic iron oxide, titania, colloidal gold, zircon, glaze stains.	15 hrs
REFERENCES		
1	Atkins, P. and Paula, J. D. Physical Chemistry, 8th Edition (International Student Edition) Oxford Univ. Press, New Delhi, 2006.	
2	Glasstone, S., Text Book of Physical Chemistry, 2nd Edition Reprint, Macmillan and Co. Ltd., New York, 1990.	
3	Puri, B. R., Sharma, L.R. and Pathania, M. S., 48 th Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar, 2020.	
4	Bahl, B. S., Bahl, A. and Tuli, G. D., Essentials of Physical Chemistry, 28 th Edition, S. Chand, Delhi, 2022.	
5	Engel, T. and Reid, P., Physical Chemistry, Pearson Prentice Hall, Noida, 2007.	
6	Mahan, B. H., University Chemistry, 3 rd Edition, Narosa Publishing House, New Delhi, 2009.	
7	Scheinmann, F, An Introduction to Spectrometric Method of Identification of Organic Compounds Vol I & II., Oxford Pergamon press, 1970.	
8	Dyer, J. R., Application of Absorption Spectroscopy of Organic Compounds, Prentice Hall of India, New Delhi, 1964.	
9	Flemming and Williams, D., Spectroscopic Methods in Organic Chemistry, McGraw Hill, London, 1966.	
10	William, K., Organic Spectroscopy , Macmillan Press, London.	
11	Kalsi, P. S., Spectroscopy of Organic Compounds, W. Eastern, N. Delhi, 1993.	
12	Williams, D. H., Fleming I., Spectroscopic Methods in Organic Chemistry, Tata McGraw-Hill, 2004.	
13	Lambert, J. B., Shurvell, H. F., Lightner, D. A., Cooks, R. G., Organic Structural Spectroscopy, , Prentice-Hall, 1998.	
14	Sharma, B. K., Environmental Chemistry, Goel Publishing House, 2014.	

15	Sharma, B. K., Instrumental methods of chemical Analysis, Goel Publishing House, 2004
16	De, A. K. and De, A. K. Environmental Chemistry, New Age International Publications, 10 th Ed., 2021.
17	Chatwal, G. and Anand, S., Instrumental Methods of Chemical Analysis, Himalaya Publication Home, 2006.
18	Day, M. C. and Selbin, J., Theoretical Inorganic Chemistry, East-West Press, 1985.
19	Cartmell, E. and Fowles G.W.A., Valency and Molecular Structure, 4th Edition. ELBS, Butterworths, 1977.
20	Kettle, S. F. A., Murrell, J. N. and Teddler, S., The Chemical Bond, ELBS, Butterworths, 1985.
21	Lee, J. D., Concise Inorganic Chemistry, 4th Edition, Chapman and Hall, 1991.
22	Emeleus, H. J. and Sharpe, A. G., Modern Aspects of Inorganic Chemistry, 4th Edition, UBS, 1994.
23	Banerjea, D., Coordination Chemistry, Tata McGraw Hill, 1993.

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	MINOR (PAPER II) <u>Ionic Equilibria, Name Reactions, Environmental Chemistry and Quantum Mechanics</u> <u>CHE3015C</u>		CREDIT	4
Semester	I			HOURS	60
OBJECTIVES : i) To understand basic concept of ionic equilibrium ii) To understand the mechanism and basics of reactions iii) To understand the basics of air pollution and its remedies. iv) To learn the basic principles of Quantum Chemistry					
COURSE CONTENT / SYLLABUS					
UNIT-I	Ionic Equilibria				15 hrs.
	Arrhenius theory of electrolytic dissociation, ionic product of water, pH scale, measurement of pH, common ion effect, Henderson’s equation, buffer solutions, buffer capacity. Hydrolysis of salts, hydrolysis constant, degree of hydrolysis, Methods of determination of degree of hydrolysis. Relationship between K_h , K_a , K_b and K_w , Theory of Acid-Base indicators. Theory of strong electrolytes, Debye-Huckel limiting law.				
UNIT-II	Reactions, mechanism and applications of the name reactions				15 hrs.
	Bayer-Villiger oxidation, Dakin reaction, Baker-Venkataraman reaction, Reformatsky reaction, Robinson annulation, Cannizzaro reaction, Dieckmann reaction, Perkin Reaction, Stobbe condensation, Bischler Napieralski reaction, Wittig rearrangement.				
UNIT-III	Environmental Chemistry -I				15 hrs
	Air pollution : Physical characteristics of the atmosphere, inversions and air pollution, types of air pollutants. Chemical and photochemical reactions in atmosphere and their effects. Methods of sampling, gaseous and particulate analysis and monitoring.				
UNIT IV	Quantum Mechanics				15 hrs
	Schrodinger wave equation, Laplacian operator, Energy associated with particle in one dimensional box (qualitative treatment). Polar coordinates r , θ and ϕ . Separation of the wave equation in translational and rotational parts, ϕ , Θ and R equations and the $\phi(\phi)$, $\Theta(\theta)$ and $R(r)$ functions. Quantum numbers derived from the wave equation, relation between quantum numbers and radial and angular nodes, spherical harmonics and shapes of orbitals. Radial probability, Screening effect and order of suborbital energies in multielectronic atoms, Ground spectral states of atoms and ions (up to $Z=30$).				

	Elementary concept of symmetry elements and symmetry operations, Point symmetries, C_{nv} , D_{4h} , D_{6h} , T_d and O_h .	
REFERENCES		
1	Atkins, P. and Paula, J. D., Physical Chemistry, 8th Edition (International Student Edition) Oxford Univ. Press, New Delhi, 2006.	
2	Glasstone, S., Text Book of Physical Chemistry, 2nd Edition Reprint, Macmillan and Co. Ltd., New York, 1990.	
3	Puri, B. R., Sharma, L.R. and Pathania, M. S., 48 th Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar, 2020.	
4	Bahl, B. S., Bahl, A. and Tuli, G.D., Essentials of Physical Chemistry, 28 th Edition, S. Chand, Delhi, 2022.	
3	Engel, T. and Reid, P., Physical Chemistry, Pearson Prentice Hall, Noida. 2007.	
4.	Mahan, B. H., University Chemistry, 3 rd Edition, Narosa Publishing House, New Delhi, 2009.	
5.	March, J., March's Advanced Organic Chemistry: Reactions, Mechanism and Structure, J W and Sons.	
6.	Hine, J., Physical Organic Chemistry, McGraw-Hill Book Co. Inc.	
7.	Pine S H, Organic Chemistry, McGraw Hill, New Delhi, 1993.	
8.	Roger, A. and Cope, A. C. (Edited by), Organic Reactions, John Wiley and Sons, Inc., New York-London.	
9.	Ferguson, L. N., The Modern Structural Theory of Organic Chemistry, Prentice Hall Publishers.	
10.	Barton, D. H. R., Comprehensive Organic Chemistry - Vols.1-6.	
11.	Morrison, R. T. and Boyd. R. N., Organic Chemistry, Prentice Hall of India, New Delhi (VI Ed).	
12.	Skyes, P., Guidebook to Mechanisms in Organic Chemistry, Pearson, 6th Edition.	
13.	Bansal, R. K., Synthetic Approaches in Organic Chemistry, Narosa Publishers, 2001.	
14.	Mukherjee, S. M. and Singh, R. P., Reaction Mechanisms in Organic Chemistry, Macmillan Publishers. 2007.	
15.	Ahluwalia, V. K. and Parashar, R. K., Organic Reaction mechanisms, Narosa Publishers, 2002	
16.	Jack, Li Jie, Name Reactions - A Collection of Detailed reaction Mechanisms, Springer, N. Y.	
17.	Parikh, A. R., Parikh, H. and Parikh, K., Name Reactions in Organic Synthesis, Foundation Books, New Delhi.	
18	Sharma, B. K., Environmental Chemistry, Goel Publishing House, 2014.	
19	Sharma, B. K., Instrumental methods of chemical Analysis, Goel Publishing House, 2004	
20	De, A. K. and De, A. K. Environmental Chemistry, New Age International Publications, 10th Ed., 2021.	
21	Chatwal, G. and Anand, S., Instrumental Methods of Chemical Analysis, Himalaya Publication Home, 2006.	
22	Day, M. C. and Selbin, J., (1985) Theoretical Inorganic Chemistry, East-West Press.	
23	Cartmell E. and Fowles G.W.A., Valency and Molecular Structure, 4th Edition. ELBS, Butterworths, 1977.	

24	Kettle, S. F. A., Murrell, J. N. and Teddler, S., The Chemical Bond, ELBS. Butterworths, 1985.
25	Lee, J. D., Concise Inorganic Chemistry, 4th Edition, Chapman and Hall, 1991.
26	Emeleus, H. J. and Sharpe, A. G., Modern Aspects of Inorganic Chemistry, 4th Edition, UBS, 1994.
27	Banerjea, D., Coordination Chemistry, Tata McGraw Hill, 1993.
28	Cotton, F. A. and Wilkinson, G., Basic Inorganic Chemistry, Wiley Eastern, 1988.
29	Huheey, J. E. and Collins, H., Inorganic Chemistry: Principles of Inorganic Chemistry, 4 th Edition, 1983.

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	MINOR (PAPER III) <u>Nuclear Chemistry, Energy of Bio-systems,</u> <u>Fundamental of Electrochemistry and Non aqueous</u> <u>solvents</u> <u>CHE3025C</u>		CREDIT	4
Semester	I			HOURS	60
OBJECTIVES :	i) To learn the basics of nuclear chemistry ii) To study the fundamentals of bio-systems iii) To learn the fundamentals of electrochemistry iv) To learn the basics of non-aqueous solvent in pharmaceutical analysis				
COURSE CONTENT / SYLLABUS					
UNIT-I	Nuclear Chemistry				15 hrs.
	Fundamental particles of nucleus, isotopes, natural abundance, stability of nucleus, n/p ratio, mass defect and nuclear binding energy, Einstein’s mass energy relationship. Natural radioactivity and disintegration rate, half life, average life, artificial transmutation and radioactivity. Radioactive series. Nuclear reactions, nuclear fission, principle and types of nuclear reactors (thermonuclear and fast breeder), nuclear fusion, thermonuclear radiations, Mechanism of solar energy (proton-proton chain and Carbon nitrogen cycle). Applications of radioactivity in Chemistry and industry.				
UNIT-II	Energy of Bio-systems				15 hrs.
	Energy obtained by oxidation of foodstuff in cells, Introduction to catabolism and anabolism, ATP: Universal currency of cellular energy, ATP hydrolysis and free energy change, Agents for transfer of electrons in biological redox system: NAD ⁺ and FAD, Outline of catabolic pathways of carbohydrates: Glycolysis, Kreb’s cycle and Fermentation, Interrelationship in the metabolic pathways of Protein, fat and Carbohydrate, Caloric Value of food, Standard caloric content of food types.				
UNIT-III	Fundamental of Electrochemistry				15 hrs
	Redox potentials and electrochemical series, analysis of redox cycle, redox stability in water, Disproportionation, oxidation by atmospheric oxygen, presentation and use of redox potential data- Frost, Latimer and Pourbaix diagrams, pH dependence of redox and conditional Latimer diagrams, trends in stabilities of the oxidation states of metals. Effect of complex formation on				

	redox potentials and stabilization of oxidation states of transition metal ions in various complexes. Water Oxidation with special reference to electrochemical processes.	
UNIT IV	Non aqueous solvents and their applications to pharmaceutical analysis	
	Introduction to non aqueous titrations • Definition and comparison with aqueous titrations • Role of non-aqueous solvents: aprotic, protogenic, protophilic, and amphiprotic • Solvent properties affecting titration behavior • Conductometric and potentiometric titrations (direct, back titration) Endpoint detection methods (visual, potentiometric) Common Titrants • Perchloric acid in glacial acetic acid (for weak bases) • Sodium methoxide in benzene-methanol (for weak acids) • Tetrabutylammonium hydroxide in DMSO (for very weak acids) • Preparation of the titrants and their Standardization Pharmaceutical Applications • Assay of weakly acidic and basic drugs and other hydrophobic drug molecules.	15 hrs
REFERENCES		
1	Arnikar. H. J., Essential of Nuclear Chemistry, 4th Edition, New Age International Publishers, New Delhi, 1995.	
2	Puri, B. R., Sharma, L.R. and Pathania, M. S., 48 th Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar, 2020.	
3	Bahl, B. S., Bahl, A. and Tuli, G.D., Essentials of Physical Chemistry, 28 th Edition, S. Chand, Delhi, 2022.	
4	Price, N. C. and Stevens, L., Fundamentals of Enzymology, Oxford Uni. Press, N Y 1998.	
5	Mann, J., Davidson, R. S., Banthrope, D. V. and Harborne, J. B., Topics in Enzymes and Fermentation Biotechnology, Alan Wiseman, 1979. Ellis Harwood Ltd. (John Wiley & Sons).	
6	Fersht, A., Enzyme structure and mechanism, W.H.Freeman & Co Ltd; 2nd edition, 1984.	
7	Lehninger, A. H., Biochemistry, 2017	
8	Karlson, P., Introduction to Modern Bio-Chemistry, Academic Press, 2017.	
9	Cotton, F. A. and Wilkinson, G., Advanced Inorganic Chemistry, 6 th Ed., Wiley Interscience, 1999.	
10	Housecroft, C. E. and Sharpe, A. G., Inorganic Chemistry, Prentice Hall, 2005.	
11	Purcell, K. F. and Kotz, J. C., Inorganic Chemistry, Holt-Saunders, 1980.	

12	Rodgers, G. E., Introduction to Coordination, Solid State and Descriptive Inorganic Chemistry, McGraw Hill Inc., 1994.
13	Atkins, P., Overton, T., Rourke, J., Weller, M. and Armstrong, F., "Shriver and Atkins – Inorganic Chemistry" 4th Edition. Oxford University Press, Oxford, 2006.
14	Mithra, S., Sample Preparation Techniques in Analytical Chemistry, Wiley Interscience, 2003
15	Kar, A., Pharmaceutical Drug Analysis, New Age International, 2005
16	Skoog, D. A., West, D. M., Holler, F. J., and Crouch, S. R., Fundamentals of Analytical Chemistry, Cengage Learning. 9 th Edition, 2014.

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	Skill Enhancement Courses Quantitative Inorganic Analysis <u>SEC3665C</u>		CREDIT	2
Semester	I			HOURS	60
OBJECTIVES :					
i) To learn various methods for Quantitative Inorganic analysis					
COURSE CONTENT / SYLLABUS					
UNIT-I	Quantitative Inorganic analysis – I				30 hrs.
	(1) Introduction to Gravimetric method of analysis and estimation of iron/ aluminium as oxide. (2) Separation of Binary mixtures of metal ions and their estimation by suitable combination of the following methods: a. Gravimetric analysis b. Alkalimetry c. Redox titrations d. Complexometric titrations e. Argentimetry The following ions will be quantitatively analysed: Cations of : Ag(e), Al(a), Ba(a). Ca(a,b), Cr(c), Cu(c,d), Fe(a,c), Mg(a,d), Mn(c,d), Ni(a,d), Zn(a,d). Anions : Cl ⁻ (e), C ₂ O ₄ ²⁻ (a,b), NO ²⁻ (c), SO ₄ ²⁻ (a) and S ₂ O ₃ ²⁻ (c). Note: The letters in parenthesis indicate the method of analysis.				
UNIT-II	Quantitative Inorganic analysis – II				30 hrs.
	Quantitative Inorganic analysis: (1) Introduction to Gravimetric method of analysis and estimation of iron/ aluminium as oxide. (2) Separation of Binary mixtures of metal ions and their estimation by suitable combination of the following methods: a. Gravimetric analysis b. Alkalimetry c. Redox titrations				

	d. Complexometric titrations e. Argentimetry The following ions will be quantitatively analysed: Cations of : Ag(e), Al(a), Ba(a). Ca(a,b), Cr(c), Cu(c,d), Fe(a,c), Mg(a,d), Mn(c,d), Ni(a,d), Zn(a,d). Anions : Cl⁻(e), C₂O₄²⁻(a,b), NO₂⁻(c), SO₄²⁻(a) and S₂O₃²⁻(c). Note: The letters in parenthesis indicate the method of analysis.	
REFERENCES		
1	Mendham J., Denney, R. C., Barnes, J. B., Thomas, M. J. K., Vogel's Textbook of Quantitative Chemical Analysis, 6 th Edition, Pearson Education, New Delhi, 2003.	
2	Suehla, G., Vogel's Qualitative Inorganic Analysis, 6th Edition, Orient Longman, 1989.	
3	Shah, R. C., Inorganic Analysis Part-I, 5 th Edition Baroda Book Depot, Vadodara, 1996.	
4	Shah, R. C., Inorganic Analysis Part-II, R C Shah, 5 th Edition, Baroda Book Depot, Vadodara, 1996.	
5	Bassett, J., (Editor) Vogel's Textbook of Quantitative Inorganic Analysis, Including Elementary Instrumental Analysis, 4th edition, Longman Science and Tech.	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	MAJOR (PAPER I) Advanced Electrochemistry, Thermodynamics, Polymer Chemistry and Instrumental Methods of Chemical Analysis <u>CHM3006C</u>		CREDIT	4 [3(T)+1(P)]
Semester	II			HOURS	75 (45+30)
OBJECTIVES :					
i) To study classical thermodynamics and its potential applications ii) To understand partial molal properties iii) To study the physical aspect of polymer chemistry iv) To learn the analytical techniques for chemical analysis					
COURSE CONTENT / SYLLABUS					
UNIT-I	Electrochemistry II				15 hrs.
	Chemical and concentration cells with and without transference. Effect of temperature on cell voltage. Electrode polarization and overvoltage. Polarography and its applications. Amperometry and coulometry. Cyclic voltammetry. Corrosion: Definition, types, theories and mechanism for dry and wet corrosion, special types of corrosion. Chemical passivators and passivation. corrosion inhibitors. Fuel cells: Principle, types and their functioning.				
UNIT-II	Chemical Thermodynamics II				15 hrs.
	Chemical potential, Gibbs-Duhem equation- effect of temperature and pressure on chemical potential, chemical potential in system of ideal gases, Duhem-Margules equation. Concept of Fugacity, activity and activity coefficient, Methods for determination of fugacity of gas. Equilibrium constant and free energy, Thermodynamic derivation of law of mass action, Le Chatelier's principle. Reaction isotherm and isochore-Clapeyron equation and Clausius Clapeyron equation, applications.				
UNIT-III	Macromolecules				15 hrs
	Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers, classification of polymers. Chain-growth (free radical) and step-growth polymerization and co-polymerization. Polydispersion-average molecular weight concept, Number, weight and viscosity average molecular weights, The practical significance of molecular weight, Molecular weight determination using viscosity method,				

	Osmometry, Cryoscopy, Ebullioscopy (qualitative description) Polymer degradation and environmental concerns.	
UNIT IV	Classical and Instrumental methods of chemical analysis - II	30 hrs
	Quantitative chemical analysis using classical and / or instrumental methods for commercial substances like ascorbic acid, boric acid, calibration of analytical equipment etc.	
REFERENCES		
1	Atkins, P. and Paula, J. D., Physical Chemistry, 8th Edition (International Student Edition) Oxford Univ. Press, New Delhi, 2006.	
2	Glasstone, S., Text Book of Physical Chemistry, 2nd Edition Reprint, Macmillan and Co. Ltd., New York, 1990.	
3	Puri, B. R., Sharma, L.R. and Pathania, M. S., 48 th Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar,2020.	
4	Bahl, B.S., Bahl, A. and Tuli, G.D., Essentials of Physical Chemistry, 28 th Edition, S. Chand, Delhi, 2022.	
6	Engel, T. and Reid, P., Physical Chemistry, Pearson Prentice Hall, Noida, 2007.	
7	Mahan, B. H., University Chemistry,3 rd Edition, Narosa Publishing House, New Delhi, 2009.	
8	Christian, G. D., Analytical Chemistry, John Willey & Sons. 6th Edition,2004.	
9	Skoog, D. A., West, D. M., Holler, F. J. and Crouch, S. R., Fundamentals of Analytical Chemistry, Cengage Learning. 9th Edition, 2014.	
10	Jeffery, G. H., Bassett, J., Mendham, J. and Denny, R. C., Vogel's Text Book of Quantitative Chemical Analysis, 5th Edn. , ELBS, 1991.	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	MAJOR (PAPER II) Chemistry of Natural Products, Reactive Intermediate, Pericyclic Reactions and Organic Estimations <u>CHM3016M</u>		CREDIT	4 [3(T)+1(P)]
Semester	II			HOURS	75 (45+30)
OBJECTIVES : i) To Study fundamentals of stereochemistry of organic compounds ii) To study the chemistry of heterocyclic compounds iii) To understand the basics of optical methods iv) To learn the organic quantitative analysis					
COURSE CONTENT / SYLLABUS					
UNIT-I		Chemistry of Natural Products			15 hrs.
		Terpenes: Classification and isolation, Structure and synthesis of Citral, Geraniol and α -Terpeniol, Essential oils. Alkaloids: Classification, Isolation, Physiological activity, and General characteristics, Structure elucidation and synthesis of Nicotine, Coniine and Papaverine.			
UNIT-II		Reactive intermediates			15 hrs.
		Structure stability and reactivity of intermediates, Generation and structure of carbocation, the concept of classical and non-classical carbocations, reactions involving carbocations, Carbanion, structure and reactivity, generation and reactions. Structure and reactivity of free radicals, carbenes and nitrenes as intermediates, their structure, generation and reactions. Aryne mechanism and ways of generation and their reactions. Introduction to hetrynes and reactions.			
UNIT-III		Pericyclic Reactions			15 hrs
		Molecular orbitals of ethylene and 1,3-butadiene, and 1,3,5- hexatriene, Photochemical and thermal reactions, [2+2] and [4+2] cycloaddition reactions, the Diels-Alder reaction, electrocyclic reactions, Claisen rearrangement as a sigmatropic reaction, Photochemical reactions: Norrish type-I and type II reactions of carbonyl compounds.			

	Enolates in organic synthesis: Acidity of α -hydrogen, halogenation of ketones, aldol condensation, Claisen condensation, Wittig reaction, alkylation of diethyl malonate and ethyl acetoacetate and its application in organic synthesis.		
UNIT-IV	Organic Estimations	30 hrs	
	1. Estimation of formaldehyde, 2. Estimation of glycine, 3. Estimation of ascorbic acid, 4. Estimation of starch content in turmeric powder and 5. Total reducing sugar content in honey.		
REFERENCES			
1	Morrison. R . T. and Boyd, R. N., Organic Chemistry, Prentice Hall of India, New Delhi (VI Ed).		
2	Pine, S. H., Organic Chemistry, McGraw Hill, New Delhi, 1993.		
3	Loudon, G. M., Organic Chemistry, Oxford, New York, 2002.		
4	Roberts, J. D. and Caserio, M. C., Basic Principles of Organic Chemistry, 2 nd Edition, W A Benjamin Inc., California, USA, 1992.		
5	Graham, S. T. W. and Fryhle, C., Organic Chemistry, John Wiley, 2002.		
6	Singh, S. P. and Mukherjee, S. M., Organic Chemistry, McMillan India, 1984.		
7	Finar, I. L., Organic Chemistry, Vol 1 & 2, Pearson Edu. Ltd., 2013.		
8	March. J., March's Advanced Organic Chemistry: Reactions, Mechanism and Structure, J W and Sons		
9	Jack, H., Physical Organic Chemistry, McGraw-Hill Book Co. Inc.		
10	Ferguson, L. N., The Modern Structural Theory of Organic Chemistry, Prentice Hall Publishers		
11	Barton, D. H. R., Comprehensive Organic Chemistry, Vols.1-6, 2007.		
12	Furniss, B. S., Hannaford, A. J., Smith, P. W. G. and Tatchel, A. R., Vogel's Textbook of Practical Organic Chemistry, Revised by 5th addition, Pearson, 2020.		
13	Ahluwalia,V. K. and Agarwal, R., Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, Universities Press, 2001.		

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	MAJOR (PAPER III) Group 3 to 12 elements, Isomerism in Complexes, Analytical Chemistry and Inorganic Qualitative Analysis <u>CHM3026C</u>		CREDIT	4 [3(T)+1(P)]
Semester	II			HOURS	75 (45+30)
OBJECTIVES :					
i) To understand the chemistry of Group 3 to 12 ii) To understand the isomerism in complexes iii) To understand GLP principles and basics of chromatographic techniques					
COURSE CONTENT / SYLLABUS					
UNIT-I		Comparative study of Group 3 to 12 elements			15 hrs.
		Occurrence and extraction of elements, Ionic salts, Stoichiometric and non-stoichiometric oxides, trends in the acidic/basic characteristic of oxides and hydroxides. Horizontal comparison in iron, cobalt and nickel groups. Iso and heteropoly acids and their salts. Tungsten bronzes. Complex formation by transition metal ions in different oxidation states, colour, magnetic properties and catalytic properties. structure and uses of representative compounds of various transition elements. Chemistry of platinum group elements, application of platinum group metals and their compounds in catalysis.			
UNIT-II		Isomerism in complexes			15 hrs.
		Stability of complexes formed by transition metal ions and the factors influencing it. M→L and L→M π interaction in metal complexes. Introduction to organometallic compounds, Metal carbon σ-bonds, π-bonding in metal carbonyls and nitrosyls. Mechanism of inorganic reactions: Hard and soft acids and bases, classification of acceptors and donors, the concept of acceptor A and B. Metal and ligand substitution reactions. Complementary and non-complementary redox processes, atom transfer and electron transfer mechanisms. Metal complexes in biology and medicine.			
UNIT-III		Analytical Chemistry			15 hrs
		GLP Principles, Documentation of laboratory work, Preparation of Standard Operating Procedures (SOPs), Validation of methods, Reporting and			

	documentation of results, Quality Control and Quality Assurance, Types of Quality Standards for laboratories, Total Quality Management, Audits. Gas Chromatography: Instrumentation, types of columns, injection systems and detectors. Capillary GC, GCMS. Liquid Chromatography: Principles, solvent delivery systems, injections system, detectors and columns. Qualitative and quantitative analysis using GC and HPLC.	
UNIT-IV	Inorganic Qualitative Analysis	30 hrs
	Qualitative analysis of mixtures containing Phosphate: Binary and Ternary mixtures including an ion of a rare element and phosphate separation scheme. (a) Cations of: Ag, Pb, Hg, Cu, Cd, Sn, Bi, As, Sb, Fe, Al, Cr, Co, Ni, Mn, Zn, Ca, Sr, Ba, Mg, Na and K. NH_4^+ . (b) Cations of rare elements: W, Mo, Ce, Ti, Th, Zr, U, V and Li. (c) Anions : Cl^- , Br^- , I^- , NO_2^- , NO_3^- , S^{2-} , SO_4^{2-} , PO_4^{3-} .	
REFERENCES		
1	Huheey, J. E., Inorganic Chemistry: Principles of Inorganic Chemistry, 4th Edition, Harper-Collins, 1983.	
2	Lee, J. D., Concise Inorganic Chemistry, 4th Edition, Chapman and Hall, 1991.	
3	Emeleus, H. J. and Sharpe, A. G., Modern Aspects of Inorganic Chemistry, 4th Edition UBS, 1991.	
4	Banerjea, D., Coordination Chemistry, Tata McGraw Hill, 1993	
5	Cotton F.A. and Wilkinson G., Basic Inorganic Chemistry, Wiley Eastern, 1998.	
6	Atkins P ., Overton T., Rourke J., Weller M. & Armstrong F., “Shriver and Atkins – Inorganic Chemistry" 4th Edition. Oxford University Press, Oxford, 2006.	
7	Harvey, D., Modern Analytical Chemistry, McGraw Hill Higher Education, New York, 2000.	
8	Christian, G. D., Analytical Chemistry, 6 th Edn., John Wiley & Sons, Inc., U.S.A., 2004.	
9	Skoog, D. A., West, D. M., Holler, F. J. and Crouch, S. R., Fundamentals of Analytical Chemistry, Cengage Learning. 9 th Edition, 2014.	
10	Bard, A. J., Faulkner, L. R., "Electrochemical Methods," 1980, Wiley, NYC.	
11	Jeffery, G. H., Bassett, J., Mendham, J. and Denny, R. C., Vogel’s Text Book of Quantitative Chemical Analysis, 5 th Edn. , ELBS, 1991.	
12	Mendham J., Denney, R. C., Barnes, J. B., Thomas, M. J. K., Vogel’s Textbook of Quantitative Chemical Analysis, 6 th Edition, Pearson Education, New Delhi, 2003.	
13	Suehla, G., Vogel’s Qualitative Inorganic Analysis, 6th Edition, Orient Longman, 1989.	
14	Shah, R. C., Inorganic Analysis Part-I, 5 th Edition Baroda Book Depot, Vadodara, 1996.	
15	Bassett, J., (Editor) Vogel’s Textbook of Quantitative Inorganic Analysis, Including Elementary Instrumental Analysis, 4th edition, Longman Science and Tech.	

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	MINOR (PAPER I)		CREDIT	4
Semester	II	Electric and Magnetic properties of Materials, NMR Spectroscopy, Applied Analytical Chemistry and Inorganic Materials <u>CHE3006C</u>		HOURS	60
OBJECTIVES :					
		i) To understand fundamental of electrical and magnetic property of materials			
		ii) To understand the principles of NMR spectroscopy			
		iii) To learn various methods for fuel and food analysis			
		iv) To understand the basics of inorganic material chemistry			
COURSE CONTENT / SYLLABUS					
UNIT-I		Electric and Magnetic properties of Materials Dipole moment, Induced polarization, polarizability, bond moment and molecular dipole moment, application of dipole moment. Magnetochemistry-magnetic permeability, magnetic susceptibility, magnetic moment, relationship between magnetic susceptibility and magnetic moment, Neel point, types of substances-paramagnetic, diamagnetic, ferromagnetic substances, Curie-Weiss law, The Gouy method of measurement of magnetic moment, Applications of magnetic susceptibility-paramagnetism in atoms, ions and molecules, determination of structure of coordinate compounds etc.			15 hrs.
UNIT-II		Nuclear Magnetic Resonance (NMR) Spectroscopy Nuclear magnetic resonance, Larmour frequency instrumentation, proton NMR, nuclear shielding and deshielding, chemical shift, factors affecting chemical shift, diamagnetic anisotropy, spin-spin splitting, coupling constant, dynamic exchange of proton, shift reagents, chiral solvating agents, nuclear overhauser effect, NMR characteristics of simple organic molecules.			15 hrs.
UNIT-III		Applied analytical chemistry – Fuels and food analysis Fuel Analysis: Introduction to fossil fuel, Properties of Fuel: Calorific value, determination of calorific value of solid and liquid fuel, Classification and combustion of fuel, explosive range, Ignition temperature, Flame temperature, fire point. Solid fuels: Proximate and ultimate analysis of coal			15 hrs

	Liquid Fuels: Distillation of petroleum, determination of flash point, knocking, octane number, cetane number, aniline point, cloud point, pour point. Gaseous fuels: LPG, CNG Biodiesel. Food Analysis: Introduction to food analysis- FSSAI, Physical and chemical properties of food: Chemical properties of food: moisture analysis, water activity, acidity of food, protein determination, fat analysis, Fibre and starch in food, analysis of ash, reducing and non-reducing sugars in food.	
UNIT IV	Inorganic Materials	15 hrs
	Silicones: Synthesis and structure of silicone fluids, greases, resins and rubbers, Thermal stability, water and chemical resistance, applications in various fields. (medicines, electronic, construction)	
	Ceramics: General properties, classifications, raw materials and formation of clay, types and typical properties of clays, manufacturing process of potteries, application of colours to pottery, use of ceramics in resistors and capacitors.	
	Refractories: Properties, classification, manufacture of fire clay bricks, silica bricks, pure oxides, super refractories and insulating refractories.	
REFERENCES		
1	Atkins, P. and Paula, J. D., Physical Chemistry, 8th Edition (International Student Edition) Oxford Univ. Press, New Delhi, 2006.	
2	Bahl, B. S., Bahl, A. and Tuli, G.D., Essentials of Physical Chemistry, 28 th Edition, S. Chand, Delhi, 2022.	
3	Puri, B. R., Sharma, L.R. and Pathania, M. S., Principles of Physical Chemistry, 48 th Edition, Vishal Publ. Co., Jalandhar, 2020.	
4	Raj, G., Advanced Physical Chemistry, 4 th Edition, Krishna Prakashan Media P. Ltd. Meerut, 2016.	
5	Silverstein, R. M., Webster, F. X., Kiemle, D., Spectrometric Identification of Organic Compounds, John Wiley & Sons, New York, 2005.	
6	Pavia, D. L., Lampman, G. M., Kriz, G. S., Introduction to Spectroscopy, Harcourt College Publishers, 2001.	
7	Kalsi, P. S, Spectroscopy of Organic Compounds, New Age International Ltd. New Delhi, 2004.	
8	Jag Mohan, Organic Spectroscopy: Principles and Applications, Narosa Publishing House, New Delhi, 2004.	
9	Sharma, Y. R., Elementary Organic Spectroscopy-Principles and Chemical Applications, S. Chand and Co, New Delhi, 2007.	
10	Eds: B Pam Ismail, B. P. and Nielson, S. S. Nielson’s Food analysis, 6 th edition, Springer, 2024.	
11	Unit 12, Physical and Chemical Analysis of Foods, IGNOU.	
12	Sharma, B. K., Industrial Chemistry, Goel Publishing House, 2006.	
13	Sharma, B. K. Industrial Chemistry including Chemical Engineering, 9th revised edition, Goel Publishing House, Merrut, 1997-98.	

14	Lee, J. D., Concise Inorganic Chemistry, 4th Edition, Chapman and Hall, 1991.
15	Mahan, B. H., University Chemistry, 3rd Edition, Narosa Publ House, New Delhi, 2009.
16	Cotton, F. A. and Wilkinson, G., Basic Principles of Inorganic Chemistry, 3rd Edition, Wiley Eastern, 2009.
17	Puri, B. R., Sharma, L.R. and Kalia, K. C., Principles of Inorganic Chemistry, 29 th Edition, Milestone Publ., Delhi, 2006.

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	MINOR (PAPER II) Ion Exchangers, Pheromones and Prostaglandins, Green Synthesis of the organic compounds and Basics of Chemometrics <u>CHE3016C</u>	CREDIT	4	
Semester	II		HOURS	60	
OBJECTIVES:					
		i) To learn the fundamentals of ion exchangers. ii) To learn basics of pheromones and prostaglandins iii) To study the various green synthesis for the organic compounds iv) To learn the basics of chemometrics			
COURSE CONTENT / SYLLABUS					
UNIT-I	Ion Exchangers			15 hrs.	
	Types, structure and properties. Synthesis and properties of ion exchange resins, Ion exchange kinetics, ion exclusion and ion retardation, ion exchange in non-aqueous and mixed solvents. Liquid ion exchangers, ion exchange membranes and transport phenomena. Water treatment with ion exchangers: Softening and desalination, mixed bed treatment, ultrapure water. Problems of organic fouling of ion exchangers in water treatment. Waste water treatment, application of ion exchangers in chemistry, pharmacy and medicine.				
UNIT-II	Pheromones and Prostaglandins			15 hrs.	
	Pheromones: Introduction and applications, total synthesis of 3,11-dimethyl-2- nonacosanone and its 29-hydroxy derivative, grandisol, exobrevicomine, frontaline and juvenile hormone. Introduction to plant hormones: structure determination and synthesis of auxins. Prostaglandins: Introduction, occurrence, nomenclature, classification and physiological effects, synthesis of PGE ₂ and PGF _{2α} , biosynthesis and biological importance.				
UNIT-III	Green Synthesis of the organic compounds			15 hrs	
	Adipic acid, catechol, methyl methacrylate, urethane, aromatic amines (4-aminodiphenylamine), benzyl bromide, acetaldehyde, disodium iminodiacetate (alternative to strecker synthesis), citral, ibuprofen, paracetamol, furfural.				

	Biomass conversion: Introduction and importance of biomass, Composition, Pre-treatment, Biorefinery; Catalytic pyrolysis of lignocellulosic biomass; Biomass to liquid Bio fuels via heterogeneous catalysis.	
UNIT IV	Basics of Chemometrics	
	• Introduction • Significant figures and their significance • Propagation of Errors in Random and systematic errors • The distribution of repeated measurements – normal and log normal distribution • Finding out outliers • Experimental design: Principles of experimental design, completely randomized design (CRD), randomized block design (RBD), Latin square and factorial design.	15 hrs
REFERENCES		
1	Helfferrich, F.G. Ion Exchange, Courier Corporation, 1995.	
2	Ion Exchange in Organic and Biochemistry, C. Calmon & T.R.E. Kressman, Interscience (1957) Calmon, C. and Kressman Ion, T. R. E., Exchange in Organic and Biochemistry, Interscience, 1957.	
3	Marinsky, J. A. and Marcus, Y. (Editors), Ion Exchange and Solvent Extraction Vol. I and II, Marcel Dekker, 1973.	
4	Marcus, Y. (Editor), Ion Exchangers: Properties and Applications, K. Dorfner, Ann Arbor, Marcel Dekker, 1972.	
5	Hendrickson, J. B., The Molecules of Nature, W. A. Benjamin, Inc., New York, 1965.	
6	Bentley, K. W., The Chemistry of Natural Products, Vol - I, Scotland. Interscience Publishers, Inc., New York, 1957.	
7	Atta-Ur-Rahman and Choudhary, M. I., New Trends in Natural Product Chemistry, Amsterdam : Harwood Academic Publishers, 1998.	
8	Anatase, P. T. and Warner, J. C., Green chemistry, Theory and Practice, Oxford University Press, 2000.	
9	Ahluwalia, V. K. and Kidwai, M. R., New Trends in Green Chemistry, 2 nd edition, Anamalaya Publishers, 2005.	
10	Cann, M. C. and Connely, M. C., Real-World cases in Green Chemistry, American Chemical Society, Washington, 2000.	
11	Ryan, M. A. and Tinnesand, M., Introduction to Green Chemistry, American Chemical Society, Washington, 2002.	
12	Lancaster, M., Green Chemistry: Introductory Text, Royal Society of Chemistry (London), 2002.	
13	Ahluwalia, V. K., Green Chemistry, 2 nd Ed: Environmentally benign reactions, Ane Books Pvt. Ltd., 2012.	

14	Jacinto, S., (editor), Fuel production with heterogeneous catalysis, CRC Press, 2015.
15	Khopkar, S. M., Basic concepts of analytical chemistry, New Age International, 1998.
16	Miller, J. C. and Miller, J. N., Statistics and chemometrics for Analytical chemistry, Prentice Hall.
17	Prichard, E., Quality in the Analytical Chemistry Laboratory, John Wiley & Sons, N.Y.
18	Skoog, D. A., West, D. M., Holler, F. J. and Crouch, S. R., Fundamentals of Analytical Chemistry, Cengage Learning. 9 th Edition, 2014.

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry		ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	Ability Enhancement Course (AEC) Exposure to Industrial Practices <u>AEC3416C</u>		CREDIT	2
Semester	II			HOURS	30
OBJECTIVES:		i) To learn fundamentals of good laboratory practices and intellectual property rights ii) To develop softskill for Chemical Sciences			
COURSE CONTENT / SYLLABUS					
UNIT-I		Exposure to Industrial Practices			15 hrs.
		Types of industries, Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP), Industrial safety. Intellectual Property rights (IPR)			
UNIT-II		Industrial Visit			15 hrs.
		Industrial Visit and report submission			
REFERENCES					
1.	Anjaneyulu, Y. and Marayya, R., Quality Assurance and Quality Management in Pharmaceutical Industry, BSP books publisher, London, 2017.				
2.	Jani, A., Bagada, H. and Patel, P., Good Manufacturing Practices and Good Laboratory Practices (Quality Assurance), Vallabh Prakashan, 1 st Edition 2019.				
3.	Durivage, M. A. (Editor), The Certified Pharmaceutical GMP Professional Handbook, 2 nd Edition, Infotech Standard, 2016.				
4.	Rattan, J., Intellectual Property Rights, Volume 1 & 2, Bharat Law House, 2024.				
5.	Verkey, E., Intellectual Property Law and Practices, Eastern Book Company, 2018.				

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Chemistry			ACADEMIC YEAR 2025-2026	
Bachelor of Science					
YEAR	III	Internship in Chemistry <u>SEC3456C</u>		CREDIT	4
Semester	II			HOURS	120
OBJECTIVES :	i) To give opportunities for career exploration and development. ii) To learn the new scientific/technical skills.				
COURSE CONTENT / SYLLABUS					
Industrial Internship, Hands on Training on Sophisticated Instruments, Project Work, Elective Papers*					
<i>*Elective courses will be offered to only those students who wish to continue for the fourth year of BSc.</i>					