VIKRAMA SIMHAPURI UNIVERSITY :: NELLORE

Common Framework of CBCS for Colleges in Andhra Pradesh

(A.P. State of Council of Higher Education)

B.Sc. Chemistry Core Syllabus under CBCS

(*with effect from the Academic Year 2020-21*)

Course Structure

Structure of Chemistry Core Syllabus under CBCS

Sem	Paper	Title of course	Credits	Hrs	Marks		
					Int	Univ	Total
I	I	Inorganic and Physical Chemistry	4	4	25	75	100
		Practical I : Analytics of SALT Mixture	1	2	0	50	50
II	II	**Organic and General Chemistry**	4	4	25	75	100
		Practical II: Volumetric Analysis	1	2	0	50	50
		Organic Chemistry and Spectroscopy	4	4	25	75	100
		Practical-III: Organic Preparation and IR Spectral Chemistry	1	2	0	50	50
IV	IV	**Inorganic, Organic and Physical Chemistry**	4	4	25	75	100
		Practical-IV: Organic Qualitative Analysis	1	2	0	50	50
IV	V	**Inorganic and Physical Chemistry**	4	4	25	75	100
		Course Conductometric and Potentiometric Titrimetry	1	2	0	50	50

SEMESTER – I

Course I (Inorganic &Physical Chemistry) 60 hrs. (4h/w)

Course outcomes:

At the end of the course, the student will be able to;

1. Understand the basic concepts of p-block elements
2. Explain the difference between solid, liquid and gases in terms of intermolecular interactions.
3. Applytheconceptsofgasequations,pHandelectrolyteswhilestudyingotherchemistrycourses.

INORGANIC CHEMISTRY 24 h

UNIT –I

Chemistry of p-block elements **8h**

Group 13: Preparation & structure of Diborane, Borazine

Group 14: Preparation, classification and uses of silicones

Group 15: Preparation & structures of Phosphonitrilic halides $\{(PNCl_2)_n$ where $n=3, 4$

Group 16: Oxides and Oxoacids of Sulphur (structures only)

Group 17: Pseudohalogens, Structures of Interhalogen compounds.

UNIT-II

1. Chemistry of d-block elements: **6h**

Characteristics of d-block elements with special reference to electronic configuration, variable valence, magnetic properties, catalytic properties and ability to form complexes.

2. Chemistry of f-block elements: **6h**

Chemistry of lanthanides - electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties. Chemistry of actinides - electronic configuration, oxidation states, actinide contraction .

3. Theories of bonding in metals:

Valence bond theory andFree electron theory, explanation of thermal and electrical conductivity of metals based on these theories, Band theory- formation of bands, explanation of conductors, semiconductors and insulators.

PHYSICAL CHEMISTRY **36h**

UNIT-III

Solidstate **10h**

Symmetry in crystals. Law of constancy of interfacial angles. The law of rationality of indices. The law of symmetry. Miller indices, Definition of lattice point, space lattice, unit cell. Bravais lattices and crystal systems. X-ray diffraction and crystal structure. Bragg's law. Powder method. Defects in crystals. Stoichiometric and non-stoichiometric defects.

UNIT-IV

1. Gaseous state **6h**

van der Waal's equation of state. Andrew's isotherms of carbon dioxide, Critical phenomena. Relationship between critical constants and vander Waal's constants. Law of corresponding states. Joule- Thomson effect.

2.Liquid state **4h**

Liquid crystals,Differences between liquid crystal and solid/liquid. Classification of liquid crystals into Smectic and Nematic. Application of liquid crystals as LCD devices.

UNIT-V

Solutions, Ionic equilibrium& dilute solutions

1. Solutions **6h**

Azeotropes-HCl-H_2O system and ethanol-water system. Partially miscible liquids-phenol-water system. Critical solution temperature (CST), Immiscible liquids and steam distillation.Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law.

2. Ionic equilibrium **3h**

Ionic product, common ion effect, solubility and solubility product.

3. Dilute solutions **7h**

Colligative properties- RLVP, Osmotic pressure, Elevation in boing point and depression in freezing point. Experimental methods for the determination of molar mass of a non-volatile

solute using osmotic pressure, Elevation in boing point and depression in freezing point. Abnormal colligative properties. Van't Hoff factor.

Co-curricular activities and Assessment Methods

1. ContinuousEvaluation:Monitoringtheprogressof student'slearning
2. ClassTests,WorksheetsandQuizzes
3. Presentations,ProjectsandAssignmentsandGroupDiscussions:Enhancescriticalthinking skillsand personality
4. Semester-endExamination:criticalindicatorofstudent'slearningandteachingmethodsadoptedby teachersthroughoutthesemester.

List of Reference Books

1. Principles of physical chemistry by Prutton and Marron
2. Solid State Chemistry and its applications by Anthony R. West
3. Text book of physical chemistry by K L Kapoor
4. Text book of physical chemistry by S Glasstone
5. Advanced physical chemistry by Bahl and Tuli
6. Inorganic Chemistry by J.E.Huheey
7. Basic Inorganic Chemistry by Cotton and Wilkinson
8. A textbook of qualitative inorganic analysis by A.I. Vogel
9. Atkins,P.W.&Paula,J.deAtkin'sPhysicalChemistryEd.,OxfordUniversityPress 10thEd(2014).
10. Castellan,G.W.PhysicalChemistry4thEd.Narosa(2004).
11. Mortimer,R. G.PhysicalChemistry3rdEd. Elsevier:NOIDA,UP(2009).
12. Barrow,G.M.PhysicalChemistry

LABORATORY COURSE -I **30**hrs (2 h / w)

Practical-I Analysis of SALT MIXTURE

(At the end of Semester-I)

Qualitative inorganic analysis (Minimum of Six mixtures should be analysed)

50 M

Course outcomes:

At the end of the course, the student will be able to;

1. Understand the basic concepts of qualitative analysis of inorganic mixture
2. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
3. Apply the concepts of common ion effect, solubility product and concepts related to qualitative analysis

Analysis of SALT MIXTURE **50 M**

Analysis of mixture salt containing two anions and two cations (From two different groups) from the following:

Anions: Carbonate, Sulphate, Chloride, Bromide, Acetate, Nitrate, Borate, Phosphate.

Cations: Lead, Copper, Iron, Aluminium, Zinc, Nickel, Manganese, Calcium, Strontium, Barium, Potassium and Ammonium.

MODEL PAPER

FIRST YEAR B.Sc., DEGREE EXAMINATION

SEMESTER-I

CHEMISTRY Course-I: INORGANIC & PHYSICAL CHEMISTRY

Time: 3 hours Maximum Marks: 75

PART- A 5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each carries **FIVE** marks

1. Explain the preparation & structures of Phosphonitrilic compounds.
2. Explain the structure of Borazine.
3. Explain in brief, catalytic properties & stability of various oxidation states of d-block elements.
4. Explain Actinide Constraction.
5. Write short note on Bravais lattices and crystal systems.
6. Write note on Miller Indices
7. What are Smectic & Nematic liquid Crystals? Explain.

8. Describe Andrew's isotherms of carbon dioxide.
9. Write account on common ion effect and solubility product
10. Explain Van't Hoff factor

PART- B 5 X 10 = 50 Marks

Answer any **FIVE** of the following questions. Each carries **TEN** marks

11. Explain Classification, Preparations & uses of Silicones

12. (i) What are Pseudohalogens.

    (ii) Explain the Structures of any one AX_3& AX_5 interhalogen compounds.

13. What is Lanthanide Contraction? Explain the Consequences of Lanthanide Contraction.
14. (i) Explain the magnetic properties of d- block elements.
    (ii) Explain about Conductors, Semi-Conductors& Insulators using Band Theory.
15. Write an essay on Crystal defects.

16. What is Bragg's Law. Explain the determination of structure of a crystal by powder method

17. Derive the relationship between Critical constants &Vanderwaal constants

18. (i) Write any 5 differences between liquid crystals & liquids, solids

    (ii)Write the applications of Liquid crystals.

19. Explain Nernst distribution Law. Explain its application

20. What are colligative properties. Write experimental methods for determination of molar mass of a non-volatile solute by using Elevation in boiling point & depression in freezing point.

Note: - For Paper Setters Choosing The Two Short Questions And Two Long Questions For Each Unit

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SEMESTER – II

Course II – (Organic & General Chemistry) 60 hrs (4h/w)

Course outcomes:

At the end of the course, the student will be able to;

1. Understandandexplainthedifferentialbehaviorof organiccompoundsbasedonfundamental conceptslearnt.
2. Formulatethemechanismoforganicreactionsby recallingandcorrelatingthefundamentalproperties ofthereactantsinvolved.
3. LearnandidentifymanyorganicreactionmechanismsincludingFreeRadical Substitution, Electrophilic AdditionandElectrophilicAromaticSubstitution.
4. Correlateanddescribethestereochemicalpropertiesoforganiccompoundsand reactions.

ORGANIC CHEMISTRY **36h**

UNIT-I

Recapitulation of Basics of Organic Chemistry

Carbon-Carbon sigma bonds (Alkanes and Cycloalkanes) **12h**

General methods of preparation of alkanes- Wurtz and WurtzFittig reaction, Corey House synthesis, physical and chemical properties of alkanes, Isomerism and its effect on properties, Free radical substitutions; Halogenation, concept of relative reactivity v/s selectivity. General molecular formulae of cycloalkanes and relative stability, Baeyer strain theory,Cyclohexane conformations with energy diagram, Conformations of monosubstituted cyclohexane.

UNIT-II

Carbon-CarbonpiBonds(AlkenesandAlkynes) **12h**

General methods of preparation ,physical and chemical properties.Reactions,Saytzeff and Hoffmann eliminations, Electrophilic Additions mechanism (Markownikoff/Antimarkownikoffaddition) with suitableexamples,,*syn*and*anti*-addition;addition of H_2,X_2,HX.

Hydroboration-oxidation,ozonolysis,hydroxylation, Diels Alderreaction,1,2- and1,4-addition reactions in conjugated dienes. Reactionsofalkynes;acidity,electrophilic and Nucleophilic Additions,

UNIT-III

Benzene and its reactivity **12h**

Concept of aromaticity, Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non - Benzenoid compounds (cyclopropenylcation, cyclopentadienyl anion and tropyliumcation) Reactions - General mechanism of electrophilic aromatic substitution, mechanism of nitration, Friedel- Craft's alkylation and acylation. Orientation of aromatic substitution - ortho, para and meta directing groups. Ring activating and deactivating groups with examples. Orientation of (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, (ii) Halogens (Explanation by taking minimum of one example from each type)

GENERAL CHEMISTRY **24 h**

UNIT-IV

1. Surface chemistry and chemical bonding

Surface chemistry **6h**

Colloids- Coagulation of colloids- Hardy-Schulze rule. Stability of colloids,Protection of Colloids, Gold number.

Adsorption-Physical and chemical adsorption, Langmuir adsorption isotherm, applications of adsorption.

2. Chemical Bonding **6h**

Valence bond theory, hybridization, VB theory as applied to ClF_3,$Ni(CO)_4$, Molecular orbital theory -LCAO method, construction of M.O. diagrams for homo-nuclear and hetero-nuclear diatomic molecules (N_2, O_2, CO and NO).

HSAB 2h

Pearson's concept, HSAB principle & its importance, bonding in Hard-Hard and Soft-Soft combinations.

UNIT-V

Stereochemistry of carbon compounds **10h**

Molecular representations- Wedge, Fischer, Newman and Saw-Horse formulae.

Optical isomerism: Optical activity- wave nature of light, plane polarised light, optical rotation and specific rotation.

Chiral molecules- definition and criteria(Symmetry elements)- Definition of enantiomers and diastereomers – Explanation of optical isomerism with examples- Glyceraldehyde, Lactic acid, Alanine, Tartaric acid, 2,3-dibromopentane.

D,L, R,S and E,Z- configuration with examples.

Definition of Racemic mixture – Resolution of racemic mixtures (any 3 techniques)

Co-curricular activities and Assessment Methods

ContinuousEvaluation:Monitoringtheprogressof student'slearning

ClassTests,WorksheetsandQuizzes

Presentations,ProjectsandAssignmentsandGroupDiscussions:Enhancescriticalthinkingskillsand personality

Semester-endExamination:criticalindicatorofstudent'slearningandteachingmethodsadoptedby teacherstlroughoutthesemester.

List of Reference Books

Theory:

Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (PearsonEducation).

Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Eliel, E. L. &Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.

Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

Practical:

Ahluwalia, V.K. &Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
Ahluwalia, V.K. &Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).
Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)

Additional Resources:

Solomons, T. W. G.; Fryhle, C. B. &Snyder, S. A. Organic Chemistry, 12th Edition, Wiley.
Bruice, P. Y. Organic Chemistry, Eighth Edition, Pearson.
Clayden, J.; Greeves, N.&Warren, S. Organic Chemistry, Oxford.
Nasipuri, D. Stereochemistry of Organic Compounds: Principles and Applications, Third Edition, NewAge International.
Gunstone, F. D. Guidebook to Stereochemistry, Prentice Hall Press, 1975.

LABORATORY COURSE-II **30**hrs (2 h / w)

Practical-II Volumetric Analysis

(At the end of Semester-II)

Course outcomes:

At the end of the course, the student will be able to;

1. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
2. Understandandexplainthevolumetric analysisbasedonfundamental conceptslearnt in ionic equilibria
3. Learnandidentifythe concepts of a standard solutions, primary and secondary standards
4. Facilitate the learner to make solutions of various molar concentrations. This may include: The concept of the mole; Converting moles to grams; Converting grams to moles; Defining concentration; Dilution of Solutions; Making different molar concentrations.

Volumetric analysis **50 M**

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Determination of Fe (II) using $KMnO_4$ with oxalic acid as primary standard.

3. Determination of Cu (II) using $Na_2S_2O_3$ with $K_2Cr_2O_7$ as primary standard.
4. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$

MODEL PAPER

FIRST YEAR B.Sc., DEGREE EXAMINATION

SEMESTER-II

CHEMISTRY COURSE -II: ORGANIC & GENERAL CHEMISTRY

Time: 3 hours Maximum Marks: 75

PART- A 5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each carries **FIVE** marks

1. Write down Corey House synthesis
2. Explain Isomerism in Alkanes
3. Explain 1,2- & 1,4- addition reactions of conjugated dienes.
4. Explain Saytzeff rule.with Example.
5. Explain the orientation effect of halogens on mono substituted benzene.
6. Explain $-No_2$ group is Meta directing group
7. Explain the structure of ClF3 by Valency Bond theory.
8. What are Hard & soft acids & bases? Explain with examples.
9. Draw the Newmann & saw-Horse representations
10. Define Enantiomers and Diastereomers and give two examples for each.

PART- B 5 X 10 = 50 Marks

Answer any **FIVE** of the following questions. Each carries **TEN** marks

11. Explain Halogenation of alkanes. Explain the reactivity and selectivity in free radical substitutions.
12. (i). Explain Baeyer Strain Theory
    (ii). Draw the conformations of Cyclohexane and explain their stability by drawing energy profile diagram.
13. (i) Write any two methods of preparation of alkenes.
    (ii).Explain the mechanism of Markownikiff and Anti-Markownikoff addition of HBr to alkene.

14. (i) Explain the acidity of 1-alkynes
    (ii) Diels Alder Reaction
15. Define Huckel rule of aromatic compounds. What are benzenoid and nonbenzenoid aromatic compounds? Give examples
16. Explain the mechanisms of Nitration and Friedel-Craft's alkylation of Benzene.
17. (i) Define Hardy-Schulze rule & Gold number.
    (ii) Differentiate Physisorption& Chemisorption. Explain Langmuir adsorption isotherm.
18. .Construct the Molecular Orbital diagram for O2 and NO and explain their bond order and magnetic property.
19. Define Racemic mixture. Explain any two techniques for resolution of Racemic mixture.
20. .(i) Define Optical activity and Specific rotation.
    (ii) Draw the R- & S- isomers of Alanine, Glyceraldehyde.
    (iii) Write the E- & Z- isomers of 2-butene.

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Note: - For Paper Setters Choosing The Two Short Questions And Two Long Questions For Each Unit

SEMESTER - III

Course III (ORGANICCHEMISTRY&SPECTROSCOPY) 60hrs (4 h / w)

Course outcomes:

At the end of the course, the student will be able to;

1. Understandpreparation,propertiesandreactionsofhaloalkanes,haloarenesand oxygencontaining functionalgroups.
2. Usethesyntheticchemistrylearntinthiscoursetodofunctionalgroup transformations.
3. Toproposeplausiblemechanismsforanyrelevantreaction

ORGANIC CHEMISTRY **34h**

UNIT – I

1. Chemistry of Halogenated Hydrocarbons: **6h**

Alkylhalides:Methodsofpreparationandproperties,nucleophilicsubstitutionreactions– SN1,SN2 andSN imechanisms with stereochemical aspects and effect of solvent etc.; nucleophilics ubstitutionvs.elimination, Williamson's synthesis. Arylhalides: Preparation (includingpreparationfromdiazoniumsalts)andproperties,nucleophilic aromatic substitution SN Ar, Benzyne mechanism.

2. Alcohols &Phenols **6h**

Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Oxidation of diols by periodic acid and lead tetra acetate,Pinacol- Pinacolonerearrangement; Phenols:Preparationandproperties;Acidityandfactorseffectingit, Ringsubstitution reactions, Reimer–Tiemannand Kolbe's–Schmidt Reactions, Fries and Claisenrearrangements with mechanism;

UNIT-II

Carbonyl Compounds **10h**

Structure,reactivity,preparationandproperties; Nucleophilicadditions,Nucleophilicaddition-eliminationreactionswithammoniaderivatives MechanismsofAldolandBenzoincondensation,Claisan-Schmidt,Perkin, Cannizzaro and Wittigreaction,BeckmannhaloformreactionandBaeyerVilligeroxidation,α-substitution reactions,oxidationsandreductions(Clemmensen, wolf –kishner, with LiAlH4 &NaBH4). Additionreactionsof α,β-unsaturatedcarbonylcompounds:Michaeladdition. Active methylene compounds:Keto- enoltautomerism.Preparationandsyntheticapplicationsofdiethyl malonateandethylacetoacetate.

UNIT-III

CarboxylicAcidsand their Derivatives **12h**

General methods of preparation, physical properties and reactions of monocarboxylic acids, effect of substituentsonacidicstrength.Typicalreactionsofdicarboxylicacids,hydroxyacidsandunsaturatedacids.

Preparationandreactionsofacidchlorides,anhydrides,estersandamides; Comparativestudyofnucleophilicsubstitutionatacylgroup-Mechanism ofacidicandalkalinehydrolysisof esters,Claisencondensation,Reformatskyreactions and Curtiusrearrangement

Reactions involving H, OH and COOH groups- salt formation, anhydride formation, acid chloride formation, amide formation and esterification (mechanism). Degradation of carboxylic acids by Huns-Diecker reaction, decarboxylation by Schimdt reaction, Arndt-Eistert synthesis, halogenation by Hell- Volhard- Zelinsky reaction.

SPECTROSCOPY **26 h**

UNIT-IV

Molecular Spectroscopy: **18h**

Interactionofelectromagneticradiationwithmoleculesandvarioustypesofspectra;

Rotation &Vibrational Spectroscopy: Selection rules, Nodes of vibration. Selection rules for vibrational transitions, Fundamental frequencies.

Electronic spectroscopy: Energy levels of molecular orbital's (σ, π, n). Selection rules for electronic spectra. Types of electronic transitions in molecules, effect of conjugation. Concept of chromophore. bathochromic and hypsochromic shifts.Beer-Lambert's law and its limitations.

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals - spin-spin coupling, coupling constants. Applications of NMR with suitable examples - ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone.

UNIT-V **8h**

Application of Spectroscopy to Simple Organic Molecules

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules.

Application of electronic spectroscopy and Woodward rules for calculating λ_{max} of conjugated dienes and α,β – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

Co-curricular activities and Assessment Methods

ContinuousEvaluation:Monitoringtheprogressof student'slearning

ClassTests,WorksheetsandQuizzes

Presentations,ProjectsandAssignmentsandGroupDiscussions:Enhancescriticalthinkingskillsand personality

Semester-endExamination:criticalindicatorofstudent'slearningandteachingmethodsadoptedby teachersthroughoutthesemester.

List of Reference Books

1. A Text Book of Organic Chemistry by Bahl and Arunbahl
2. A Text Book of Organic chemistry by I L FinarVol I
3. Organic chemistry by Bruice
4. Organic chemistry by Clayden
5. Spectroscopy by William Kemp
6. Spectroscopy by Pavia
7. Organic Spectroscopy by J. R. Dyer
8. Elementary organic spectroscopy by Y.R. Sharma
9. Spectroscopy by P.S.Kalsi
10. Spectrometric Identification of Organic Compounds by Robert M Silverstein, Francis X Webster
11. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
12. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. &Tatchell, A.R. Practical Organic Chemistry, 5th Ed. Pearson (2012)

13. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

LABORATORY COURSE -III **30hrs (2 h / w)**

Practical Course-IIIOrganic preparations and IR Spectral Analysis

(At the end of Semester- III)

Course outcomes:

Onthecompletionofthecourse,thestudentwillbe abletodothefollowing:

1. how to use glassware, equipment and chemicals and follow experimental procedures in the laboratory
2. how to calculate limiting reagent, theoretical yield, and percent yield
3. how to engage in safe laboratory practices by handling laboratory glassware, equipment, and chemical reagents appropriately
4. how to dispose of chemicals in a safe and responsible manner
5. how to perform common laboratory techniques including reflux, distillation, recrystallization, vacuum filtration.
6. how to create and carry out work up and separation procedures
7. how to critically evaluate data collected to determine the identity, purity, and percent yield of products and to summarize findings in writing in a clear and concise manner

Organic preparations: **40M**

i. Acetylation of one of the following compounds:

amines (aniline, o-, m-, ptoluidines and o-, m-, p-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method:

a. Using conventional method.

b. Using green approach

ii. Benzolyation of one of the following amines

(aniline, o-, m-, p- toluidines and o-, m-, p-anisidine)

iii. Nitration of any one of the following:

a. Acetanilide/nitrobenzene by conventional method

b. Salicylic acid by green approach (using ceric ammonium nitrate).

IR Spectral Analysis **10M**

IR Spectral Analysis of the following functional groups with examples

a) Hydroxyl groups

b) Carbonyl groups

c) Amino groups

d) Aromatic groups

MODEL PAPER

SECOND YEAR B.Sc., DEGREE EXAMINATION

SEMESTER-III

CHEMISTRY COURSE-III: ORGANIC CHEMISTRY & SPECTROSCOPY

Time: 3 hours Maximum Marks: 75

PART- A 5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each carries **FIVE** marks

1. Discuss two methods for preparation of aryl halides.
2. Explain the mechanism for Pinacol-Pinacolone rearrangement.
3. Discuss the mechanism for Bayer-villiger oxidation reaction.
4. Write the Mechanism of Aldol condensation
5. Explain the effect of substituents on acidic strength of mono-carboxylic acids.
6. Write the mechanism for Claisen Condensation reaction.
7. Write the selection rules in rotational spectroscopy
8. Types of molecules in IR spectra
9. Explains Spin – Spin coupling and Coupling Constant.
10. Write down the range of IR spectra

PART- B 5 X 10 = 50 Marks

Answer any **FIVE** of the following questions. Each carries **TEN** marks

11. Give the mechanism & stereochemistry of SN^1 & SN^2 reactions of alkyl halides with suitable example.

12. Explain the following reactions with mechanism.
13. (i) Reimer-Tiemann reaction Write the selection rules in rotational spectroscopy
    (ii) Fries rearrangement.
14. Discuss the mechanism for following reactions.
    (i) Perkin reaction.
    (ii) Cannizaro reaction

15. Write the preparation and any three synthetic applications of diethyl malonate.
16. Explain acid and base hydrolysis reaction of esters with mechanism.
17. Explain the mechanisms of Curtius rearrangement & Arndt –Eistert reaction.
18. Explain different modes of vibrations & selection rules in IR spectroscopy.
19. (i) Define Bathochromic shift. Explain the effect of conjugation in U.V. spectroscopy.

    (ii) Discuss the principle of NMR spectroscopy.
20. Write Woodward-Fieser rules for calculating λmax for conjugated dienes and α,β – unsaturated carbonyl compounds , and apply them for one example each.

Note: - For Paper Setters Choosing The Two Short Questions And Two Long Questions For Each Unit

SEMESTER - IV

Course IV (INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY) 60hrs (4 h / w)

Course outcomes:

At the end of the course, the student will be able to;

1. Tolearnaboutthelawsofabsorptionoflightenergybymoleculesandthesubsequentphotochemical reactions.
2. Tounderstandtheconceptofquantumefficiencyandmechanismsofphotochemicalreactions.

UNIT - I

Organometallic Compounds **8h**

Definition andclassification of organometallic compounds on the basis of bond type,Concept of hapticity of organicligands.Metalcarbonyls:18 electron rule,electron count of mononuclear, polynuclear and substituted metalcarbonyl so f3dseries.General methods of preparationof mono and binuclearcarbonyls of 3d series.P-acceptor behaviour of carbon monoxide.

UNIT – II

Carbohydrates **8h**

Occurrence,classification and their biologicalimportance,Monosaccharides: Constitution and absoluteconfigurationofglucoseandfructose,epimersandanomers,mutarotation,determinationo fringsize of glucose and fructose ,Haworth projections and conformational structures ; Inter conversions of aldoses and ketoses;Killiani-FischersynthesisandRuffdegradation;

UNIT- III

Amino acids and proteins **6h**

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids - definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples.

Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples - Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Gabriel Phthalimide synthesis c) strecker's synthesis.

Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating- peptide bond (amide linkage). Nomenclature of peptides and proteins synthesis.

Heterocyclic Compounds **7h**

Introduction and definition: Simple five membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole - Aromatic character – Preparation from 1, 4, -dicarbonyl compounds, Paul-Knorr synthesis.

Properties: Acidic character of pyrrole - electrophillic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions - Diels Alder reaction in furan.

UNIT- IV

Nitrogen Containing Functional Groups

Preparation, propertiesandimportantreactionsof nitrocompounds,aminesanddiazoniumsalts.

1. Nitro hydrocarbons **3h**

Nomenclature and classification-nitro hydrocarbons, structure -Tautomerism of nitroalkanes leading to aci and keto form, Preparation of Nitroalkanes, reactivity -halogenation, reaction with HONO (Nitrous acid), Nef reaction and Mannich reaction leading to Micheal addition and reduction.

2.Amines: **11h**

Introduction,classification,chiralityinamines(pyramidal inversion),importance and general methods of preparation.

Properties: Physical properties, Basicity of amines: Effect of substituent, solvent and steric effects.DistinctionbetweenPrimary, Secondary and tertiaryaminesusing Hinsberg'smethod And nitrousacid.Discussionof the followingreactionswithemphasisonthemechanistic pathway:Gabriel Phthalimidesynthesis,Hoffmann- Bromamidereaction, Carbylaminereaction, Mannichreaction,

3. Diazonium Salts: Preparation and synthetic applications of diazonium salts including preparation of arenes,haloarenes, phenols,cyanoand nitrocompounds. Coupling reactions of diazoniumsalts (preparation of azo dyes).

UNIT- V

Photochemistry **5h**

Difference between thermal and photochemical processes, Laws of photochemistry- Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield-Photochemical reaction mechanism- hydrogen- chlorine and hydrogen- bromine reaction. Qualitative description of fluorescence, phosphorescence, Jablonski diagram,

Thermodynamics **12 h**

The first law of thermodynamics-statement, definition of internal energy and enthalpy, Heat capacities and their relationship, Joule-Thomson effect- coefficient, Calculation of work for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes, State function. Temperature dependence of enthalpy of formation- Kirchoff s equation, Second law of thermodynamics Different Statements of the law, Carnot cycle and its efficiency, Carnot theorem, Concept of entropy, entropy as a state function, entropy changes in reversible and irreversible processes. Entropy changes in spontaneous and equilibrium processes.

Co-curricular activities and Assessment Methods

ContinuousEvaluation:Monitoringtheprogressof student'slearning

ClassTests,WorksheetsandQuizzes

Presentations,ProjectsandAssignmentsandGroupDiscussions:Enhancescriticalthinkingskillsand personality

Semester-endExamination:criticalindicatorofstudent'slearningandteachingmethodsadoptedby teachersthroughoutthesemester.

List of Reference Books

1. Concise coordination chemistry by Gopalan and Ramalingam
2. Coordination Chemistry by Basalo and Johnson
3. Organic Chemistry by G.Mareloudan, Purdue Univ
4. Text book of physical chemistry by S Glasstone
6. Concise Inorganic Chemistry by J.D.Lee
7. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
8. A Text Book of Organic Chemistry by Bahl and Arunbahl
9. A Text Book of Organic chemistry by I L FinarVol I
10. A Text Book of Organic chemistry by I L FinarVol II
11. Advanced physical chemistry by Gurudeep Raj

LABORATORY COURSE -IV 30hrs(2 h / w)

Practical Course-IVOrganic Qualitative analysis **50 M**

(At the end of Semester- IV)

Course outcomes:

At the end of the course, the student will be able to;

1. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
2. Determine melting and boiling points of organic compounds
3. Understand the application of concepts of different organic reactions studied in theory part of organic chemistry

Organic Qualitative analysis **50 M**

Analysis of an organic compound through systematic qualitative procedure for functional group identification including the determination of melting point and boiling point with suitable derivatives.

Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic primary amines, amides and simple sugars

MODEL PAPER

SECOND YEAR B.Sc., DEGREE EXAMINATION

SEMESTER-IV

CHEMISTRY COURSE -IV: INORGANIC, ORGANIC & PHYSICAL CHEMISTRY

Time: 3 hours Maximum Marks: 75

PART- A 5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each carries **FIVE** marks

1. Describe the 18 electron rule of mono nuclear and polynuclear metal carbonyls with suitable examples.
2. Write the down the concept of Hapticity of organic ligands.
3. What are epimers and anomers. Give examples.
4. Write down the conversion of keto Hexose to Aldo Hexose
5. Discuss about iso electric point and zwitter ion.
6. Discuss the Paul-Knorr synthesis of five membered heterocyclic compounds.
7. Explain Tautomerism shown by nitro alkanes
8. Discuss the basic nature of amines.
9. Write the differences between thermal and photochemical reactions.
10. Derive heat capacities and derive Cp – Cv = R

PART- B 5 X 10 = 50 Marks

Answer any **FIVE** of the following questions. Each carries **TEN** marks

11. What are organometallic compounds? Discuss their Classification on the basis of type of bonds with examples.

12. Discuss the general methods of preparations of mono & bi-nuclear carbonyls of 3d series.

13. Discuss the constitution, configuration and ring size of glucose. Draw the Haworth and Conformational structure of glucose.

14. (i) Explain Ruff's degradation.

    (ii) Explain Kiliani- Fischer synthesis.

15. What are amino acids? Write any three general methods of preparation of amino acids.

16. Discuss the aromatic character of Furan, Thiophene and Pyrrole.

17. . Write the mechanism for the following.

    (i) Nef reaction

    (ii) (ii) Mannich reaction

18. (i) Explain Hinsberg separation of amines.

    (ii) Discuss any three synthetic applications of diazonium salts.

19. What is quantum yield? Explain the photochemical combination of HydrogenChlorine and Hydrogen - Bromine.

20. Define entropy. Describe entropy changes in the reversible and irreversible process.

Note: - For Paper Setters Choosing The Two Short Questions And Two Long Questions For Each Unit

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SEMESTER - IV

CourseV(INORGANIC &PHYSICAL CHEMISTRY) 60 hrs (4 h / w)

Course outcomes:

At the end of the course, the student will be able to;

1. Understand concepts ofboundaryconditionsandquantization,probabilitydistribution,mostprobablevalues, uncertainty andexpectationvalues
2. Applicationofquantizationtospectroscopy.
3. Varioustypesofspectraandtheiruseinstructuredetermination.

INORGANIC CHEMISTRY **26 h**

UNIT –I

Coordination Chemistry **12 h**

IUPAC nomenclature of coordination compounds, Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Valence Bond Theory (VBT): Inner and outer orbital complexes. Limitations of VBT, Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Factors affecting the magnitude of crystal field splitting energy, Spectrochemical series, distortion of,Jahn-Teller distortion,.

UNIT –II

1. Inorganic Reaction Mechanism: **4h**

Introductiontoinorganicreactionmechanisms.Conceptofreaction pathways,transitionstate,intermediateand activatedcomplex. Labile and inert complexes, ligand substitution reactions - SN^1 and SN^2, Substitution reactions in squareplanar complexes,Trans-effect, and its applications

2. Stability of metal complexes: **2h**

Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method and mole ratio method.

BioinorganicChemistry: **8h**

Metalionspresent inbiological systems,classificationofelements according totheiractioninbiolog icalsystem. Geo chemical effect on the distribution of Metals like Sodium/Potassium and Excess and deficiency of these metals.

Toxicityofmetalions (Hg,Pb,CdandAs), reasonsfortoxicity,Useof chelatingagentsinmedicine,Cisplatinasananti-cancerdrug. Ironanditsapplicationinbio-systems, and structure of Hemoglobin,

PHYSICAL CHEMISTRY **34 h**

UNIT-III

1 .Phase rule

Concept of phase, components, degrees of freedom. Thermodynamic derivation of Gibbs phase rule. Phase diagram of one component system - water system, Study of Phase diagrams of Simple eutectic systems i) Pb-Ag system, desilverisation of lead ii) NaCl-Water system, Congruent and incongruent melting point- Definition and examples for systems having congruent and incongruent melting point , freezing mixtures.

UNIT-IV

Electrochemistry **14h**

Specific conductance, equivalent conductance and molar conductance- Definition and effect of dilution. Cell constant. Strong and weak electrolytes,Kohlrausch's law and its applications, Definition of transport number,determination of transport number by Hittorf's method. Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only), Application of conductivity measurements- conductometric titrations.

Electrochemical Cells- Single electrode potential, Types of electrodes with examples: Metal-Metal ion, Gas electrode, Inert electrode, Redox electrode, Determination of EMF of a cell, Nernst equation, Fuel cells- Basic concepts, examples and applications

UNIT-V

Chemical Kinetics: **14 h**

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction, Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Enzyme catalysis- Specificity,

factors affecting enzyme catalysis, Michaels- Menten equation- derivation.

Co-curricular activities and Assessment Methods

ContinuousEvaluation:Monitoringtheprogressof student'slearning

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3. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
4. Advanced physical chemistry by Gurudeep Raj
5. Principles of physical chemistry by Prutton and Marron
6. Advanced physical chemistry by Bahl and Tuli
7. Inorganic Chemistry by J.E.Huheey
8. Basic Inorganic Chemistry by Cotton and Wilkinson
9. A textbook of qualitative inorganic analysis by A.I. Vogel
10. Atkins,P.W.&Paula,J.deAtkin'sPhysicalChemistryEd.,OxfordUniversityPress 10thEd(2014).
11. Castellan,G.W.PhysicalChemistry4thEd.Narosa(2004).
12. Mortimer,R. G.PhysicalChemistry3rdEd. Elsevier:NOIDA,UP(2009).
13. Barrow,G.M.PhysicalChemistry

SEMESTER - IV

CourseV **LABORATORY COURSE** **30**hrs (2 h / w)

Practical-Course –V Conductometric and Potentiometric Titrimetry **50 M**

Course outcomes:

At the end of the course, the student will be able to;

1. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
2. Apply conceptsof electrochemistry in experiments
3. Be familiar with electroanalytical methods and techniques in analytical chemistry which study an analyte by measuring the potential (volts) and/or current (amperes) in an electrochemical cell containing the analyte

Conductometric and Potentiometric Titrimetry **50 M**

1. **Conductometric titration-** Determination of concentration of HCl solution using standard NaOH solution.
2. **Conductometric titration-** Determination of concentration of CH_3COOH Solution using standard NaOH solution.
3. **Conductometric titration-** Determination of concentration of CH_3COOH and HCl in a mixture using standard NaOH solution.
4. **Potentiometric titration-** Determination of Fe (II) using standard $K_2Cr_2O_7$ solution.
5. Determination of rate constant for acid catalyzed ester hydrolysis.

MODEL PAPER

SECOND YEAR B.Sc., DEGREE EXAMINATION

SEMESTER-IV

CHEMISTRY COURSE V: INORGANIC & PHYSICAL CHEMISTRY

Time: 3 hours Maximum Marks: 75

PART- A 5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each carries **FIVE** marks

1. Write note on Jahn-Teller distortion.
2. Write IUPAC Nomenclature of Co-ordinate compounds
3. Explain Labile & inert complexes.
4. Explain Job's method for determination of composition of complex.
5. Explain Thermodynamic derivation of Gibb's phase rule.
6. Explain the concept phase with example
7. Explain any two conduct metric titrations.
8. Write note on Fuel Cells with examples and applications.
9. What is enzyme catalysis? Write any three factors effecting enzyme catalysis.

10. Derive Michaels- Menten equation

PART- B 5 X 10 = 50Marks

Answer any **FIVE** of the following questions. Each carries **TEN** marks

11. Explain Valence Bond theory with Inner and Outer orbital complexes. Write limitations of VBT.

12. Define CFSE. Explain the factors effecting the magnitude of crystal field splitting energy.

13. Explain Tran's effect. Write any Three applications of Tran's effect

14. (i) Write the biological functions and structure of Haemoglobin
(ii) Write note on use of chelating agents in medicines.

15. Define Phase rule and terms involved in it. Explain phase diagram of Pb-Ag system.

16. (i) Explain phase diagram for NaCl-water system.
(ii) Explain briefly about Freezing mixtures.

17. Define Transport number. Write experimental method for the determination of transport number by Hittorf method.

18. (i) Define single electrode potential.

(ii)Explain four types of electrodes with examples.

19. Explain general methods for determination of order of a reaction.

20. Explain Collision theory and Activated complex theory of bimolecular reactions.

Note: - For Paper Setters Choosing The Two Short Questions And Two Long Questions For Each Unit

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Recommended Question Paper Patterns and Models

BLUE PRINT FOR QUESTION PAPER PATTERN

Unit	S.A.Q (including choice)	E.Q (including choice)	Total Marks
I	2	2	30
II	2	2	30
III	2	2	30
IV	2	2	30
V	2	2	30
Total	**10**	**10**	**150**

S.A.Q = Short answer questions (5 Marks)
E.Q = Essay questions (10 Marks)

Short answer questions : 5 X 5 = 25 Marks
Essay questions : 5 X 10 = 50 Marks

Total Marks = 75 Marks

Note: - For Paper Setters Choosing The Two Short Questions And Two Long Questions For Each Unit