JECRC™
UNIVERSITY
BUILD YOUR WORLD

Department of Chemistry

Course Structure and Syllabi

B.Sc. Course

(Chemistry Minor)

Session 2020-21

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)

JECRC UNIVERSITY
SCHOOL OF SCIENCES
SESSION 2020-21

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

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

Semester I

Old Code	New Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						L	P	
BCE 025A	BCE 025A	Core-1: Basics of Chemistry	4	-		4		4
BCE 026A	BCE 026A	Acid –Base Titrations and Radical identification (Practicals)			2		1	1

Semester II

Old Code	New Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						L	P	
BCE 027A	BCE 027A	Core-1: Periodic Trends in s- and p-Block Elements and Basics of Chemical Kinetics	4	-	-	4		4
BCE 028A	BCE 028A	Mixture Analysis and Functional Group identification (Practicals)			2		1	1

Semester III

Old Code	New Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						L	P	
BCE 029B	BCE 029B	Core-1: Coordination Compounds, Aldehydes & Ketones and Thermodynamics	4	-		4		4
BCE 030A	BCE 030A	Chromatographic Analysis and Calibrations (Practicals)			2		1	1

Semester IV

Old Code	New Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						L	P	
BCE 031B	BCE 031B	**Core-1:** Lanthenides, Actinides, Spectroscopy and Chemical Equillibrium	4	-		4		4
BCE 032A	BCE 032A	Volumetric Analysis, Identification of Organic Compounds and Conductometric Analysis (Practicals)			2		1	1

Semester V

Old Code	New Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						L	P	
BCE 033B	BCE 033B	**Core-1:** Basics of Photochemistry and Electrochemistry	4	-		4		4
BCE 034A	BCE 034A	Inorganic Preparations, Organic Mixture Separation and Adsorption Isotherms (Practicals)			2		1	1

Semester VI

Old Code	New Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						L	P	
BCE 035A	BCE 035A	**Core-1:** Organometalic Chemistry, Hetrocyclic Compounds and Elementry Quantum Mechanics	4	-	-	4		4
BCE 036A	BCE 036A	Inorganic and Organic Preparations and Optical Analysis (Practicals)			2		1	1

SEMESTER-I

BCE 025A: Basics of Chemistry

Course Outcome: On completion of this course student will be able to-
CO-1 understand the principles of covalent bond and hybridization.
CO-2 analyze the basic knowledge of sterochemistry and isomerisation.
CO-3 describe the basic concept of types of organic reactions.
CO-4 think critically on different laws of symmetry and crystal defects .
CO-5 understand molecular velocities qualitatively and its relationship

Unit-I

Covalent Bond : Valence bond theory and its limitations, directional characteristic of covalent bond. Hybridisation and shapes of simple inorganic molecules and ion,valence shell electron pair repulsion (VSEPR) theory of NH_3, H_3O^+, SF_4, ClF_3, ICl_2, H_2O.
MO theory for 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.

Structure & Bonding

Hybridization, bond length, bond angles and bond energy, localized & delocalised chemical bond, vander - waals interaction, resonance, hyperconjugation, aromaticity, Inductive & field effect, H-bonding.

Unit-II

Stereochemistry

Concept of isomerism,Types of isomerism, Optical isomerism - Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, chiral & achiral molecules with two stereogenic centre, diastereomers, erythro,threo isomers, resolution of enantiomers, walden inversion, retention, Absolute configuration, D & L and R & S systems of nomenclature.
Geometric isomersism - cis & trans-Isomerism, E & Z system of nomenclature, determination of configuration of geometrical isomers, geometrical isomerism in oximes & alicyclic compounds.
Conformational isomerism - Projection formulae (Fischer, Sawhorse, Newman & flying wedge formula,conformational analysis of ethane,n-butane and cyclohexane,difference between configuration and conformation.

Unit-III

Mechanism of Organic Reactions.

Types of reagents, Electrophiles & nucleophiles, Types of organic reactions, Energy consideration, reactive intermediates-Carbocation, carbanion, free-radicals, carbenes, nitrenes, arynes, Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic & stereochemical studies).

Alkanes

Nomenclature, isomerism, methods of preparation (with special reference to Wurtz reaction, Corey-House reaction. Kolbe reaction & decarboxylation of carboxylic acids), physical properties, mechanism of free radical, halogenation of alkanes, reactivity & selectivity.

Unit-IV

Solid State

Defination of space lattice, unit cell, Laws of crystallography - (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry, Symmetry elements in crystals, stoichiometric and non stoichiometric defects in solids, thermography & seven segment cell, X-ray diffraction by crystals, Derivation of Bragg's equation, Determination of crystal structure of NaCl, and CsCl (Laue's method and powder method)

Gaseous States

Postulates of kinetic theory of gases, deviation from ideal behaviour,Vander-Waals equation of state.

Unit-V

Molecular velocities

Root means square velocities, average velocities and most probable velocities, Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, means free path and collision diameter, Liquification of gases (based on Joule-Thomson effect).

Suggested Books

1. Concise Inorganic Chemistry by J.D.Lee
2. Inorganic Chemistry Principles of Structure and Reactivity-Huheey James,E.Keiter Ellen, A. Pearson Edu Delhi
3. Stereochemistry of organic compounds-P.S.Kalsi,New age International
4. Organic chemistry Reaction and Reagents-O.P.Agarwal,KrishnaPrakashan Meerut
5. Advanced Organic Chemistry by Bahl & Bahl, S.Chand Publications.
6. Organic Chemistry by Morrison Boyd, Pearson Publications.
7. Advanced Organic Chemistry by Bahl & Bahl, S.Chand Publications
8. Advanced Organic chemistry-Jagdamba singh and LDS Yadav
9. Advanced Physical chemistry –Gurdeep Raj,Goel Publication
10. Essentials of physical Chemistry-Puri, Sharma,Pathania

BCE026A: Acid –Base Titrations and Radical identification (Practicals)

INORGANIC CHEMISTRY

1. To analyse acidic radicals of dilute H_2SO_4 and concentrated H_2SO_4 group.
2. To analyse mixture containing three acidic and three basic radicals (Group I ,II andVII).
3. To analyse mixture containing three acidic and three basic radicals(Group II,III and VII).
4. To analyse mixture containing three acidic and three basic radicals(GroupIV,VI and VII).
5. To analyse mixture containing three acidic and three basic radicals(Group I ,II and V).

ORGANIC CHEMISTRY

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.

PHYSICAL CHEMISTRY

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.

SEMESTER-II

BCE027A: Periodic Trends in s- and p-Block Elements and Basics of Chemical Kinetics

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

CO-1 understand the principles of periodic trends in S-block Elements and P- block elements.
CO-2 analyze the basic knowledge of nomenclature, isomerism, and properties of alkenes and alkynes.
CO-3 describe the basic concept of alkyl and aryl halides.CO-4 think critically on classification of colloids. CO-5 understand practical aspects of chemical kinetics.

Unit-I

Periodic trends in S-Block Elements and P- Block elements

Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies, Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-16.

Compounds of P-Block Elements

Boranes, borazine, borohydrides, carbides, silicates (structural principle).

Unit-II

Alkenes : Nomenclature, isomerism, relative stabilities, methods of preparation: dehydration of alcohols, dehydrohalogenation of alkyl halides, dehalogenation of vic-dihalides, pyrolysis of quarternary ammonium hydroxides; physical properties, chemical reactions: - Catalytic hydrogenation, addition of hydrogen halides, hydroboration - oxidation oxymercuration reduction, epoxidation, ozonolysis, hydration, hydroxylation with $KMnO_4$, substitution reactions at the allylic & vinylic positions, polymerization; regioselectivity in alcohol dehydration. Saytzeff & Hoffmann rules for elimination.

Alkynes : Nomenclature, isomerism, structure & bonding in alkynes, methods of preparation, physical properties, chemical reactions - addition of hydrogen, mechanism of electrophilic & nucleophilic addition, acidity of alkynes, hydroboration - oxidation, metal - ammonia reductions, oxidation & polymerisation.

Unit-III

Alkyl Halide

Nomenclature & classes of alkyl halides, methods of formation, chemical reaction. Mechanism of nucleophilic substitution reactions of alkyl halides, SN^2 & SN^1 reaction with energy profile diagrams.

Aryl Halides

Methods of formation of aryl halides, nuclear & side chain reactions, The addition - elimination & the elimination - addition mechanisms of nucleophilic aromatic substitution reactions, Relative reactivities of alkyl halides versus alyl, vinyl & aryl halides.

Unit-IV

Colloidal State

Definition of colloids, classification of colloids. Solids in liquids (sols) : Properties - kinetic, optical and electrical; stability of colloids, protective action. Hardy-Schulze law, Gold number, Liquid in liquids (emulsions), types and preparation of emulsions, emulsifier, Liquids in solids (gels) : Classification, preparation and properties, inhibition, general application of colloids.

Unit-V

Chemical Kinetics

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction Concentration dependence of rates, mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo order, half life and mean life, Determination of the order of reaction – differential method, integration method, method of half life period and isolation method, Radioactive decay as a first order phenomenon, Experimental methods of chemical kinetics: conductomertric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics,effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

Suggested Books

1. Selected topics in inorganic chemistry –Malik tuli, Madan.
2. Kinetics and Mechanism of Chemical Transformation-J. Rajaram and J. C. Kuriacose
3. Advanced Physical Chemistry –Gurdeep Raj,Goel Publication
4. Organic Chemistry Reaction and Reagents-O.P.Agarwal,Krishna Prakashan Meerut
5. Chemical Kinetics-Laidler

BCE 028A: Mixture Analysis and Functional Group identification (Practicals)

INORGANIC CHEMISTRY

1. To analyse mixture containing three acidic and three basic radicals including BO_3^{-3}as the interfering radical.
2. To analyse mixture containing three acidic and three basic radicals including PO_4^{-3}as the interfering radical.
3. To analyse mixture containing three acidic and three basic radicals including $C_2O_4^{-2}$ or F^- the interfering radical.
4. To analyse mixture containing three acidic and three basic radicals including $C_2O_4^{-2}$ or F^- the interfering radical.

5. To analyse mixture containing three acidic and three basic radicals. Mixture contains combination of acidic radicals. (Chloride in presence of Bromide or Iodide)
6. To analyse mixture containing three acidic and three basic radicals. Mixture contains combination of acidic radicals.(Oxalate in presence of Carbonate)

ORGANIC CHEMISTRY

1. To detect the functional group (alcoholic and phenolic) from the given organic compound.
2. To detect the functional group (Carboxylic and ester) from the given organic compound.
3. To detect the functional group (Carbonyl and Amide) from the given organic compound.
4. To detect the functional group (Amine and Aniline) from the given organic compound.
5. To detect the functional group (Carbohydrate And Nitro) from the given organic compound.

PHYSICAL CHEMISTRY

1. To determine the specific reaction rate of the hydrolysis of methyl or ethyl acetate catalysed by HCl at room temperature.
2. 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.
3. To determine the specific reaction rate of the hydrolysis of methyl or ethyl acetate catalysed by HCl at higher temperature (40°C) and also determine energy of activation for the reaction.
4. To study the effect of acid strength on the hydrolysis of ester.
5. To prepare colloidal solution of arsenius sulphide.

SEMESTER-III

BCE029B: Coordination Compounds, Aldehydes & Ketones and Thermodynamics

Course Outcome: On completion of this course student will be able to learn-
CO-1 explain properties of the elements of the first transition series and their binary compounds .
CO-2 identify common organic ligands used to construct coordination complexes, and learn how certain ligands interact with transition metal .
CO-3 explains the chemical reaction, physical properties and acidic character of alcohols and phenols
CO-4 able to explain mechanism of nucleophilic additions to carbonyl group.
CO-5 explain laws of thermodynamics and express it mathematically

Unit-I
Chemistry of Elements of Transition Series
Characteristic properties of d-block elements, Properties of the elements of the first transition series and their binary compounds, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.

Unit-II
CoordinationCompounds

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes, Complexes illustrating relative stability of their oxidation states, coordination number and geometry.

Unit-III

Alcohol

Classification and nomenclature

Monohydric alcohol - nomenclature, methods of formation by reduction of aldehyde, Ketones, Carboxylic acids and esters. Hydrogen bonding, Acidic nature, Physical and Chemical properties of Alcohols.

Dihydric alcohol - nomenclature, method of formation, chemical reaction of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol - Pinacolone rearrangement.

Trihydric alcohols - nomenclature and methods of formation, chemical reaction of glycerol.

Phenols

Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, Comparative acidic strength of alcohols and phenols resonance stabilization of phenoxide-ion, chemical reactions of phenols, electrophilic aromatic substitution, alkylation, acylation and carboxylation, Mechanism of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer manasse reaction & Reimer Tiemann reaction.

Unit-IV

Aldehyde and Ketone - I

Nomenclature and structure of the carbonyl group, Synthesis of aldehyde and Ketones with particular reference to the synthesis of aldehydes from acid chlorides using, 1,3-dithianes, synthesis of ketones from nitrites and from carboxylic acids, physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin condensation, aldol, Perkin and Knoevengel reactions.Condensation with ammonia and its derivatives, Witting reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones. Cannizzaro's reaction. Meerwine Pondrof Verlay reduction, Clemmensen and Wolff Kishner Reduction, $LiAlH_4$ and $NaBH_4$ reductions.

Unit-V

Thermodynamics

Definition of theromdynamic terms : System, surroundings etc. Types of systems, intensive and extensive properties, concept of heat and work.

First Law of Thermodynamics : Statement, definition of internal energy and enthalpy, Heat capacity- heat capacities at constant volume and pressure and their relationship, Joule's law, Joule-Thomson coefficient and inversion temperature, Standard state, standard enthalpy of formation Hess's law of heat summation and its application, Heat of reaction at constant pressure and at constant volume, Enthalpy of neutralization, Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy, Kirchhoff's equation.

Suggested Books

1. Concise Inorganic Chemistry 5 ^{ed}- J. D. Lee
2. Advanced Inorganic chemistry-S. K Agarwal, Keemtilal

3.. Organic Chemistry by Morrison& Boyd
3. Advanced Organic chemistry-Jagdamba singh and LDS Yadav
4. Reaction mechanism in Organic chemistry –S M Mukherji and S P Singh, Macmillan
5. Chemical thermodynamics-R. P. Rastogi and R.R Mishra
6. Advanced Physical chemistry –Gurdeep Raj, Goel Publication
7. Chemical thermodynamics-R. C. Srivastava, S. K. Sahaand Abhay K. Jain

BCE: 030A: Chromatographic Analysis and Calibrations (Practicals)

INORGANIC CHEMISTRY

1. To calibrate fractional weights, pipettes and burettes.
2. To prepare standard solution and dilution -0.1 M to .001M solution.
3. To estimate hardness of water by EDTA.
4. To measure dissolved oxygen in water.
5. To measure Total Solid in sewage.
6. To measure chloride in water.

ORGANIC CHEMISTRY

Thin Layer Chromatography

1. To separate the mixture of Methyl Orange and Methylene Blue by using cyclohexane and ethyl acetate(8.5:1.5) as solvent system.
2. Preparation and separation of 2,4-dinitro Phenylhydrazone of acetone , 2-butanone, hexane-2-one and hexane-3-one using toluene and petroleum ether(40:60).

Paper Chromatography

3. To separate the mixture of phenylalanine and glycine.Alanine and aspartic acid.Leucine and glutamic acd.Spray reagent –Ninhydrin.
4. To separate the mixture of D,L-alanine,glycine and L-leucine using n-butanol : acetic acid :water (4:1:5).Spray reagent- Ninhydrin.
5. To separate monosaccharides –a mixture of D –galactose and D-fructose using n-butanol : acetone: water (4:1:5). Spray reagent –aniline hydrogen phthalate.

PHYSICAL CHEMISTRY

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 hence calculate its heat of ionization or enthalpy of ionization.
5. To determine heat of neutralization of a weak base say NH_4OH and hence calculate its heat of ionization or enthalpy of ionization.

SEMESTER-IV

BCE 031B: Lanthanides, Actinides, Spectroscopy and Chemical Equillibrium

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

CO-1 understand the principles and chemistry of Lanthanide and Actinide Elements.

CO-2 analyze the basic knowledge of UV and IR spectra.

CO-3 describe the basic concept structure and nomenclature of Carboxylic Acid and derivatives CO-4 understand Carnot cycle and its efficiency. CO-5 understand practical aspects of chemical equilibrium

Unit-I

Chemistry of Lanthanide and Actinide Elements

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, Separation of Np, Pu and Am from U, Comparison between the actinides and the lanthanides

Non-aqueous Solvents

Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2.

Unit-II

UV Spectra

Elecctromagnetic Spectrum. Absorption spectra; Ultraviolet (UV) absorption Spectroscopy - absorption laws (Beer - Lambert's Law), molar absorptivity, presentation and analysis of UV spectra.types of electronic transition, effect of conjugation, Concept of Chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shift.. Problems pertaining to the structure elucidation of simple organic compounds using UV spectroscopy

IR-Spectra

Molecular vibration, Hooke's Law, selection rules, intensity on deposition of IR bands, measurement of IR spectrum, finger print region, characteristic absorption of various functional groups and interpretation of IR spectra of simple organic compounds. Problems pertaining to the structure elucidation of simple organic compounds using IR spectroscopy

Unit-III

Carboxylic Acid

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength, preparation of carboxylic acid. Reaction of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, ester and amides, Reduction of Carboxylic acids. Mechanism of decarboxylation, method of formation and chemical reactions of unsaturated monocarboxylic acids. Dicarboxylic acid, methods of formation and effect of heat and dehydrating agents haloacid, hydroxy acids – malic, tartaric & citric acid.

Carboxylic Acid Derivatives

Structure and nomenclature of acid chloride, ester, amides (Urea) and acid anhydrides, Relative stability of acyl derivatives, Physical properties, inter-conversion of acid derivatives by

nucleophilic acyl substitution. Preparation of carboxylic acid derivatives. Chemical reaction. Mechanism of esterification and hydrolysis (Acidic and Basic)

Unit-IV

Second Law of Thermodynamics : Need for the law, different statements of the law, Carnot cycle and its efficiency. Carnot theorm. Concept of Entropy : Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, Clausius inequality, entropy as a criteria of spontaneity and equilibrium

Third law of thermodynamics : Nernest heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions: Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity.Variation of G and A with P, Vand T.

Unit-V

Chemical Equilibrium

Equilibrium constant and free energy, Thermodynamic derivation of law of mass action, Le Chatelier's principle. Reaction isotherm and reaction isochore. Clapeyron equation and Clausius Clapeyron equation, applications.

Suggested Books

1. Concise Inorganic Chemistry 5 ed- J. D. Lee
2. Inorganic Chemistry by Cotton-Willikinson
3. Organic spectroscopy-William Kemp, Macmillan
4. Elementry Organic spectroscopy-Y.R . Sharma, S.Chand
5. Organic Chemistry-R. T. Morrison and R. N. Boyd, Prentice Hall
6. Physical Chemistry –P W. Atakins, ELBS
7. Advanced Physical chemistry –Gurdeep Raj, Goel Publication

BCE032A:Volumetric Analysis, Identification of Organic Compounds and Conductometric Analysis (Practicals)

INORGANIC CHEMISTRY

Volumetric Analysis

1. To determine alkali content in anta acid tablet using HCl.
2. To estimate copper using thiosulphate.
3. To determine acetic acid in commercial vinegar using NaOH solution.

Synthesis

4. To prepare Tetraammine copper (II) sulphate.
5. To prepare Ni-DMG complex.

ORGANIC CHEMISTRY

1. To identify an organic compound (I) through the functional group analysis, determine

its M.P and prepare its suitable derivative.

2. To identify an organic compound (2) through the functional group analysis,determine its M.P and prepare its suitable derivative.

3. To identify an organic compound (3) through the functional group analysis,determine its M.P and prepare its suitable derivative.

4. To identify an organic compound (4) through the functional group analysis,determine its M.P and prepare its suitable derivative.

5. To identify an organic compound (5) through the functional group analysis,determine its M.P and prepare its suitable derivative.

PHYSICAL CHEMISTRY

1. To determine the strength of given acid pH metrically.For this you are provided with standard NaOH solution.

2. 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.

3. To determine the C.S.T of phenol-water system in presence of 1% NaCI solution and 1% succinic acid solution.

4. To determine the dissociation constant of a weak acid conductometrically and verify Ostwalds dilution law.

5. To determine the transition temperature of the given substance by thermometric method ($MnCI_2.4H_2O$)

SEMESTER-V

BCE 033B: Basics of Photochemistry and Electrochemistry

Course Outcome: After the completion of the course, student will be able to-

CO-1understand concept of bonding between metal and ligand.

CO-2 gain Efficient knowledge of various techniques of structure elucidation by PMR Spectroscopy techniques. .

CO-3 interpretation and synthesis of chemical information and skills in the practical application of phase equilibria.

CO-4 describe and explain photochemical and photophysical processes and mechanisms with suitable theoretical models, and apply established experimental methods for the investigation of these processes

CO-5 galvanic cell.Determination of pH by using glass electrode and calomel electrode. Potentiometric Titrations

Unit-I

Metal-Ligand Bonding in Transition Metal complexes

Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting crystal-field parameters. nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

Unit-II

NMR Spectroscopy

Nuclear magnetic resonance (NMR) spectroscopy, Proton magnetic resonance (H^1 NMR) spectroscopy, Nuclear shielding and deshielding, chemical shift and molecular structure, spin-

spin splitting and coupling constants, area of signals. Interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol , acetaldehyde, 1,1,2-tribromoethane, ethyl acetate,toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using PMR spectroscopy techniques.

Unit-III
Phase Equilibrium

Statement and meaning of the terms - phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilbrium of one component system- water, and S systems phase equilibria of two component system - solid - liquid equilibria, simple eutectic Pb-Ag systems, desilverisation of lead, solid solution - compound formation with congruent melting point (Mg-Zn) and incongruent melting point ($NaCl-H_2O$), ($FeCl_3$ - H_2O). Freezing mixtures, acetone-dry ice.

Unit-IV
Photochemistry
Introduction, difference between thermal and photochemical processes. Laws of photochemistry: Grothus-Drapper law, Stark -Einstein law, 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.

Unit-V
Electrochemistry
Electrical transport - conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlarusch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes. Ostwald's dilution law. Transport number, definition and determination by Hittorf's method and moving boundary method.

Types of reversible electrodes - gas - metal ion, metal -metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode, reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. EMF of a cell and its measurementsDetermination of pH by using glass electrode and calomel electrode. Potentiometric Titrations

Suggested Books
1. Concise Inorganic Chemistry 5 ed- J. D. Lee
2. Inorganic Chemistry by Cotton-Willikinson
3. Organic Chemistry-R. T. Morrison and R. N. Boyd, Prentice Hall
4. Advanced Organic Chemistry-Jagdamba singh and LDS Yadav
5. Advanced Physical Chemistry –Gurdeep Raj,Goel Publication
6. Essentials of Physical Chemistry-Puri, Sharma, Pathania
7. A Text book of Electro- Chemistry-Glasstone

BCE 034A: Inorganic Preparations, Organic Mixture Separation and Adsorption Isotherms (Practicals)

INORGANIC CHEMISTRY

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.

ORGANIC CHEMISTRY

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 NaOH and prepare their suitable derivatives.
3.To separate and identify the organic mixture containing two solid components using NaOH and prepare their suitable derivatives.
4.To separate and identify the organic mixture containing two solid components using $NaHCO_3$ and prepare their suitable derivatives.
5.To separate and identify the organic mixture containing two solid components using $NaHCO_3$ and prepare their suitable derivatives

PHYSICAL CHEMISTRY

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 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 .
5. To investigate the adsorption of oxalic acid from aqueous solution by activated charcoal and examine validity of Freundlich and Langmuir adsorption isotherm.

SEMESTER-VI

BCE 035A: Organometalic Chemistry, Hetrocyclic Compounds and Elementry Quantum Mechanics

Course Outcome:_After the completion of this course student will be able to learn-

CO-1 Students will be able to understand the classification of acids and bases as hard and soft .
CO-2 Students will be able to analyze the basic knowledge on nomenclature and classification of organometallic compounds .
CO-3 Students will be able to describe the basic concept structure and synthesis of heterocyclic compounds.
CO-4 Students will be able to think critically on Elementary quantum Mechanics and Schrodinger wave equation.
CO-5 Students will be able to understand practical aspects of Optical activity, polarization and dipole moment

Unit-I

Hard and Soft Acids and Bases (HSAB) :

Classification of acids and bases as hard and soft, Pearson's HSAB concept, acid-base strength and hardness and softness, Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

Unit-II

Organometallic Chemistry

Definition, nomenclature and classification of organometallic compounds, A brief account of metal-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

Unit-III

Heterocyclic Compounds

Introduction : Molecular orbital picture and aromatic characteristics of pyrrol, furan, thiophene and pyridine, Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives.Comparison of basicity of pyridine, piperidine and pyrrole, Introduction to condensed five and six membered heterocycles. Preparation and reactions of Indole, quinoline and isoquinolme with special reference to Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis, Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

Unit-IV

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.

Unit-V

Physical Properties and Molecular Structure

Optical activity, polarization - (Calusius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment, temperature

method and refractivity method, dipole moment and structure of molecules, magnetic properties paramagnetism, diamagnetism and ferromagnetics.

Suggested Books

1. Selected topics in inorganic chemistry –Malik tuli,Madan
2. Inorganic Chemistry Principles of structure and reactivity-Huheey James ,E.Keiter Ellen, A. Pearson,Edu.Delhi
3. Organic Chemistry Reaction and Reagents-O. P. Agarwal, Krishna Prakashan Meerut
4. Organometallic Chemistry, R.C Mehrotra
5. Reaction mechanism in Organic chemistry –S M Mukherji,and S P Singh,Macmillan
6. A Text book of Quantam Chemistry-A.K .Chandra
7. Organic chemistry –I. L. Finar

BCE 036A: Inorganic and Organic Preparations and Optical Analysis (Practicals)

INORGANIC CHEMISTRY

1. To synthesize Hexaammine nickel (II)chloride.
2. To synthesize prussian blue.
3. To measure fluoride in the given sample by SPANDS method.
4. To separate and estimate Mg(II) and Zn(II).
5. To separate and estimate Cu(II) and Ni(II).

ORGANIC CHEMISTRY

1. (a)To prepare acetanilide from aniline (Acetylation).
   (b) To prepare phenylbenzoate from phenol (Benzoylation).
2. To prepare Iodoform from ethanol and acetone. (Aliphatic Electrophilic Substitution).
3. To prepare m-dinitro benzene from nitro benzene .
4. To prepare p-nitro acetanilide from acetanilide.
5. To prepare Benzoic acid from toluene.

PHYSICAL CHEMISTRY

1. To determine the specific rotation of a given optically active compound.
2. To determine the equivalent conductance of a strong electrolyte KCI or NaCI at several concentrations and verify the applicability of Debye Huckel Onsager equation.
3. To determine the equivalent conductance of a strong electrolyte HCI at several concentrations and verify the applicability of Debye Huckel Onsager equation.
4. To study saponification of ethyl acetate conductometrically.
5. To determine the freezing point depression constant of camphor using naphthalene as solute and hence determine the molecular weight of acetanilide by Rast's method.

Department of Chemistry
JECRC University
B.Sc. (Minor Chemistry)2020-21
Mapping of CO-PO~ PSO

SEMESTER-I

BCE 025A: Basics of Chemistry

UNIT 1	**Covalent Bond**
UNIT 2	**Stereochemistry**
UNIT 3	**Mechanism of Organic Reactions**
UNIT 4	**Solid State**
UNIT 5	**Molecular velocities**

Course Outcome: On completion of this course student will be able to-
CO-1 understand the principles of covalent bond and hybridization.
CO-2 analyze the basic knowledge of sterochemistry and isomerisation.
CO-3 describe the basic concept of types of organic reactions.
CO-4 think critically on different laws of symmetry and crystal defects .
CO-5 understand molecular velocities qualitatively and its relationship

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	M
C05	M	H	L	L		L	M	H	H	M

BCE 027A: Periodic Trends in s- and p-Block Elements and Basics of Chemical Kinetics

UNIT 1	**Periodic trends in S-Block Elements and P- Block elements**
UNIT 2	**Alkenes and alkynes**
UNIT 3	**Alkyl and aryl Halide**
UNIT 4	**Colloidal State**
UNIT 5	**Chemical Kinetics**

Course Outcome: On completion of this course student will be able to-
CO-1 understand the principles of periodic trends in S-block Elements and P- block elements.
CO-2 analyze the basic knowledge of nomenclature, isomerism, and properties of alkenes and alkynes.
CO-3 describe the basic concept of alkyl and aryl halides.
CO-4 think critically on classification of colloids.
CO-5 understand practical aspects of chemical kinetics.

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	M
C05	M	H	L	L		L	M	H	H	M

BCE 029B: Coordination Compounds, Aldehydes & Ketones and Thermodynamics

UNIT 1	**Chemistry of Elements of Transition Series**

UNIT 2	Coordination Compounds
UNIT 3	Alcohol and Phenol
UNIT 4	Aldehyde and Ketone - I
UNIT 5	Thermodynamics

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

CO-1 explain properties of the elements of the first transition series and their binary compounds

CO-2 identify common organic ligands used to construct coordination complexes, and learn how certain ligands interact with transition metal

CO-3 explains the chemical reaction, physical properties and acidic character of alcohols and phenols

CO-4 able to explain mechanism of nucleophilic additions to carbonyl group

CO-5 explain laws of thermodynamics and express it mathematically

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	M
CO5	M	H	L	L		L	M	H	H	H

BCE 031B: Lanthanides, Actinides, Spectroscopy and Chemical Equillibrium

UNIT 1	Chemistry of Lanthanide and Actinide Elements
UNIT 2	U-V and IR-Spectra
UNIT 3	Carboxylic Acid and derivatives
UNIT 4	Thermodynamics
UNIT 5	Chemical Equilibrium

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

CO-1 understand the principles and chemistry of Lanthanide and Actinide Elements.

CO-2 analyze the basic knowledge of UV and IR spectra.

CO-3 describe the basic concept structure and nomenclature of Carboxylic Acid and derivatives

CO-4 understand second law of thermodynamic &Carnot cycle and its efficiency

CO-5 understand practical aspects of chemical equilibrium.

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	M
CO5	M	H	L	L		L	M	H	H	M

BCE 033B: Basics of Photochemistry and Electrochemistry

UNIT 1	Metal ligand Bonding in transition Metal complexes
UNIT 2	NMR Spectroscopy
UNIT 3	Phase equilibrium
UNIT 4	Photochemistry
UNIT 5	Electrochemistry

Course Outcome: After the completion of the course, student will be able to-

CO-1Understand the concept of bonding between metal and ligand

CO-2 Gain Efficient knowledge of various techniques of structure elucidation by PMR Spectroscopy techniques. .
CO-3 Interpretation and synthesis of chemical information and skills in the practical application of phase equilibria.
CO-4 Describe and explain photochemical and photophysical processes and mechanisms with suitable theoretical models, and apply established experimental methods for the investigation of these processes
CO-5 Galvanic cell, determination of pH by using glass electrode and calomel electrode. Potentiometric Titrations

Mapping of PO/CO

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

BCE 035A: Organometalic Chemistry, Hetrocyclic Compounds and Elementry Quantum Mechanics

UNIT 1	**Hard and Soft Acids and Bases (HSAB)**
UNIT 2	**Organometallic Chemistry**
UNIT 3	**Heterocyclic Compounds**
UNIT 4	**Elementary quantum Mechanics**
UNIT 5	**Physical Properties and Molecular Structure**

Course Outcome: After the completion of this course student will be able to learn-
CO-1 Students will be able to understand the classification of acids and bases as hard and soft .
CO-2 Students will be able to analyze the basic knowledge on nomenclature and classification of organometallic compounds .
CO-3 Students will be able to describe the basic concept structure and synthesis of heterocyclic compounds.
CO-4 Students will be able to think critically on Elementary quantum Mechanics and Schrodinger wave equation.
CO-5 Students will be able to understand practical aspects of Optical activity, polarization and dipole moment.

Mapping of PO/CO

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	M
CO5	M	H	L	L		L	M	H	H	H