JECRC™
UNIVERSITY
BUILD YOUR WORLD

Department of Chemistry
Course Structure and Syllabi

Session 2020-21

JECRC UNIVERSITY, JAIPUR

Dated: 15.06.2020

Minutes of Meeting

A meeting of Board of Studies of Chemistry was conducted on **29 May 2020** at **5.30 pm** on Zoom app during work from home.

The agenda of meeting was to **Revise the syllabi of UG and PG courses in Chemistry.**

Members BOS

Prof. SonuPareek — Chairperson
Prof. R.N.Prasad — Member
Prof. S.K. Sharma — Member
Prof. Sapna Sharma — Member
Dr. SwapnaSantra — Member
Dr. Saurabh Dave — Member
Dr. NidhiBansal — Member

External Members:

1. **Prof. Pahup Singh**, Ex-Professor& Head, University of Rajasthan, Jaipur
2. **Prof. M.P. Dhobal**, Ex-Professor University of Rajasthan, Jaipur

The recommendations of the members are as follows-

1. The suggestions to revise the syllabus of B.Sc. Chemistry Major, M.Sc. Chemistry, which were proposed by the BOS members were discussed.
2. On the basis of the suggestions and feedback given by faculty and students, revisions in syllabus of all the courses was reviewed, relevance of revisions was also discussed in detail .
3. The syllabus of B.Sc.(Minor Chemistry) was approved without any change.
4. A minor revision was approved in paper **BCE007B** of **B.Sc. II Semester** by adding few new topics and by removing few common topics.
5. On the basis of the suggestions of faculty and other stake holders, minor revisions were proposed in M.Sc. Chemistry syllabus of paper MCE001C, MCE009B and MCE10B ,all the changes were approved by BOS.

At the end of meeting chairperson expressed gratitude to external members and thanked all the members of Board of Studies.

Prof. Sonu Pareek
HOD Chemistry

JECRC™
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Department of Chemistry

Course Structure and Syllabi

B.Sc. Course

(Chemistry Major)

Session 2020-21

JECRC UNIVERSITY
SCHOOL OF SCIENCES
SESSION 2020-21

Details of various subjects and their credits with contact hours are given below:

Scheme of Teaching: B.Sc. Chemistry (MAJOR)

Semester I

Old Code	New Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						L	P	
BCE 001A	BCE 001A	**Major-1:** Hydrocarbons, Reaction Mechanisms and Stereochemistry	4	-		4		5
BCE 002A	BCE 002A	Element and Functional Group Detection (Practicals)	-	-	2	-	1	
BCE 003A	BCE 003A	**Major-2:** Chemistry of s and p-block elements	4	-		4		5
BCE 004B	BCE 004B	Mixture Analysis (Practicals)			2		1	
		Minor-1	4	-	2	4	1	5
		Minor-2	4	-	2	4	1	5
BMC 001A		**Fundamental of computers**	2	-		2	-	2
BMC 002A		**Fundamental of computers Lab**	-	-	2	-	1	1
BMC 051A		**Environmental Studies**	3	0	1	4	-	4
								Total Credits = 27

Semester II

Old Code	New Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						L	P	
BCE 005A	BCE 005A	**Major-1:** Thermodynamics, Electrochemistry and Chemical Kinetics	4	-		4		5
BCE 006A	BCE 006A	Mixture Analysis and Kinetic Studies (Practicals)			2		1	
BCE 007B	BCE 007C	**Major-2:** Industrial Chemistry	4	-		4		5
BCE	BCE	Lubricants Testing			2		1	

Dr. Sonu Jain

008B	008B	and Analysis (Practicals)						
		Minor-1	4	-	2	4	1	5
		Minor-2	4	-	2	4	1	5
BMC 003A		Computer Application-II (Advanced MS-Excel)	-	-	2		1	1
BMC 102A		Communication Skills	2	1	-	3	-	3
								Total Credits = 24

Semester III

Old Code	New Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						L	P	
BCE 009B	**BCE 009B**	**Major-1:** Alcohols, Aldehydes and Ketones	4	-		4		5
BCE 039A	**BCE 039A**	Organic analysis and preparation			2		1	
BCE 011B	**BCE 011B**	**Major-2:** Non-aqeous Solvents and Transition Metals	4	-		4		5
BCE 012B	**BCE 012B**	Titrometric Analysis (Practicals)			2		1	
		Minor-1	4	-	2	4	1	5
		Minor-2	4	-	2	4	1	5
BMC 004A		Computer Application-III(MS-Projects)	-	-	2	-	1	1
BMC 105A		Communication Skills	3	-	-	3	-	3
								Total Credits = 24

Semester IV

Old Code	New Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						L	P	
BCE 013B	BCE 013B	**Major-1:** Phase Equilibria and Surface Chemistry	4	-		4		5
BCE	BCE	Acid-Base Analysis			2		1	

014A	014A	(Practicals)						
BCE 015B	BCE 015B	**Major-2:** Analytical Chemistry	4	-		4		5
BCE 040A	BCE 040A	Estimations,Calibrations & Chromatographic analysis (Practicals)			2		1	
		Minor-1	4	-	2	4	1	5
		Minor-2	4	-	2	4	1	5
BMC 005A		Computer Application-IV (Web Designing)	2	-	-	2	-	2
BMC 006A		Computer Application-IV (Web Designing Lab)	-	-	2	-	1	1
BMC 111A		Communication Skills	2	1	-	3	-	3
								Total Credits = 26

Semester V

Old Code/Old Paper	NewCode/New Paper	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						L	P	
BCE 019A	BCE 019A	Coordination Compounds and Organometalic Chemistry	4	-		4		5
BCE 020A	BCE 020A	Inorganic Preparations and Estimation of Metal ions (Practicals)			2		1	
BCE024 B	BCE024 B	**Major-2:** Spectroscopy	4	-		4		5
BCE 037B	BCE 037B	Spectroscopic Determination of Compounds(Practicals)			2		1	
		Minor-1	4	-	2	4	1	5
		Minor-2	4	-	2	4	1	5
BMC 109A		Value Education	3	-	-	3	-	3
BMC 113A		Communication Skills	2	1	-	3	-	3
								Total Credits = 26

Semester VI

Old Code/Old Paper	New code New Paper	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						T	P	
BCE 022B	BCE 022B	Major-1: Photochemistry and Nuclear Chemistry	4	-		4		5
BCE 023A	BCE 023A	Conductometric Analysis (Practicals)			2		1	
BCE017B	BCE017B	Acid Derivatives and Heterocyclic Chemistry	4	-		4		5
BCE 018B	BCE 018B	Organic Preparations and Mixture Separation (Practicals))			2		1	
		Minor-1	4	-	2	4	1	5
		Minor-2	4	-	2	4	1	5
BCE 038A		Project						6
						Total Credits = 26		

CREDIT SUMMARY

Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI	Total Credits
27	24	24	26	26	26	153

Program Outcome(PO's)

PO1 Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from differentperspectives.

PO2 Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3 Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4 Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5 Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

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

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context sociotechnological changes

Program Specific Outcome (PSO)

PSO1 The ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to the subject areas identified.(learning skills)

PSO2 The ability to recognise and analyse problems and plan strategies for their solution.(problem solving skills)

PSO3 Skills in the evaluation, interpretation and synthesis of chemical information and
skills in the practical application of theory and skills in communicating scientific material and arguments(interpretation skills)

SEMESTER –I

BCE 001A: Hydrocarbons, Reaction Mechanisms and Stereochemistry

Course Outcomes(CO): At the end of this course student will be able to understand-CO1: the structure and bonding involved in hydrocarbon. CO2: the reaction mechanism of various organic reactions CO3: the stereochemistry of hydrocarbons.CO4: the nomenclature of alkanes and cycloalkanes, their properties, method of formation and reactions they generally undergo. CO5 the nomenclature of Alkenes, Cycloalkenes, Dienes and alkynes.their properties, method of formation and reactions they generally undergo.

Unit-I
Structure and Bonding

Bond lengths and bond angles. bond energy, localized and delocalized chemicalbond, hybridization, vander waals interactions, inclusion compounds, clatherates, charge transfer complexes.resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

Unit-II
Mechanism of Organic Reactions

Curved arrow notation,drawing electron movements with arrows, half headed and double headedarrow, homolytic and heterolytic bond breaking. Types of reagents, electrophiles and nucleophiles.Types of organic reactions, Energy considerations. Reactive intermediates-carbocations, carbanions, freeradicals, carbenes, arynes and nitrenes (With examples). Assigning formal charges on intermediates and other ionic species.

Unit-III
Stereochemistry of Organic Compounds

Concept of isomerism, types of isomerism.Optical isomerism:elements of symmetry, molecular chirality enantiomers. stereogenic centre, opticalactivity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres,diastereomers, threo and erythro diastereomers. meso compounds, resolution of enantiomers, inversion,retention and racemization.Relative and

absolute configuration: sequence rules, D&L and R&S systems of nomenclature.Geometrical isomerism:determination of configuration of geometrical isomers, E&Z systems ofnomenclature, geometric isomerism in oximes and alicyclic compounds.Conformationl isomerism: conformational analysis of ethane and n-butane. conformations of cyclohexane, axial and equatorial bond, conformation of mono substituted cyclohexane derivatives.Newmann projection and sawhorse formulae, Difference between configuration and conformation.

Unit-IV

Alkanes and Cycloalkanes

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids).Physical properties and chemical reaction of alkanes.Mechanism of free radical halogenations of alkanes, orientation,reactivity and selectivity. Cycloalkanes nomenclature,methods of formation, chemical reactions, Baeyer's strain theory and its limitations, Ring strains in small rings (cyclopropane and cyclobutane), theory of strainless rings.The case ofcyclopropane ring;banana bonds.

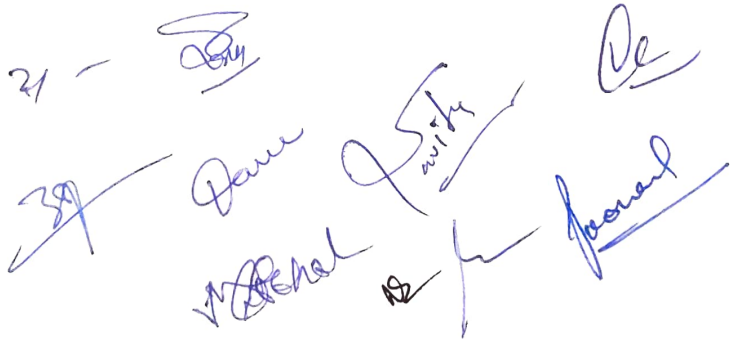
Unit-V

Alkenes, Cycloalkenes, Dienes and Alkynes

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halide, regioselectivity in alcohol dehydration The Saytzeff rule, Hofmann's elimination, physical properties and relative stabilities of alkenes.Chemical reactions of alkenes-mechanisms involved in hydrogenation, electrophilic and free radicaladditions, Markownikof's rule, hydroboration- oxidation, oxymercutation -reduction. Epoxidation,ozonolysis, hydration, hydroxylation and oxidation with KMnO4. Polymerization of alkenes. Substitutionat the allylic and vinylic-positions of alkenes. Industrial applications of ethylene and propene.Methods of formation, conformation and chemical reactions of cycloalkenes. Nomenclature andclassification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene,methods of formation, polymerization. Chemical reactions-1,2- and 1,4- additions, Diels-alderreaction.Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes,acidity of alkynes.

Books Suggested :

1. A Text Book of Organic Chemistry : K. S. Tiwari, S. N. Mehrotra and N. K. Vishnoi
2. Modern Principles of Organic Chemistry : M. K. Jain and S. C. Sharma
3. A Text Book of Organic Chemistry: (Vol. I & II) O. P. Agarwal
4. A Text Book of Organic Chemistry : B. S. Bahl and Arun Bahl
5. A Text Book of Organic Chemistry : P. L. Soni
6. Organic Chemistry : (Vol. I, II & III) S. M. Mukherji, S. P. Singh and R. P. Kapoor, WileyEastern Ltd. (New Age International)
7. Organic Chemistry : Morrison & Boyd, Prentice Hall



BCE 002A: Element and Functional Group Detection (Practicals)

1. To purify the impure sample of organic compounds by sublimation .
2. To separate the mixture (1 solid+1 liquid) by distillation .
3. To detect the elements (N and S) from the given organic compound.
4. To detect the element (halogen) from the given organic compound.
5. To purify the impure sample of organic compound by crystallization and decolourised the compound by charcoal.
6. To detect the functional group (alcoholic and phenolic) from the given organic compound.
7. To detect the functional group (Carboxylic) from the given organic compound.
8. To detect the functional group (Ester) from the given organic compound.
9. To detect the functional group (Carbonyl) from the given organic compound.
10. To detect the functional group (Amine and Aniline) from the given organic compound.
11. To detect the functional group (Carbohydrate And Nitro) from the given organic compound.
12. To detect the functional group (Amide) from the given organic compound

BCE 003A: Chemistry of s and p-block elements

Course outcome

On completion of the course, B.Sc. student will be able to understand:
CO-1 about the atomic structure, Quantum numbers and electronic configuration of elementsbased on respective rules. **CO-2** the periodic properties like Atomic and ionic radii, ionization energy, ionization potential and electron negativity and their determinations and applications**CO-3** different types of bonding like ionic bonding, covalent bonding, metallic bonding and hydrogen bonding and also molecular geometry based on VBT, VSEPR and MOT to know structure of different molecules and ions. **CO-4** s-block Elements of alkali metals and Alkaline earth metals and their industrial &biological applications.**CO-5** p- block Elements and their different compounds having the applications at industrial and biological applications.

Unit-I

Atomic Structure : Defects in Bohr Model, Idea of de Broglie matter waves. Heisenberg's uncertainty principle. Schrodinger wave equation, wave functions and their significanc. Atomic orbitals. Quantum numbers. Aufbau Princuipal, Hund's multiplicity rule and Paulis exclusion principles. Variation of orbital energies with atomic number and energy level diagram,electronic configuration of elements,effective nuclear charge and shielding; radial and angular wave functions and distribution curves, shape of s,p,d orbitals and their characteristics.

Unit-II

Periodic Properties : Atomic and ionic radii, ionization energy, electrode potential (use of redox potential-reaction feasibility), electron affinity and electronegativity – definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behavior, electronic configuration.

Unit-III

Chemical Bonding :

(i) **Ionic Bond** – Types of ionic solids, radius ratio effect and coordination number, limitations of radius ratio, lattice defects, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability, Fajan's rules.

(ii) **Covalent Bond :** Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridizations and shapes of simple inorganic molecules and ions such as NH_3,H_3O^+, SF_4, ClF_3 $ICl_2^-$and H_2O by valence shell electron pair repulsion (VSEPR) theory and Molecular Orbital Theory, bonding, nonbonding and antibonding molecular orbitals, linear combination of atomic orbitals(LCAO). Applications of MO theory.

(iii) **Bond Energy :** Dissociation and average bond energies – determination and its periodic trends, applications. Metallic Bond : Free electron, valence bond and band theories. Weak Interactions: Hydrogen Bond – experimental evidence, van der Waal's forces.

Unit-IV

s-Block Elements : Tendencies of alkali and alkaline-earth metals, hydration energies, solvation and complexation. Hydride (classification, general methods of preparation and salient features), principle of metallurgical extraction, Chemistry of Li and Be, their anomalous behaviour and diagonal relationships, alkyls and aryls and their role in biology.

Unit-V

p-Block Elements : Comparative study (group-wise) of group 13 & 14 elements with respect to periodic properties. Compounds such as hydrides, halides, oxides and oxyacids; diagonal relationship; preparation, properties, bonding and structure of diborane, borazine and alkali metal borohydrides. Preparation, properties and technical applications of carbides and fluorocarbons. Silicones and structural principles of Silicates.

Books Recommended

1. "A New Concise Inorganic Chemistry", **J. D. Lee**, 5th Edition (1996), Chapman & Hall, London.
2. "Modern Inorganic Chemistry", **R. C. Aggarwal**, 1st Edition (1987), Kitab Mahal, Allahabad.
3. "Basic Inorganic Chemistry", **F. A. Cotton, G. Wilkinson, and Paul L. Gaus,** 3rd Edition (1995),John Wiley & Sons, New York.

BCE 004B: Mixture Analysis (Practicals)

Prerequisites: Theoretical basis of qualitative analysis, Systematic analysis of Acidic and Basic radicals (including interfering radicals). Chemical reactions involved.Common-ion effect, solubility product & their applications. Oxidizing and reducing agents and buffers used in analysis.

1.To identify carbonate, Sulphite , Sulphide of dilute H_2SO_4 group.
2.To identify Nitrite and Acetate of dilute H_2SO_4 group.
3.To identify Chloride , Bromide and Iodide of concentrated H_2SO_4 group.
4.To identify Nitrate and Oxalate of concentrated H_2SO_4 group.
5.To identify acidic radicals not identified with dilute or concentrated H_2SO_4 group.
6.To analyze basic radicals of group I and II.
7.To analyze basic radicals of group III and IV.
8.To analyze basic radicals of group V,VI and VII.
9.To calibrate pipettes.
10.To calibrate burettes.
11.To prepare standard solution and dilution -0.1 M to .001M solution.
12. To standardize a secondary standard solution

SEMESTER –II

BCE005A: Thermodynamics, Electrochemistry and Chemical Kinetics

Course Outcome: After the completion of this course student will be able to-
CO-1 understand the principles of liquid state.CO-2 analyze the basic knowledge of solid state.
CO-3 describe the basic concept of kinetic theory of gaseous state.CO-4 think critically ondifferent terms and process of thermodynamics. CO-5 understand practical aspects of different theories of electrochemistry and chemical kinetics

Unit-I

Solid State : Crystal structure of NaCl, KCl, Graphite, and Diamond. Types of crystals (molecular,covalent, metallic, ionic). Imperfections in crystals : point defect, Schottky defect, Frankel defect, metal excess defect (colour centre), line defect (dislocations), edge and screw dislocations. Imperfection due to transient atomic displacement.Indexes.

Unit-II

Liquid State : Surface tension of liquids, capillary action, surface tension and temperature, interfacial tension, surface active agents, the Parachor and chemical constitution (atomic and structural parachors). Viscosity of liquids, experimental determination of viscosity coefficient, its variation with temperature. Intermolecular forces of liquids. Liquid Crystals and thermography.

Unit-III

Gaseous State : Kinetic theory of gases, ideal gas laws and kinetic theory. Collision in a gas-mean free path, collision diameter, collision number. Behaviour of real gases - the van der Waal's equation, brief mention of other equations of state. Critical phenomena - critical constants of a gas and their determination, continuity of state, the Vander Waals equation and critical state. Principle of corresponding states, liquefaction of gases.

Unit-IV

Thermodynamics : Introduction of different terms and processes in thermodynamics : [Systems (isolated, closed, open) and surroundings, macroscopic properties (extensive and intensive), kinds ofprocesses], First Law of thermodynamics and internal energy, state and state functions (exact and inexact differential), path dependence of work and heat. Enthalpy, heat changes at constant volume and constant pressure, heat capacities (Cv , Cp) and relation between them for ideal gases. Joule-Thomson effect, Joule- Thomson coefficient in ideal and real (van der Waal) gases, inversion temperature, Variation of heat of reaction with temperature (Kirchhoff's equation).

Unit-V

Electrochemistry : Arrhenius theory of electrolytic dissociation, classification of electrolytes; buffer solutions, Migration of ions : transference number and its determination (Hittorf and Moving Boundary methods).Conductance of solutions- equivalent,molecular and specific conductance. Ionic conductance, relationship between ionic conductance and ionic mobility, Kohlrausch law and its applications.

Chemical Kinetics : Introduction, order and molecularity of a chemical reactions, integrated rate equations for zeroth, first, second and third order reactions, effect of temperature on reaction rates (Arrheninus equation),collision theory and transition state theory (derivation thermodynamically), deviations from collision theory.

Books Recommended

1. "Physical Chemistry", **P. C. Rakshit,** 5th Edition (1988), 4th Reprint (1997), Sarat Book House,Calcutta.
2. "Principles of Physical Chemistry", **B. R. Puri, L. R. Sharma, and M. S. Pathania,** 37th Edition(1998), Shoban Lal Nagin Chand & Co., Jalandhar.
3. "Physical Chemistry", **K. J. Laidler and J. M. Meiser**, 3rd Edition
4. Text Book of Physical Chemistry by **Samuel Glasstone**

BCE 006A: Mixture Analysis and Kinetic Studies (Practicals)

1. To prepare standard 0.1 N NaOH solution using 0.1 N Oxalic acid as primary standard solution.
2. To determine strength of unknown CH_3COOH using 0.1 N NaOH as intermediate solution.

3. To determine the percentage composition of a given mixture (non interacting system) by viscosity method.
4. To determine the percentage composition of a given mixture (non interacting system) by surface tension method.
5. To determine the partition coefficient of Iodine between water and carbon tetrachloride (or chloroform, carbon disulphide etc) at room temperature.
6. To determine the specific reaction rate of the hydrolysis of methyl or ethyl acetate catalysed by HCl at room temperature.
7. To determine the specific reaction rate of the hydrolysis of methyl or ethyl acetate catalysed by H_2SO_4 at room temperature and compare the relative strength of acids.
8. To determine the specific reaction rate of the hydrolysis of methyl or ethyl acetate catalysed by HCl at 40°C, 45 °C and 50°C and calculate energy of activation graphically as well as employing the rate constant relationship with energy of activation.
9. To prepare colloidal solution of arsenius sulphide.
10. To study the reaction rate of decomposition of iodide by H_2O_2 Kinetically.
11. To study the hydrolysis of methyl acetate catalysed by HCl solution and equinormal solution of urea hydrochloride and determines the degree of hydrolysis of the salt.
12. To determine the relative strength of acids (HCl,H_2SO_4) during hydrolysis of an ester.

BCE007C: Industrial Chemistry

On completion of the course, B.Sc. student will be able to understand: **CO-1** about the various types, theories and mechanism of corrosion and various prevention methods.**CO-2** about the various types of lubricants and its mechanism with various types of properties of lubricants.**CO**-3 about the various types of fuel, its calorific values and its determination along-with carbonization process and synthetic fuel with manufacturing process.
CO-4 about various types of dyes and its classification and types .**CO-5**, about composition and manufacturing of cement, glass and ceramics and also principles and applications of green chemistry.

Unit-I

Water and its Treatment : Types of impurities in Water, Hardness of Water, Disadvantages of Hard Water, Temporary and Permanent hardness. Units and inter conversions of Units. Estimation of hardness by EDTA Methods.. Methods of Treatment of Water for Domestic Purposes - Sedimentation, Coagulation, Filtration, Disinfection, Sterilization, Chlorination, Break point chlorination, Ozonization. Brief introduction of softening processes.

Unit-II

Corrosion

Definition, Examples, Types of Corrosion: Theories of Corrosion and Mechanism - Dry Corrosion, (Direct Chemical attack), Wet Corrosion, (Electro Chemical Theory) ,Principles of Corrosion, Galvanic Series, Galvanic Corrosion, Concentration Cell Corrosion,Mechanism of Wet Corrosion.Factors Influencing Corrosion. Control of Corrosion; Modification of Design,Cathodic Protection,Sacrificial anodic and Impressed Current cathodic protection.Protective Coatings; Metallic coating and non metallic coating.

Unit-III

Lubricants and Cement

Lubricants, Types of lubricants oils, greases and solid lubricants, Synthetic lubricants, Functions and Mechanism of lubricants, Properties of lubricants- Saponification and Iodine value, Cloud and Pour point, Flash and Fire point, Aniline Point and Viscocity.

Cement: Types of cement, composition, manufacturing process, setting and hardening of cement

Unit-IV

Fuel

Classification of Fuels, Calorific value, Gross and Net calorific values (SI units). Determination of calorific value of a solid and liquid fuel, Carbonization, Petroleum, Cracking- fluidized catalytic cracking, Reforming of petrol, Knocking, Octane number, Cetane number, prevention of knocking, anti-knocking agents, Synthetic petrol, Bergius process and Fischer Tropsch process.

Unit-V

Green Chemistry

Introduction, Significance and principles,Industrial applications of green chemistry; R4M4 (Reduce, Reuse, Recycle, Redesign; Multipurpose, Multidimensional, Multitasking, Multi-tracking;) model with special reference of survismeter, econoburette; Safer Technique for Sustainable development.Concept of molecular and atomic economy & its use in green chemistry.

REFERENCE BOOKS:

1. B.K. Sharma, "Industrial Chemistry", Krishna Prakasam Media (P) Ltd., Meerut, 2001.
2. A text book of Engineering Chemistry by Jain & Jain, Dhanpat Rai Publishing Company, New Delhi(15 Ediction) (2006).
3. Chemistry of Engineering Materials by C.P. Murthy, C.V. Agarwal and A. Naidu BS Publication Hyd. 2007.
4. Engineering Chemistry by J C Kuriacose and J. Rajaram, Tata McGraw-Hill Co, New Delhi (2004)
5. Organic Chemistry by Morrison&Boyd, Prentice Hall.

BCE008B: Lubricants Testing and Analysis (Practicals)

1. To determine the hardness of Water by complexometric method.
2. To determine the hardness of Water by HCl method.
3. To determine the amount of free chlorine in given water sample.
4. Determination of Total residual Chlorine in water sample.
5. To standardize pH by buffer solution and determine pH of different given water samples.
6. Determination of Viscosity of a given lubricant by Redwood Viscometer No.1.
7. Determination of Flash and Fire Points of a given lubricant by Pensky Martin Apparatus.
8. Determination of Cloud and Pour Points of a given lubricant.

9. To determine moisture, volatile and ash content in a given coal sample by proximate analysis.
10. To determine the calorific value of Solid Fuel by Bomb's Calorimeter.
11. To measure dissolved oxygen in water.
12. To measure Total Solid in sewage.

SEMESTER –III

BCE009B: Alcohols, Aldehydes and Ketones

On completion of the course, B.Sc. student will be able to understand:
CO-1 The preparations, reactions and properties of Arenes, their use as solvent and important synthetic reagents. Student will also learn about the aromaticity and aromatic character.
CO-2 The preparations, reactions and properties of alkyl and aryl halides and their derivatives and various reactions of synthetic applications like SN^1/SN^2,SN' etc.
CO-3 The synthesis and reaction of alcohols and their synthetic and industrial applications. Student will also learn about their use as solvent and important synthetic reagents.
CO-4 The synthesis and reaction of phenols and their synthetic and industrial applications. Student will also learn about their use as solvent and important synthetic reagents.
CO-5 The synthesis and reaction of Carbonyl compounds (aldehydes and ketones) along with industrial applications of various condensation and polymerization reactions.

Unit-I

Arenes & Aromaticity: Nomenclature of benzene derivatives. The aryl group, aromatic nucleus and side chain structure of benzene, molecular formula and Kekule structure,stability. Aromaticity: Huckle's rule, aromatic ions.
Aromatic electrophilic substitution-general pattern of the mechanism, role of σ and π complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction, energy profile diagrams. Activating & deactivating substituents, orientation and otho/para ratio. Side chain reactions of benzene derivatives. Birch reduction.

Unit-II

Alkyl & Aryl Halides: Nomenclature of alkyl halides, methods of preparation,chemical reactions. Mechanism of nucleophilic substitution reactions of alky halides, SN2 and SN1 reactions with energy profile diagrams. Polyhalogen compounds, chloroform, carbon tetrachloride. Methods of formation of aryl halides, nuclear and side chain reactions. The addition,elimination and the elimination-addition mechanism of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl,allyl,vinyl and aryl halides. Synthesis and use of D.D.T. and B.H.C.

Unit-III

Alcohols :Classification and nomenclature.Monohydric alcohols - Nomenclature, Method of formation by Reduction of aldehydes,Ketones,Carboxylic acids and esters, Hydrogen bonding. Acidic nature. Reactions of alcohols.Dihydric Alcohols - Nomenclature, methods of formation, Chemical reaction of vicinal glycols,Oxidative-Cleavage [Pb (OAc)4 and HIO4] and pinacol-

pinacolone rearrangement.Trihydric Alcohols - Nomenclature and methods of formation, chemical reactions of glycerol.

Unit-IV

Phenols :Nomenclature, Structure and bonding. Preparation of Phenols, Physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, Resonance stabilization of phenoxide ion. Reactions of phenols: electrophilic aromatic substitution, acylation and carboxylation.Mechanism of fries rearrangement, Claisen rearrangement, Gatter-man synthesis. Hauben- HoeschReaction, Lederer-manasse reaction and Reimer-tiemann Reaction.

Unit-V

Aldehydes And Ketones :Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particularreference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-Dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties.Mechanism of Nucleo-philic additions to carbonyl, Aldol, Perkin and Knoevenagel condensations.Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketone, Cannizzaro's reaction,MPV, Clemmensen, Wolff-kishner, LiAlH4 reductions.

Books Suggested :

1. A Text Book of Organic Chemistry : K. S. Tiwari, S. N. Mehrotra and N. K. Vishnoi
2. Modern Principles of Organic Chemistry : M. K. Jain & S. C. Sharma
3. A Text Book of Organic Chemistry: (Vol. I & II) O. P. Agarwal
4. A Text Book of Organic Chemistry : B. S. Bahl and Arun Bahl
5. Organic Chemistry by Morrison& Boyd,Prentice Hall
6. A Text Book of Organic Chemistry : P. L. Soni
7. Organic Chemistry: (Vol. I, II & III) S. M. Mukherji, S. P. Singh and R P. Kapoor

BCE 039A: Organic analysis and Preparation

1.To identify an organic compound through the functional group analysis, determine its M.P and prepare its suitable derivative.
2.To identify an organic compound number 1 through the functional group analysis, determine its M.P and prepare its suitable derivative.
3.To identify an organic compound number 2 through the functional group analysis, determine its M.P and prepare its suitable derivative.
4.To identify an organic compound number 3 through the functional group analysis, determine its M.P and prepare its suitable derivative.
5.To identify an organic compound number 4 through the functional group analysis, determine its M.P and prepare its suitable derivative.
6.To identify an organic compound number 5 through the functional group analysis, determine its M.P and prepare its suitable derivative.
7.To identify an organic compound number 6 through the functional group analysis, determine its M.P and prepare its suitable derivative

pinacolone rearrangement.Trihydric Alcohols - Nomenclature and methods of formation, chemical reactions of glycerol.

Unit-IV

Phenols :Nomenclature, Structure and bonding. Preparation of Phenols, Physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, Resonance stabilization of phenoxide ion. Reactions of phenols: electrophilic aromatic substitution, acylation and carboxylation.Mechanism of fries rearrangement, Claisen rearrangement, Gatter-man synthesis. Hauben- HoeschReaction, Lederer-manasse reaction and Reimer-tiemann Reaction.

Unit-V

Aldehydes And Ketones :Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particularreference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-Dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties.Mechanism of Nucleo-philic additions to carbonyl, Aldol, Perkin and Knoevenagel condensations.Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketone, Cannizzaro's reaction,MPV, Clemmensen, Wolff-kishner, LiAlH4 reductions.

Books Suggested :

1. A Text Book of Organic Chemistry : K. S. Tiwari, S. N. Mehrotra and N. K. Vishnoi
2. Modern Principles of Organic Chemistry : M. K. Jain & S. C. Sharma
3. A Text Book of Organic Chemistry: (Vol. I & II) O. P. Agarwal
4. A Text Book of Organic Chemistry : B. S. Bahl and Arun Bahl
5. Organic Chemistry by Morrison& Boyd,Prentice Hall
6. A Text Book of Organic Chemistry : P. L. Soni
7. Organic Chemistry: (Vol. I, II & III) S. M. Mukherji, S. P. Singh and R P. Kapoor

BCE 039A: Organic analysis and Preparation

1.To identify an organic compound through the functional group analysis, determine its M.P and prepare its suitable derivative.
2.To identify an organic compound number 1 through the functional group analysis, determine its M.P and prepare its suitable derivative.
3.To identify an organic compound number 2 through the functional group analysis, determine its M.P and prepare its suitable derivative.
4.To identify an organic compound number 3 through the functional group analysis, determine its M.P and prepare its suitable derivative.
5.To identify an organic compound number 4 through the functional group analysis, determine its M.P and prepare its suitable derivative.
6.To identify an organic compound number 5 through the functional group analysis, determine its M.P and prepare its suitable derivative.
7.To identify an organic compound number 6 through the functional group analysis, determine its M.P and prepare its suitable derivative

8.To identify an organic compound number 7 through the functional group analysis, determine its M.P and prepare its suitable derivative
9.To identify an organic compound number 8 through the functional group analysis, determine its M.P and prepare its suitable derivative
10.To identify an organic compound number 9 through the functional group analysis, determine its M.P and prepare its suitable derivative

BCE 011B: Non-aqeous Solvents and Transition Metals

Course outcome: On completion of this course student will be able to: CO-1 Students will be able to explain explain the unique characteristics of different types of
acid and base. CO-2 Students will be able to analyze the chemical reaction in different non-aqueous solvents and advantages limitations of various solvents CO-3 Students will be able to explains the trends in atomic and physical properties of group 15,
16, 17& 18 elements.CO-4 Students will be able to able to identify common organic ligands used to construct coordination complexes, and learn how certain ligands interact with transition metal ions CO-5 Students will be able to understand practical aspects of separation of different lanthanides

Unit-I
Acids and Bases: Acid and base, pH and hydrolysis of salts.Arrhenius, Brönsted-Lowry, Lux flood, Solvent System and Lewis concepts of acids and bases. Factors affecting strengths of Lewis acids and bases.

Unit-II
Non-aqueous Solvents: Physical properties of a solvent for functioning as an effective reaction medium. Types of solvents and their general characteristics. Reactions in liquid ammonia and liquid sulfur dioxide.

Unit-III
Chemistry of P-block elements (Groups 15, 16, 17 and 18) : Group trend in periodic properties,hydrides, oxides, oxyacids and halides. Structures of oxides and oxyacids of nitrogen, phosphorus, sulphur, selenium, tellurium and halogens.Chemistry of cyclophosphazines and tetrasulphur tetranitride. Basic properties of iodine,structure and bonding of interhalogens and polyhalides,compounds of xenon.

Unit-IV
Transition Metals: Characteristic properties of 3d elements – ionic radii, oxidation states, complexation tendency,magnetic behaviour and electronic spectral properties. Spectrophotometric estimation of metal ions.

Unit-V
Lanthanides & Actinides : Comparative study of lanthanide elements with respect to electronic configuration, atomic and ionic radii, oxidation state and complex formation. Lanthanide contraction. Occurrence and principles of separation of lanthanides. Actinides: electronic configuration, atomic and ionic radii, oxidation state,Magnetic and spectral properties.

Books Recommended

1. "Concise Inorganic Chemistry", **J. D. Lee**, 5th Edition (1996), Chapman & Hall, London.
2. "Modern Inorganic Chemistry", **R. C. Aggarwal** ,1st Edition (1987), Kitab Mahal, Allahabad.
3. "Basic Inorganic Chemistry", **F. A. Cotton, G. Wilkinson, and Paul L. Gaus**, 3rd Edition (1995), John Wiley & Sons, New Yorrk.

BCE 012B: Titrometric Analysis (Practicals)

1.To determine alkali content in antaacid tablet using HCl.
2.To estimate copper using thiosulphate.
3.To determine acetic acid in commercial vinegar using NaOH solution.
4.To prepare Tetraammine copper (II)sulphate.
5.To prepare Ni-DMG complex.
6.To determine the amount of Na and K in a given sample by Flame Photometer
7.Analysis of the mixture number 1containing three acidic and three basic radicals.
8.Analysis of the mixture number 2containing three acidic and three basic radicals.
9.Analysis of the mixture number 3containing three acidic and three basic radicals.
10.Analysis of the mixture number 4containing three acidic and three basic radicals.
11.Analysis of the mixture number 5containing three acidic and three basic radicals.
12.Analysis of the mixture number 6containing three acidic and three basic radicals.

SEMESTER –IV

BCE 013B: Phase Equilibria and Surface Chemistry

Course Outcome: On completion of this course student will be able to- CO-1 understand the principles of laws of thermodynamics.CO-2 analyze the basic knowledge of phase equilibrium.CO-3 describe the basic principles and concept of electrochemical cell.CO-4 think critically on different terms and process of surface chemistry.CO-5 understand Schrodinger wave equation and its importance

Unit-I

Thermodynamics : Second law of thermodynamics and spontaneous processes, Carnot Cycles, entropy, entropy changes in reversible and irreversible processes and of universe, physical concept of entropy, entropy changes of an iead gas in different processes, entropy of an ideal gas. Third Law of thermodynamics. The concept of residual entropy. Applications of Third Law.Free energy and its concept, Gibbs and Helmholtz free energies and their relationship,variation of freeenergy with temperature and pressure. Maxwell's relations, Gibbs-Helmholtz equations, its applicationfor the determination of ΔG, ΔH, ΔS of a reversible cell reaction. Thermodynamics of phase transition, Clapeyron-Clausius equation and its applications.

Unit-II

Phase Equilibria : Phase rule, phase, component, degree of freedom, thermodynamic derivation of phase rule, phase diagrams of one component systems (water and sulfur), two component systems(phenol-water, lead-silver, tin-magnesium).

Unit-III

Electrochemical Cells : Galvanic cells, reversible and irreversible cells, cell emf and its measurement.Reactions in reversible cells, free energy and emf of reversible cell. Single electrode potential (Nernst equation), its measurement and sign convention. Standard electrode potential. Emf of reversible cell from electrode potentials. Types of reversible electrode, reference electrodes. Applications of emf measurements:determination of ionic activities,pH, potentiometric titrations (acid-base, redox,precipitation type reactions), equilibrium constant. Basic Idea of Concentration cells with and without transference. Liquid junction potential and its elimination.

Unit-IV

Surface and Colloids Chemistry : Adsorption, absorption and sorption, Freundlich isotherms, its demerits and Langmuir Adsorption isotherm.Multi layer adsorption-BET equation (no derivation) and its application to surface area measurement. Sols (reversible and irreversible), emulsions and emulsifiers, association colloids (micelles), gels.Applications of colloids.

Unit-V

Elementray quantum Mechanics

Black-body, radiation, Planck's radiation law, photoelectric effect, heat capacity of solids. Compton effect. De-Broglie hypothesis.Heisenberg's uncertainty principle,Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box.

Books Recommended

1. "Physical Chemistry", **P. C. Rakshit,** 5th Edition (1985), 4th Reprint (1997), Sarat Book House,Calcutta.
2. "Principles of Physical Chemistry", **B. R. Puri, L. R. Sharma, and M. S. Pathania,** 37th Edition(1998), Shoban Lal Nagin Chand & Co., Jalandhar.
3. "Physical Chemistry", **K. J. Laidler and J. M. Meiser**, 3rd Edition, Houghton Mifflin Comp., NewYork, International Edition (1999).
4. An Introduction of Electrochemistry by S. Glasstone
5. D A McQuarrie, Introduction to Quantum Chemistry
6. Introduction to Quantum Mechanics by Pauling and Wilson
7. Quantum Mechanics by Griffiths.

BCE 014A: Acid-Base Analysis (Practicals)

1. To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.
2. To determine the water equivalent of the thermos flask or calorimeter.
3. To determine the enthalpy of neutralization or heat of neutralization for a strong acid and strong base.
4. To determine heat of neutralization of a weak acid say acetic acid and to calculate its heat of ionization or enthalpy of ionization.
5. To determine heat of neutralization of a weak base say NH_4OH and to calculate its heat of ionization or enthalpy of ionization.
6. To determine the strength of given acid pH metrically.For this you are provided with standard NaOH solution.
7. To draw the solubility curve of phenol –water system and to determine critical solution temperature of the system and the composition of phenol-water system at C.S.T.
8. To determine the C.S.T of phenol-water system in presence of 1% NaCI solution and 1% succinic acid solution.
9. To determine the dissociation constant of a weak acid conductometrically and verify ostwalds dilution law.
10. To determine the transition temperature of the given substance by thermometric method ($MnCl_2.4H_2O$)
11. To determine enthalpy of solution of solid $CaCl_2$ and calculate lattice energy of $CaCl_2$.
12. To determine the heat of reaction involving precipitation of a salt say $BaSO_4$.

BCE015B: Analytical Chemistry

Course outcome: On completion of the course, B.Sc. student will be able to understand:

CO-1 about the various types of error with curves and methods of minimizing errors with significant figures and computation rules.**CO-2** about the Properties and formation of precipitates, contamination and methods of remiving impurities in precipitates.**CO-3** about the theoretical and practical aspects of various analytical reagents and their applications.**CO-4** about the solvent extraction systems, distribution laws and Craig concept also with Radioanalytical Methods and their applications.**CO-5** about classification of chromatographic methods and applications and Elementary idea of HPLC, GC, TGA, DTA.

Unit-I

Statistical Evaluation : Determinate and Indeterminate errors. Normal error curve. Accuracy andPrecision, relative and standard deviation. Methods for minimizing errors. Criteria for rejection of an observation. Significant figures and computation rules.

Unit-II

Precipitation: Desirable properties of gravimetric precipitates. Formation of gravimetric precipitates.Conditions for quantitative precipitation. Contamination in precipitates. Methods for

removing impurities in precipitates. Organic precipitants (oxime,dithiozone,α-nitroso-(-naphthol, cupeferron,dimethyl glyoxime) in chemical analysis.

Unit-III

Analytical Reagents : Principles of qualitative and quantitative analysis; acid-base, oxidation-reduction and complexometric titrations using EDTA; Karl Fischer reagent and periodate in chemical analysis. precipitation reactions; use of indicators; use of organic reagents in inorganic analysis.

Unit-IV

Solvent Extraction : Distribution law, solvent extraction, equilibrium constant from distribution coefficient ($KI + I_2 = KI_3$).Craig concept of counter-current distribution, Important solvent extraction systems.

Radioanalytical Methods : Elementary theory, isotope dilution and Neutron activation methods and applications,applications of isotopes.

Unit-V

Chromatography : Classification of chromatographic methods, general principle and application of adsorption, partition, ion-exchange, thin layer, column and paper chromatography. Elementary idea of HPLC, GC,GSC. TGA& DTA analysis.

Books Recommended

1. "Modern Methods of Chemical Analysis", **R. L. Pecsock, L. D. Shields, T. Cairns, and I. C. McWilliam**, 2nd Edition (1976), John Wiley, New York.
2. "Basic Concepts of Analytical Chemistry", **S. M. Khopkar**, 2nd Edition (1998), New Age InternationalPublications, New Delhi.
3. "Environmental Chemistry", **A. K. De**, 3rd Edition (1994), Wiley Eastern, New Delhi.
4. "Instrumental Methods of Analysis", **H. H. Willard, L. L. Merritt, and J. A. Dean**, 6th Edition (1986),CBS Publishers & Distributors, Shahdara, Delhi.
5. "Analytical Chemistry", **G. D. Christian**, 4th Edition (1986), John Wiley & Sons, New York.
6. "Principles and Methods of Chemical Analysis", **H. F. Walton**, 2nd Edition (1966), Prentice Hall, NewDelhi.

BCE 040A: Estimations,Calibrations and Chromatographic analysis (Practicals)

1. Calibration of weights and calculation of errors in it.
2. .Prepare a standard solution of Na_2CO_3 and standardize the given solution of HCl/H_2SO_4
3. Prepare a standard solution of sodium oxalate and standardize given solution of $KMnO_4$
4. 4.Determine percentage purity of commercial sample of NaOH
5. Prepare a standard solution of $K_2Cr_2O_7$ and standardize given solution of $Na_2S_2O_3$
6. Estimation of Barium as $BaSO_4$ gravimetrically

7. Preparation of 0.1 N solution of HCl/ HNO_3 using density and percentage by weight and their standardization by using Na_2SO_3
8. Prepare a calibration curve using $KMnO_4$ and determine concentration in unknown given sample solution.
9. Prepare a calibration curve using $K_2Cr_2O_7$ and determine concentration in unknown given sample solution.
10. Preparation of 0.05 N H_2SO_4 using density and weight percentage and its standardization.
11. To separate the mixture of Methyl Orange and Methylene Blue by using cyclohexane and
12. ethyl acetate(8.5:1.5) as solvent system by TLC.
13. 12.To separate the mixture of Aldehyde and Ketones by TLC.
14. 13.To separate the pigments from spinach leaves by column Chromatography.
15. 14.Preparation and separation of 2,4-dinitro Phenylhydrazone of acetone , 2-butanone using toluene and petroleum ether(40:60).
16. 15.To separate the mixture of D,L-alanine,glycine and L-leucine using n-butanol : acetic acid :water(4:1:5).Spray reagent- Ninhydrin.
17. To separate monosaccharides –a mixture of D –galactose and D-fructose using n-butanol : acetone: water (4:1:5).Spray reagent –aniline hydrogen phthalate

SEMESTER –V

BCE 019A: Coordination Compounds and Organometalic Chemistry

Course outcome: Students will be able to-

CO-1 identify common organic ligands used to construct coordination complexes, and learn how certain ligands interact with transition metal .CO-2 explain the formation of different types of bonds, predict the geometry of simple molecules, explain the different types of hybridisation and draw shapes of simple covalent molecules. CO-3 relate electronic configurations to the basic magnetic properties of coordination complexes,Calculate the "spin-only" magnetic moment of simple coordination complexes. CO-4 understand practical aspects of separation of different lanthanides. CO-5 understand the classification, properties and applications oforganometallic compounds , study the methods of preparation, properties, structure and bonding of metal carbonyls and metal clusters and understand the role of metals in biological systems.

Unit-I

Coordination Compounds : Werner's theory, nomenclature, chelates, stereo-chemistry of coordination numbers 4, 5 and 6. Various types of isomerism in coordination complexes. Important applications of coordination compounds. Theories of metal-ligand bonding in transition metal complexes- Sidgwick effective atomic number concept, valence bond theory of coordination compounds.

Unit-II

Theories of Metal-Ligand bonding : Limitations of valence bond theory; Crystal-field theory and crystal-field splitting in octahedral and tetrahedral complexes; factors affecting the crystal-field parameters.

Unit-III

Magnetic Properties of Transition Metal Complexes : Types of magnetic behaviour, methods of determining magnetic susceptibility, L-S and J-J coupling, orbital contribution to magnetic moments. Correlation of magnetic moment data and stereochemistry of Co(II) and Ni(II) complexes; anomalous magnetic moments.

Unit-IV

Chemistry of f-block Elements : Comparative study of lanthanide elements with respect to electronic configuration, atomic and ionic radii, oxidation states and complex formation; occurrence and principles of separation. General features and chemistry of actinides, principles of separation of Np, Pu and Am from U. Trans-Uranium elements.

Unit-V

Organometallic Chemistry : Definition, nomenclature and classification of organometallic compounds.Preparation, properties, bonding and applications of alkyl and aryls of Li, Al, Hg, Sn, Ti. A brief account of metal-ethylenic complexes and homogeneous hydrogenation. Essential and trace element in biological process, oxygen transport with reference to haemoglobin, biological role of alkali metals.

Books Recommended

1. "Concise Inorganic Chemistry", **J. D. Lee**, 5th Edition (1996), Chapman & Hall, London.
2. "Modern Inorganic Chemistry", **R. C. Aggarwal**, 1st Edition (1987), Kitab Mahal, Allahabad.
3. "Basic Inorganic Chemistry", **F. A Cotton, G. Wilkinson, and Paul L. Gaus**, 3rd Edition (1995),John Wiley & Sons, New York.
4. "Inorganic Chemistry", **A. G. Sharpe**, 3rd International Student Edition (1999), ELBS / Longman,U.K.
5. "Inorganic Chemistry", **D. F. Shriver and P. W. Atkins**, 3rd Edition (1999), ELBS, London.

BCE 020A: Inorganic Preparations and Estimation of Metal ions (Practicals)

1. To prepare cis-potassium-dioxalatodiaquachromate (III).
2. To prepare trans-potassium-dioxalatodiaquachromate (III).
3. To prepare sodium trioxalatoferrate (III).
4. To estimate Ni as Ni-DMG in given solution.
5. To estimate Cu as CuSCN in given solution.

6. To prepare potash alum.
7. To synthesize Tetraammine copper (II)sulphat.
8. To synthesize Hexaammine nickel (II)chloride.
9. To synthesize prussian blue.
10. To measure fluoride in the given sample by SPANDS method.
11. To separate and estimate Mg(II) and Zn(II).
12. To separate and estimate Cu(II) and Ni(II).

BCE024B :Spectroscopy

Course Outcome: On completion of the course, B.Sc. student will be able to understand:
CO-1 Principles of Atomic Spectroscopy,AAS, FAS etc and their instrumentation and applications in various fields like in checking of contamination of water by heavy metals and toxic substances.
CO-2 Common terms in spectroscopy. Principles of UV and Visible spectroscopy, its applications in structure determination and working method of Instrument. **CO-3** Principles of IR spectroscopy, its applications in structure determination, instrumentation, finger print region and functional group region and their role in determination of structure of organic compounds. Principle of Raman spectra, Raman and Rayleigh line. **CO-4** Principles of NMR Spectroscopy, instrumentation and applications. Student will also learn about the use of NMR technique in medical sciences.**CO-5** Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann
distribution)

Unit-I

Atomic Spectroscopy: Elecromagnetic radiations, concept of electromagnetic spectrum. Introductionof Absorption and Emission spectroscopy. Principle of Flame Emission Spectroscopy (FES) and Atomic adsorption Spectroscopy (AAS), comparison, instrumentation and applications, Burners (Total consumption burner and Premix burners), Inductively coupled plasma Emission Spectroscopy (ICPES)

Unit-II

Ultraviolet and Visible Spectrophotometry: Origin of UV Spectra, Principle, instrumentation,Electronic transition (σ-σ^*, n-σ^*, π-π^* and n-π^*), relative positions of λmax considering conjugative effect, steric effect, solvent effect(with reference to π-π^* and n-π^* transitions), red shift (bathochromic shift), blue shift (hypsochromic shift), hyperchromic effect, hypochromic effect (typical examples). Aromatic and Polynuclear aromatic hydrocarbons. Woodward-Fiesher rules for Dienes and enones and calculation of λ_{max}. Problems of aromatic ketones, aldehydes and esters using empirical rules.

Unit-III

Infrared Spectroscopy: Introduction, principle of IR spectroscopy, instrumentation, sampling techniques, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies, applications. Application of Hooke's law, characteristic stretching frequencies of O-H, N-H, C H, C-D, C=C, C=N, C=O functions; factors affecting stretching frequencies (H-bonding, mass effect, electronic factors, bond multiplicity, ring size).

Raman Spectra
Basic principal, Instrumentation, Application of Raman spectra, Comparison of IR and Raman Spectra

Unit-IV
Nuclear Magnetic Resonance: Principle, Magnetic and non magnetic nuclei, absorption of radio frequency. Equivalent and non equivalent protons, chemical shifts, shielding and De-shielding effects, anisotropic effect, relative strength of signals, spin-spin coupling, long range coupling, coupling constant, applications to simple structural problems, Phenomenon of Chemical Exchange.

Unit-V
Rotational Spectroscopy
Diatomic molecules, energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution), determination of bond length; qualitative description of non-rigid rotor, isotope effect.

Reference Books

1. Spectrometric Identification of Organic Compounds: Robert M. Silverstein, Francis X. Webster, David Kiemle Wiley; 7th Edition.
2. Applications of spectroscopic techniques in Organic Chemistry: P.S. Kalsi, New Age International; 6th Edition.
3. Elementary Organic Spectroscopy; Principles And Chemical Applications: Y. R. Sharma, S. Chand & Co Pvt Ltd.
4. Fundamentals of Molecular Spectroscopy: C. M. Banwell and E. McCash, Tata McGraw Hill, 4th Edition.
5. Organic spectroscopy by William Kemp

BCE 037B: Spectroscopic Determination of Compounds(Practicals) All experiments will be based on problem solving technology by interpreting various types of spectrographs and subsequent discussion. The list of compounds may vary by keeping representation of each category of organic and inorganic compounds.

1. To identify the following functional group in the given compounds by IR spectroscopy: –OH, $-NH_2$, $-NO_2$, –COOH; Hydrogen Bonding (Intermolecular and Intramolecular)
2. To Identify the compound by U.V Spectroscopy containing: Π –Bonding; Π –Conjugation; Aromaticity
3. Elucidate the structure of given unknown organic compound by NMR spectroscopy.
4. To calculate the molecular mass of unknown organic molecules.
5. To draw spectral absorption curve for given substance ($K_2Cr_2O_7$) using spectrophotometer and determine the wavelength for maximum absorption.

6. To draw spectral absorption curve for given substance ($KMnO_4$) using spectrophotometer and determine the wavelength for maximum absorption.
7. To determine the concentration of unknown solution by verifying Lambert Beer's Law for $K_2Cr_2O_7$
8. To determine the concentration of unknown solution by verifying Lambert Beer's Law for $KMnO_4$
9. To determine the percentage of two optically active substances say sucrose and tartaric acid in given solution polarimetrically
10. To determine the specific rotation of a given optically active compound(cane sugar)
11. To determine the specific rotation of a given optically active compound tartaric acid.
12. To determine the molecular weight of non volatile substance glucose using water as solvent by cryoscopic method.

SEMESTER–VI

BCE 017B Acid Derivatives and Heterocyclic Chemistry

Course outcome: On completion of the course, B.Sc. student will be able to understand:

CO-1 The preparations, reactions and properties of Ethers and Epoxides, their use as solvent and important synthetic reagents.

CO-2 The preparations, reactions and properties of carboxylic acid and its derivatives and various reactions of synthetic applications.

CO-3 The synthesis and reaction of Nitrogen containing compounds and their synthetic and industrial applications.

CO-4 The synthesis and reaction of 5, 6 member and condensed heterocyclic systems along with their industrial and medicinal applications.

CO-5 The types of Carbohydrates and sugars, their occurrence, structure, configuration and properties. Student will also get the knowledge of the role of these bio-molecules in biological system and day to day life. Student will also learn to analyse adultration of food and its prevention.

Unit-I

Ethers and Epoxides : Nomenclature of ethers and methods of formation, physical properties. Chemical reaction, cleavage and autoxidation, ziesel's method of synthesis of epoxides. Acid and Base catalyzed ring opening, Reactions of Grignard and organolithium reagents with epoxides.

Unit-II

Carboxylic Acids : Nomenclature structure and bonding, Physical properties, Acidic nature of carboxylic acids, Effect of subsituents on acid Strength. preparation of carboxylic acids. Reactions of carboxylic acids, Hell-Volhard Zelinsky reaction.

Carboxylic Acid Derivatives : Structure and nomenclature of acid chlorides, esters, amides and acid- anhydrides. Relative stability and reactivity of acid derivatives. physical properties, Inter conversion of acid derivatives by nucleophilic acyl substitution. preparation of carboxylic acid derivatives, chemical reactions. mechanism of esterification and hydrolysis (Acidic and Basic)

Unit-III

Organic Compounds of Nitrogen : Preparation of nitro alkanes and nitro arenes. Chemical Reactions of Nitro alkanes. Mechanism of nucleophilic substitution in nitro arenes and their

reduction in acidic, neutral and alkaline media. Reactivity, Structure and nomenclature of amines, Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines . Amine salts as phase- transfer catalysts, Gabriel-Phthalimide reaction, Hofmann bromamide Reaction. Reactions of amines. Electrophilic Aromatic substitution in arylamines, Reactions of amines with nitrous acid. Synthetic transformations of aryl- diazonium salts, azo coupling.

Unit-IV

Heterocylic Compounds : Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions, with particular emphasis on the mechanism ofelectrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives.Comparison of basicity of pyridine, piperidine and pyrrole.Introduction to condensed five and six-membered heterocyles. Preparation and reactions of indole,quauinoline and isoquinoline. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquionoline.

Unit-V

Carbohydrates : Classification and nomenclature of monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+) glucose.

Books Suggested :

1. Organic Chemistry, Morrison and Boyd, Prentice Hall.
2. Organic Chemistry, L.G. Wade Jr. Prentice Hall.
3. Fundamentals of Organic Chemistry, Solomons, John Wiley.
4. Organic Chemistry Vol. I, II, III S.M. Mukerji, S.P. Singh and RP. Kappor, Wiley EasternLtd. (New Age International)
5. Organic Chemistry, F.A. Carey, McGraw Hill, Inc.
6. Introduction to Organic Chemistry. Streitwieser. heathcock and Kosover. Macmilan.31
7. Organic Chemistry (Vol. I & II) : S. M. Mukherji, S. P. Singh and R. P. Kapoor, WileyEastern Ltd.
8. A Text Book of Organic Chemistry (Vol. I & II) : K. S. Tiwari, S. N. Mehrortra & N. K.Vishnoi
9. Organic Chemistry : M. K. Jain and S. Sharma
10. A Text Book of Organic Chemistry (Vol. I & II) : O. P. Agarwal
11. A Text Book of Organic Chemistry : R. K. Bansal
12. Organic Chemistry (Vol. I & II) : I. L. Finar
13. Organic Reaction and Their Mechanisms : P. S. Kalsi
14. Introduction of Petrochemicals : Sukumar Maiti,
15. Organic Chemistry : P. L. Soni
16. A Text Book of Organic Chemistry: V. K. Ahluwalia and Maduri Foyal,Narosa PublishingHouse Pvt. Ltd.

BCE 018B: Organic Preparations and Mixture Separation (Practicals)

1. To separate and identify the organic mixture containing two solid components using water and prepare their suitable derivatives.
2. To separate and identify the organic mixture containing two solid components using water and prepare their suitable derivatives.
3. To separate and identify the organic mixture containing two solid components using hot water and prepare their suitable derivatives.
4. To separate and identify the organic mixture containing two solid components using NaOH and prepare their suitable derivatives.
5. To separate and identify the organic mixture containing two solid components using NaOH and prepare their suitable derivatives.
6. To separate and identify the organic mixture containing two solid components using $NaHCO_3$ and prepare their suitable derivatives.
7. To separate and identify the organic mixture containing two solid components using $NaHCO_3$ and prepare their suitable derivatives.
8. (a)To prepare acetanilide from aniline (Acetylation).
   (b) To prepare phenylbenzoate from phenol (Benzoylation).
9. To prepare Iodoform from ethanol and acetone. (Aliphatic Electrophilic Substitution).
10. To prepare m-dinitro benzene from nitro benzene .
11. To prepare p-nitro acetanilide from acetanilide.
12. To prepare Benzoic acid from toluene.

BCE 022B: Photochemistry and Nuclear Chemistry

Course Outcome: On completion of this course student will be able to-

CO-1 understand the kinetics of unimolecular and bimolecular reactions.
CO-2 analyze the basic knowledge of laws of photochemistry.
CO-3 describe the basic principles of laws of thermodynamics and colligative properties.
CO-4 think critically on different terms of electrochemistry of strong and weak electrolytes.
CO-5 understand practical aspects and applications of nuclear chemistry.

Unit-I

Chemical Kinetics: Heterogeneous catalysis (surface reactions):Kinetics of unimolecular reactions- inhibition and activation energy. Bimolecular surface reactions - reactions between a gasmolecule and an adsorbed molecule, reaction between two adsorbed moecules. Nature of surface,concept of active centres. Kinetics of enzymatic reactions: Michaelis-Menten's equation, significance of Michaelis constant, effect of temperature and pH in enzyme catalyzed reactions.

Unit-II

Photochemistry: Law of photochemical equivalence, quantum efficiency, reasons for low and high quantum efficiency. Jablosnski diagram depicting various processes occuring in the exited sate, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized Reactions.

Kinetics of thermal and photochemical reactions ($H_2 + Br_2 = 2HBr$, $H_2 + Cl_2 = 2HCl$, $2HI = H_2 + I_2$), photostationary state. Chemical actinometers (ferri-oxalate, uranyl oxalate).

Unit-III

Thermodynamics of Solutions : Partial molal quantities, chemical potential, the Gibbs-Duhem equation,fugacity,activity and activity coefficient (concept and physical significance), reference and standard states.Variation of fugacity with temperature and pressure, Lewis-Randall rule, thermodynamic functions ofmixing (DGmix , DSmix , DVmix , DHmix), ideal solutions and their characteristic properties, Duhem-Margules equation and its application, Henry and Raoult's law. Thermodynamics of colligativeproperties : Freezing point depression, elevation of boiling point, osmotic pressure, Van't Hoff equation.
Measurement of osmotic pressure and determination of molecular weight of macromolecules.

Unit-IV

Electrochemistry : Theory of strong electrolytes :- Qualitative idea of Debye-Huckel theory of ion-ion interactions, Debye-Huckel limiting law for activity coefficient of ions in electrolyte solution (derivation not required), its modification for concentrated solutions. Debye-Huckel-Onsager (D-H-O) theory ofelectrolytic conductance : qualitative idea of electrophoretic and relaxation effects, D-H-O equation for conductance of electrolyte solutions.

Unit-V

Nuclear Chemistry : Isotopes, their separation and applications. Nuclear forces, nuclear binding energy, stability of nucleus, energy changes in nuclear reactions, nuclear fission and fusion. Uses of nuclear radiations (radiation, sterilization, radiation energy for chemical synthesis). Radio isotopes as a source of electricity.

Books Recommended

1. "Physical Chemistry", **P. C. Rakshit,** 5th Edition (1988), 4th Reprint (1997), Sarat Book House,Calcutta.
2. "Physical Chemistry", **K. J. Laidler and J. M. Meiser**, 3rd Edition (International Edition ,1999),Houghton Mifflin Co., New York.
3. "Physical Chemistry", **I. N. Levine**, 4th Edition (International Edition, 1995), Mc Graw-Hill Inc., NewYork.
4. "Essentials of Nuclear Chemistry" **H. J. Arnikar,** 4th Edition (1995), New Age International (p) Ltd.,Wiley Eastern Ltd., New Delhi.
5. *Physical Chemistry,* IIIrd Year, PD. Sharma and P.S. Verma, Ramesh Book Depot

BCE 023A: Conductometric Analysis (Practicals)

1. To determine the strength of the given acid (HCI) conductometrically using standard alkali solution.
2. To determine the strength of the given acid (CH_3COOH) conductometrically using standard alkali solution.
3. To determine the solubility and solubility product of a sparingly soluble salt conductometrically.

4. To determine the dissociation constant of a weak acid conductometrically and verify ostwalds dilution law.
5. To draw spectral absorption curve for given substance ($K_2Cr_2O_7$ or $KMnO_4$) using spectrophotometer and determine the wavelength for maximum absorption for each of them.Also verify the Lambert -Beer's Law and determine the concentration of unknown solution .
6. To investigate the adsorption of oxalic acid from aqueous solution by activated charcoal and examine validity of Freundlich and Langmuir adsorption isotherm.
7. To determine the specific rotation of a given optically active compound.
8. To determine the equivalent conductance of a strong electrolyte KCI or NaCI at several concentrations and verify the applicability of Debye Huckel Onsager equation.
9. To determine the equivalent conductance of a strong electrolyte HCI at several concentrations and verify the applicability of Debye Huckel Onsager equation.
10. To study saponification of ethyl acetate conductometrically.
11. To determine conductometrically the concentration of KCl and KI in a given solution.
12. To determine the concentration of salt of a weak acid and strong base like sodium acetate conductometrically

BCE038A: Project

Department of Chemistry

JECRC University

B.Sc. (Major Chemistry) 2020-21

Mapping of CO-PO - PSO

Semester-I

BCE 001A Hydrocarbons, Reaction Mechanisms and Stereochemistry

S.No.	
UNIT 1	**Structure and Bonding**
UNIT 2	**Mechanism of Organic Reactions**
UNIT 3	**Stereochemistry of Organic Compounds**
UNIT 4	**Alkanes and Cycloalkanes**
UNIT 5	**Alkenes, Cycloalkenes, Dienes and alkynes**

Course Outcomes(CO)

CO1: Understanding the structure and bonding involved in hydrocarbon.
CO2: Understanding the reaction mechanism of various organic reactions
CO3: Understanding the stereochemistry of hydrocarbons.
CO4: Understanding the nomenclature of alkanes and cycloalkanes, their properties, method of formation and reactions they generally undergo.
CO5: Understanding the nomenclature of Alkenes, Cycloalkenes, Dienes and alkynes, their properties, method of formation and reactions they generally undergo.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES and PROGRAM SPECIFIC OUTCOME

Course Outcome	Program Outcome									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	L	L	L	M	H	H	H	H	M
CO2	H	M	H	M	L	L	M	H	H	M
CO3	L	H	H	H	M	H	L	H	H	M
CO4	M	M	M	H	H	M	M	H	H	M
CO5	H	L	M	H	L	L	H	H	H	M

H = 3; M = 2 L = 1

BCE 003A: Chemistry of s and p-block elements

UNIT 1 Atomic Structure	**UNIT 2 Periodic Properties**
UNIT 3 Chemical Bonding	**UNIT 4 s-Block Elements**
UNIT 5 p-Block Elements	

Course outcome

On completion of the course, B.Sc. student will be able to understand:
CO-1 about the atomic structure, Quantum numbers and electronic configuration of elements based on respective rules.
CO-2 the periodic properties like Atomic and ionic radii, ionization energy, ionization potential and electron negativity and their determinations and applications
CO-3 different types of bonding like ionic bonding, covalent bonding, metallic bonding and hydrogen bonding and also molecular geometry based on VBT, VSEPR and MOT to know structure of different molecules and ions.

CO-4 s- block Elements of alkali metals and Alkaline earth metals and their industrial & biological applications
CO-5 p- block Elements and their different compounds having the applications at industrial and biological applications.

Mapping of CO-PO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	L	M	M	H	H	H	H	H	M
CO2	M	H	M	M	H	H	M	H	H	M
CO3	H	L	M	L	M	H	H	H	H	M
CO4	M	M	M	M	H	H	M	H	H	H
CO5	H	L	M	M	L	L	H	H	H	H

Semester-II

BCE 005A: Thermodynamics, Electrochemistry and Chemical Kinetics

UNIT 1	**Solid State**
UNIT 2	**Liquid State**
UNIT 3	**Gaseous State**
UNIT 4	**Thermodynamics**
UNIT 5	**Electrochemistry**

Course Outcome

CO-1 Students will be able to understand the principles of solid state.
CO-2 Students will be able to analyze the basic knowledge of liquid state.
CO-3 Students will be able to describe the basic concept of kinetic theory of gaseous state.
CO-4 Students will be able to think critically on different terms and process of thermodynamics.
CO-5 Students will be able to understand practical aspects of different theories of electrochemistry and chemical kinetics.

Mapping of CO-PO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	M	L			L	H	H	H	M
CO2	L	M				M	H	H	H	M
CO3	M	M	L			M	M	H	H	M
CO4	H	M	L	L		L	H	H	H	H
C05	M	H	L	L		L	M	H	H	H

BCE 007C: Industrial Chemistry

UNIT 1 Water & its Treatment
UNIT 2 Corrosion
UNIT 3 Lubricants &Cement
UNIT 4 Fuel
UNIT 5 Green Chemistry

Course outcome

On completion of the course, B.Sc. student will be able to understand:
CO-1.about water related problems, their methods of analysis and different methods of treatment.
CO-2 about the various types, theories and mechanism of corrosion and various prevention methods
CO-3 about the various types of lubricants and its mechanism with various types of properties of lubricants and manufacturing process of cement.
CO-4 about the various types of fuel, its calorific values and its determination along-with carbonization process and synthetic fuel with manufacturing process.
CO-5, about principles and applications of green chemistry.

Mapping of CO-PO

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	L	M	M	H	H	H	H	H	H
CO2	M	M	H	H	H	M	M	H	H	H
CO3	H	L	M	M	H	H	H	H	H	H
CO4	M	M	M	M	H	H	M	H	H	H
CO5	H	M	M	M	H	H	H	H	H	H

Semester-III

BCE 009B: Alcohols, Aldehydes and Ketones

UNIT 1	**Arenes & Aromaticity**
UNIT 2	**Alkyl & Aryl Halides:**
UNIT 3	**Alcohols,**
UNIT 4	**Phenols**
UNIT 5	**Aldehydes and Ketones**

Course outcome

On completion of the course, B.Sc. student will be able to understand:

CO-1 The preparations, reactions and properties of Arenes, their use as solvent and important synthetic reagents. Student will also learn about the aromaticity and aromatic character.

CO-2 The preparations, reactions and properties of alkyl and aryl halides and their derivatives and various reactions of synthetic applications like SN^1/SN^2,SN^i etc.

CO-3 The synthesis and reaction of alcohols and their synthetic and industrial applications. Student will also learn about their use as solvent and important synthetic reagents.

CO-4 The synthesis and reaction of phenols and their synthetic and industrial applications. Student will also learn about their use as solvent and important synthetic reagents.

CO-5 The synthesis and reaction of Carbonyl compounds (aldehydes and ketones) along with industrial applications of various condensation and polymerization reactions,

Mapping of CO-PO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	L	M	M	H	H	H	H	H	M
CO2	M	M	H	H	H	M	M	H H	H H	M
CO3	H	L	M	M	H	H	H	H H	H H	H
CO4	M	M	M	M	H	L	M	H H	H H	H
CO5	H	L	M	M	H	H	H	H H	H H	H

BCE011B Non-ageous Solvents and Transition Metals

UNIT 1 Acids and Bases
UNIT 2 Non-aqueous Solvents
UNIT 3 Chemistry of p-block elements (Groups 15, 16, 17 and 18)
UNIT 4 Transition Metals
UNIT 5 Lanthanides and Actinides

Course outcome: On completion of this course student will be able to:

CO-1 Students will be able to explain the unique characteristics of different types of acid and base.

CO-2 Students will be able to analyze the chemical reaction in different non-aqueous solvents and advantages /limitations of various solvents

CO-3 Students will be able to explains the trends in atomic and physical properties of group 15, 16, 17& 18 elements.

CO-4 Students will be able to able to learn about the vast world of transition elements and their unique properties.

CO-5 Students will be able to understand basic knowledge of lanthanides and actinide chemistry.

Mapping of CO-PO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	M	L			L	H	H	H	M
CO2	L	M				M	H	H	H	H
CO3	M	M	L			M	M	H	H	M
CO4	H	M	L	L		L	H	H	H	H
CO5	M	H	L	L		L	M	H	H	M

B.Sc. IV Semester

BCE 013B: Phase Equilibria and Surface Chemistry

UNIT 1	**Thermodynamics**
UNIT 2	**Phase Equilibria**
UNIT 3	**Electrochemical Cells**
UNIT 4	**Surface and Colloids Chemistry**
UNIT 5	**Elementray Quantum Mechanics**

Course Outcome

CO-1 Students will be able to understand the principles of laws of thermodynamics.

CO-2 Students will be able to analyze the basic knowledge of phase equilibrium.

CO-3 Students will be able to describe the basic principles and concept of electrochemical cell.

CO-4 Students will be able to think critically on different terms and process of surface chemistry.

CO-5 Students will be able to understand Schrodinger wave equation and its importance

Mapping of COs and POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	M	L			L	H	H	H	M
CO2	L	M				M	H	H	H	M
CO3	M	M	L			M	M	H	H	M
CO4	H	M	L	L		L	H	H	H	H
C05	M	H	L	L		L	M	H	H	M

BCE 015B: Analytical Chemistry

UNIT 1	**Statistical Evaluation**
UNIT 2	**Precipitation**
UNIT 3	**Analytical Reagents**
UNIT 4	**Solvent Extraction** **Radioanalytical Methods**
UNIT 5	**Chromatography**

Course Outcome

On completion of the course, B.Sc. student will be able to understand:

CO-1 about the various types of error with curves and methods of minimizing errors with significant figure and computation rules.

CO-2 about the Properties and formation of precipitates, contamination and methods of removing impurities in precipitates.

CO-3 about the theoretical and practical aspects of various analytical reagents and their applications.

CO-4 about the solvent extraction systems, distribution laws and Craig concept also with Radioanalytical Methods and their applications.

CO-5 about classification of chromatographic methods and applications and Elementary idea of HPLC, GC, TGA, DTA

Mapping of COs and POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	L	M	M	H	H	H	H	H	M
CO2	M	M	H	H	H	M	M	H	H	M
CO3	H	L	M	M	H	H	H	H	H	M
CO4	M	M	M	M	H	H	M	H	H	M
CO5	H	M	M	M	H	H	H	H	H	M

SEMESTER-V

BCE 019A Coordination Compounds and Organometalic Chemistry

UNIT 1 Coordination Compounds
UNIT 2 Theories of Metal-Ligand bonding
UNIT 3 Magnetic Properties of Transition Metal Complexes
UNIT 4 Chemistry of f-block Elements
UNIT 5 Organometallic Chemistry

Course outcome

CO-1 Students will be able to identify common organic ligands used to construct coordination complexes, and learn how certain ligands interact with transition metal .

CO-2 Students will be able to explain the formation of different types of bonds, predict the geometry of simple molecules, explain the different types of hybridisation and draw shapes of

simple covalent molecules

CO-3 Students will be able to relate electronic configurations to the basic magnetic properties of coordination complexes,Calculate the "spin-only" magnetic moment of simple coordination complexes.

CO-4 Students will be able to understand practical aspects of separation of different lanthanides and actinides

CO-5 Students will be able to understand the classification, properties and applications of organometallic compounds , study the methods of preparation, properties, structure and bonding of metal carbonyls and metal clusters and understand the role of metals in biological systems.

Mapping of CO-PO/PSO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	M	L	M	L	M	H	H	H	M
CO2	M	L	L			L	H	H	H	M
CO3	H	M	L	L	M	M	M	H	H	M
CO4	M	L	M			L	H	H	H	H
CO5	H	H	M	M	H	M	M	H	H	M

BCE 024B: Spectroscopy	
UNIT 1	**Atomic Spectroscopy**
UNIT 2	**Ultraviolet and Visible Spectrophotometry**
UNIT 3	**Infrared Spectroscopy, Raman Spectra**
UNIT 4	**Nuclear Magnetic Resonance**
UNIT 5	**Rotational Spectroscopy**

Course outcome

On completion of the course, B.Sc. student will be able to understand:

CO-1 Principles of Atomic Spectroscopy,AAS, FAS etc and their instrumentation and applications in various fields like in checking of contamination of water by heavy metals and toxic substances.

CO-2 Common terms in spectroscopy. Principles of UV and Visible spectroscopy, its applications in structure determination and working method of Instrument.

CO-3 Principles of IR spectroscopy, its applications in structure determination, instrumentation, finger print region and functional group region and their role in determination of structure of organic compounds. Principle of Raman spectra, Raman and Rayleigh lines

CO-4 Principles of NMR Spectroscopy, instrumentation and applications. Student will also learn about the use of NMR technique in medical sciences.

CO-5 Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution)

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	H	L	M	L	H	H	H	H	H
CO2	H	H	L	M	L	H	H	H	H	H
CO3	H	H	L	M	L	H	H	H	H	H
CO4	H	H	L	M	L	H	H	H	H	H
CO5	H	H	L	M	L	H	H	H	H	H

B.Sc. VI Semester

BCE 017B Acid Derivatives and Heterocyclic Chemistry

UNIT-1	**Ethers and Epoxides**
UNIT-2	**Carboxylic Acids and Carboxylic Acid Derivatives**
UNIT-3	**Organic Compounds of Nitrogen**
UNIT-4	**Heterocylic Compounds**
UNIT-5	**Carbohydrates**

Course outcome

On completion of the course, B.Sc. student will be able to understand:

CO-1 The preparations, reactions and properties of Ethers and Epoxides, their use as solvent and important synthetic reagents.

CO-2 The preparations, reactions and properties of carboxylic acid and its derivatives and various reactions of synthetic applications.

CO-3 The synthesis and reaction of Nitrogen containing compounds and their synthetic and industrial applications.

CO-4 The synthesis and reaction of 5, 6 member and condensed heterocyclic systems along with their industrial and medicinalapplications.

CO-5 The types of Carbohydrates and sugars, their occurrence, structure, configuration and properties. Student will also get the knowledge of the role of these bio-molecules in biological system and day to day life. Student will also learn to analyse adultration of food and its prevention.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	L	M	M	H	H	H	H	H	M
CO2	H	L	M	M	H	H	H	H	H	H
CO3	H	L	M	M	H	H	M	H	H	H
CO4	H	L	M	M	H	H	H	H	H	H
CO5	H	L	M	M	H	H	M	H	H	H

BCE 022B: Photochemistry and Nuclear Chemistry

UNIT 1	**Chemical Kinetics**
UNIT 2	**Photochemistry**
UNIT 3	**Thermodynamics of Solutions**
UNIT 4	**Electrochemistry**
UNIT 5	**Nuclear Chemistry**

Course Outcome

CO-1 Students will be able to understand the kinetics of unimolecular and bimolecular reactions.

CO-2 Students will be able to analyze the basic knowledge of laws of photochemistry.

CO-3 Students will be able to describe the basic principles of laws of thermodynamics and colligative properties.

CO-4 Students will be able to think critically on different terms of electrochemistry of strong and weak electrolytes.

CO-5 Students will be able to understand practical aspects and applications of nuclear chemistry.

Mapping of COs and POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	M	L			L	H	H	H	M
CO2	L	M				M	H	H	H	M

CO3	M	M	L			M	M	H	H	M
CO4	H	M	L	L		L	H	H	H	H
CO5	M	H	L	L		L	M	H	H	M

BCE 038A: Project

Students will be able to

CO-1 search and Identify the relevant problems or topics of research in the field of Chemistry

CO-2 understand the mechanism and process of data collection,review and analysis.

CO-3 correlate and analyze a current topic for innovation and for the benefits of society at large .

CO-4 understand the ethics of research, plagiarism, copyrights etc .

CO-5 develop an insight for choosing the field of specialization during higher studies.

CO PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H	L	M	H	H	M	H	H	H	H
CO2	H	H	M	H	H	M	H	H	H	H
CO3	H	L	M	H	H	M	H	H	H	H
CO4	H	M	M	H	L	M	H	H	H	H
CO5	H	H	M	H	L	M	H	H	H	H