ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

(A Statutory body of the Government of Andhra Pradesh)

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REVISED SYLLABUS OF B.Sc (Chemistry)

UNDER CBCS FRAMEWORK WITH EFFECT FROM 2020-2021

PROGRAMME: THREE-YEAR B.Sc. (B.Sc Chemistry)

(With Learning Outcomes, Unit-wise Syllabus, References, Co-curricular Activities & Model Q.P.)

For Fifteen Courses of 1, 2, 3 & 4 Semesters)

(To be Implemented from 2020-21 Academic Year)
Andhra Pradesh State Council of Higher Education

B.Sc. Chemistry Revised Syllabus under CBCS

w.e.f. 2020-21

Structure of Chemistry Core Syllabus under CBCS

YEAR	SEMESTER	COURSE	TITLE	MARKS	CREDITS
I	I	I	Inorganic and Physical Chemistry	100	03
			Practical – I Analysis of SALT MIXTURE	50	02
	II	II	Organic and General Chemistry	100	03
			Practical – IIVolumetric Analysis	50	02
II	III	III	Organic Chemistry and Spectroscopy	100	03
			Practical – IIIOrganic preparations and IR Spectral Analysis	50	02
	IV	IV	Inorganic, Organic and Physical Chemistry	100	03
			Practical – IVOrganic Qualitative analysis	50	02
		V	Inorganic and Physical Chemistry	100	02
			Practical-V Course Conductometric and Potentiometric Titrimetry	50	02

SEMESTER – I

Course I (Inorganic&PhysicalChemistry) 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 inter molecular interactions.
3. Apply the concepts of gas equations, pH and electrolytes while studying other chemistry courses.

INORGANICCHEMISTRY 24 h

UNIT–I

Chemistry ofp-blockelements 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 ofd-blockelements: 6h

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

2. Chemistry off-blockelements: 6h

Chemistry of lanthanides - electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties. Extraction of lanthanides by solvent extractionChemistry of actinides - electronic configuration, oxidation states, actinide contraction, comparison of lanthanides and actinides.

3. Theories of bonding in metals: 4h

Valence bond theory and Free electron theory, explanation of thermal and electrical conductivity of metals based on these theories, Band theory- formation of valance and conduction band, band gap, explanation of conductors, semiconductors and insulators.

PHYSICALCHEMISTRY **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. Gaseousstate **6h**

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

2.Liquidstate **4h**

Liquid crystals, mesomorphic state. 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), Effect of impurity on consulate temperature. Immiscible liquids and steam distillation.Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law.

2. Ionicequilibrium **3h**

Ionic product, common ion effect, solubility and solubility product. Calculations based on solubility product.

3. Dilutesolutions **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:Monitoringtheprogressofstudent'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 andMarron
2. Solid State Chemistry and its applications by Anthony R.West
3. Text book of physical chemistry by K LKapoor
4. Text book of physical chemistry by SGlasstone
5. Advanced physical chemistry by Bahl andTuli
6. Inorganic Chemistry byJ.E.Huheey
7. Basic Inorganic Chemistry by Cotton andWilkinson
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

LABORATORYCOURSE-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 inorganicmixture
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 qualitativeanalysis

Analysis ofSALTMIXTURE **50M**

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 Phosphonitriliccompounds.
2. Explain in brief, catalytic properties & stability of various oxidation states of d-blockelements.
3. Write short note on Bravais lattices and crystalsystems.
4. What are Smectic&Nematic liquid Crystals?Explain.
5. Write an account on Common ion effect & Solubilityproduct.
6. Describe Andrew's isotherms of carbondioxide.
7. Explain Actinidecontraction.
8. Explain the structure ofBorazine.

PART- B 5 X 10 = 50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

9(a). Explain Classification, Preparations & uses ofSilicones

(or)

(b). (i) What are Pseudohalogens.
(ii) Explain the Structures of any one AX_3& AX_5interhalogen compounds.

10 (a). What is Lanthanide Contraction? Explain the Consequences of Lanthanide Contraction.

(or)

(b). (i) Explain the magnetic properties of d- block elements.
(ii) Explain about Conductors, Semi-Conductors& Insulators using Band Theory.

11.(a). Write an essay on Crystal defects.

(or)

(b). What is Bragg's Law. Explain the determination of structure of a crystal by powdermethod.

12.(a). Derive the relationship between Critical constants &Vanderwaalconstants.

(or)

(b).(i) Write any 5 differences between liquid crystals & liquids, solids
(ii) Write the applications of Liquidcrystals.

13.(a). Explain Nernst distribution Law. Explain its applications

(or)

(b).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.

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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. Understandandexplainthedifferentialbehavioroforganic compoundsbasedonfundamentalconceptslearnt.
2. Formulatethemechanismoforganicreactionsby recallingandcorrelatingthefundamentalpropertiesofthereactantsinvolved.
3. LearnandidentifymanyorganicreactionmechanismsincludingFreeRadical Substitution, ElectrophilicAdditionandElectrophilicAromaticSubstitution.
4. Correlateanddescribethe stereochemicalpropertiesoforganiccompoundsand reactions.

ORGANICCHEMISTRY **36h**

UNIT-I

BasicsofOrganicChemistry

Carbon-Carbon sigma bonds (AlkanesandCycloalkanes) **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 radicalsubstitutions; Halogenation, concept of relative reactivity v/s selectivity. Conformational analysis of alkanes (Conformations, relative stability and energy diagrams of Ethane, Propane and butane).General molecular formulae of cycloalkanes and relative stability, Baeyer strain theory, Cyclohexane conformations with energy diagram, Conformations of monosubstitutedcyclohexane.

UNIT-II

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

General methods of preparation, physical and chemical properties. Mechanism of E1,E2,E1cB reactions, Saytzeff and Hoffmann eliminations, Electrophilic addition mechanism(Markownikoff/Antimarkownikofadditionwith suitable examples, *syn*and*anti*-addition;addition ofH_2,X_2 ,HX, oxymercuration demercuration, hydroboration-oxidation,ozonolysis,hydroxylation, Diels Alderreaction,1,2- and1,4-additionreactions in conjugateddienes.

Reactionsofalkynes; acidity, electrophilic andnucleophilic additions, hydration toformcarbonyl compounds, Alkylation of terminalalkynes.

UNIT-III

Benzene anditsreactivity **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 (Electronic interpretation of various groups like NO_2 and Phenolic). Orientation of (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, nitrile, carbonyl and sulphonic acidgroups (iii) Halogens

(Explanation by taking minimum of one example from each type)

GENERALCHEMISTRY **24 h**

UNIT-IV

1. Surface chemistry and chemicalbonding

Surfacechemistry **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 ofadsorption.

2. ChemicalBonding **6h**

Valence bond theory, hybridization, VB theory as applied toClF_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).

3. HSAB **2h**

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

UNIT-V

Stereochemistry ofcarboncompounds **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's learning

ClassTests,WorksheetsandQuizzes

Presentations,ProjectsandAssignmentsandGroupDiscussions:Enhancescriticalthinkingskillsand personality

Semester-endExamination: criticalindicatorofstudent's learningandteachingmethodsadoptedby teachersthroughoutthesemester.

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 OrganicChemistry, 5th Ed., Pearson (2012)

AdditionalResources:

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, ThirdEdition,NewAge International.
Gunstone, F. D. Guidebook to Stereochemistry, Prentice Hall Press, 1975.

LABORATORYCOURSE-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 analysisbased on fundamental conceptslearnt in ionicequilibria.
3. Learnandidentifytheconceptsofastandardsolutions,primaryandsecondarystandards
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.

Volumetricanalysis **50 M**

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in amixture.
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 primarystandard.
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 = 25Marks

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

1. Write different conformations of n-butane. Explain their relativestability..
2. Explain 1,2- & 1,4- addition reactions of conjugateddienes.
3. Explain the orientation effect of halogens on mono substitutedbenzene.
4. Explain the mechanism of $E1^{CB}$ eliminationreaction.
5. Explain the structure of ClF_3 by Valency Bondtheory.
6. What are Hard & soft acids & bases? Explain withexamples.
7. Draw the Wedge, Fischer, Newmann& saw-Horse representations for Tartaric acid.
8. Define Enantiomers and Diastereomers and give two examples foreach.

PART-B 5 X 10 = 50Marks

Answer **ALL** the questions. Each carries **TEN** marks

9 (a). (i) Write the preparation of alkanes by Wurtz and Corey-Housereaction.
(ii) Explain Halogenation of alkanes. Explain the reactivity and selectivity in free radical substitutions.

(or)

(b). (i) Explain Baeyer Strain Theory
(ii) Draw the conformations of Cyclohexane and explain their stability by drawing energy profile diagram.

10 (a). (i) Write any two methods of preparation ofalkenes.
(ii) Explain the mechanism of Markownikiff and Anti-Markownikoff addition of HBr to alkene.

(or)

(b). (i) Explain the acidity of 1-alkynes
(ii) How will you prepare acetaldehyde and acetone fromalkynes?
(iii) Write alkylation reaction of terminalalkne.

11.(a). Define Huckel rule of aromatic compounds. What are benzenoid and non-benzenoid aromatic compounds? Give examples.

(or)

(b). Explain the mechanisms of Nitration and Friedel-Craft's alkylation of Benzene.

12.(a). (i) Define Hardy-Schulze rule & Gold number.
(ii) Differentiate Physisorption& Chemisorption. Explain Langmuir adsorption isotherm.

(or)

(b). Construct the Molecular Orbital diagram for O_2 and NO and explain their bond order and magnetic property.

13.(a). Define racemic mixture. Explain any two techniques for resolution of racemic mixture.

(or)

(b).(i) Define Optical activity and Specific rotation.
(ii) Draw the R- & S- isomers of Alanine,Glyceraldehyde.
(iii) Write the E- & Z- isomers of2-butene.

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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 oxygencontainingfunctionalgroups.
2. Usethesyntheticchemistrylearnt inthiscoursetodofunctionalgroup transformations.
3. Toproposeplausiblemechanismsforanyrelevantreaction

ORGANICCHEMISTRY 34h

UNIT – I

1. ChemistryofHalogenatedHydrocarbons: 6h

Alkylhalides:Methodsofpreparationandproperties,nucleophilicsubstitutionreactions– SN1,SN2andSNimechanismswithstereochemicalaspectsandeffectofsolvent etc.; nucleophilicsubstitutionvs.elimination, Williamson's synthesis.

Arylhalides:Preparation(includingpreparationfromdiazoniumsalts)andproperties,nucleophilic aromatic substitution;SNAr,Benzynemechanism.

Relativereactivityofalkyl,allyl,benzyl,vinylandarylhalidestowardsnucleophilicsubstitutionrea ctions.

2. Alcohols&Phenols 6h

Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt Blanc Reduction; Oxidationofdiolsbyperiodicacidandleadtetra acetate,Pinacol- Pinacolone rearrangement.

Phenols:Preparationandproperties;Acidityandfactorseffectingit, Ringsubstitution reactions, Reimer–Tiemannand Kolbe's–Schmidt Reactions, Fries and Claisenrearrangements with mechanism.

UNIT-II

CarbonylCompounds 10h

Structure,reactivity,preparationandproperties;

Nucleophilicadditions,Nucleophilicaddition-eliminationreactionswithammoniaderivatives

MechanismsofAldolandBenzoincondensation,Claisan-Schmidt,Perkin,

CannizzaroandWittigreaction,Beckmannhaloformreactionand BaeyerVilligeroxidation,α-

substitutionreactions,oxidationsandreductions(Clemmensen, wolf –kishner, with LiAlH4 &NaBH4).

Additionreactionsof α,β-unsaturatedcarbonylcompounds:Michaeladdition.

Activemethylenecompounds:Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonateandethylacetoacetate.

UNIT-III

CarboxylicAcidsandtheirDerivatives **12**

General methods of preparation, physical properties and reactions of monocarboxylic acids,effectofSubstituentsonacidicstrength.Typicalreactionsofdicarboxylicacids,hydroxyacidsandunsaturatedacids.Preparationandreactionsofacidchlorides,anhydrides,estersandamides;Comparative studyofnucleophilicsubstitutionatacylgroup-Mechanism ofacidicandalkalinehydrolysisofesters,Claisencondensation,Reformatskyreactionsand 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

MolecularSpectroscopy: **18h**

Interactionofelectromagneticradiationwithmoleculesandvarioustypesof spectra.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrationalspectroscopy: Classicalequationofvibration, computationofforceconstant, Harmonic and anharmonic oscillator, Morsepotentialcurve,vibrational degreesoffreedom forpolyatomic molecules, modesofvibration. Selection rules for vibrational transitions, Fundamentalfrequencies, overtones and hotbands.

Electronic spectroscopy: Energy levels of molecular orbitals (σ, π, n). Selection rules for electronic spectra. Types of electronic transitions in molecules, effect of conjugation. Concept of chromophore, auxochrome. bathochromic and hypsochromic, hyperchromic and hypochromic 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 – unsaturatedcompounds.

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 substitutionon >C=O stretching absorptions).

Co-curricular activities and Assessment Methods Continuous Evaluation: Monitoring student's learning ClassTests,WorksheetsandQuizzes, Presentations,ProjectsandAssignmentsandGroupDiscussions:Enhancescritical thinking skills and personality

Semester-endExamination:criticalindicatorof student's learning andteachingmethodsadoptedby teachersthroughoutthesemester.

List of Reference Books

1. A Textbook of Organic Chemistry by Bahl andArunbahl
2. A Text Book of Organic chemistry by I L FinarVolI
3. Organic chemistry byBruice
4. Organic chemistry byClayden
5. Spectroscopy by WilliamKemp
6. Spectroscopy byPavia
7. Organic Spectroscopy by J. R.Dyer
8. Elementary organic spectroscopy by Y.R.Sharma
9. Spectroscopy byP.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 OrganicChemistry: Preparation and Quantitative Analysis, University Press(2000).

LABORATORYCOURSE-III 30hrs (2 h /w)

Practical Course-IIIOrganicpreparations 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 experimentalprocedures in thelaboratory
2. how to calculate limiting reagent, theoretical yield, and percentyield
3. how to engage in safe laboratory practices by handling laboratory glassware, equipment, and chemical reagentsappropriately
4. how to dispose of chemicals in a safe and responsiblemanner
5. how to perform common laboratory techniques including reflux, distillation, recrystallization, vacuumfiltration.
6. how to create and carry out work up and separationprocedures
7. how to critically evaluate data collected to determine the identity, purity, andpercent yield of products and to summarize findings in writing in a clear and concisemanner.

Organicpreparations: 40M

i. Acetylation of one of the followingcompounds:

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

a. Using conventionalmethod.

b. Using greenapproach

ii. Benzolyation of one of the followingamines

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

iii. Nitration of any one of thefollowing:

a. Acetanilide/nitrobenzene by conventionalmethod

b. Salicylic acid by green approach (using ceric ammoniumnitrate).

IRSpectralAnalysis 10M

IR Spectral Analysis of the following functional groups with examples

a) Hydroxylgroups

b) Carbonylgroups

c) Aminogroups

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 = 25Marks

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

1. Discuss two methods for preparation of arylhalides.
2. Explain the mechanism for Pinacol-Pinacolonerearrangement.
3. Discuss the mechanism for Bayer-villiger oxidationreaction.
4. Explain the effect of substituents on acidic strength of mono-carboxylicacids.
5. Write the mechanism for Claisen Condensationreaction.
6. Write the selection rules in rotationalspectroscopy.
7. Explain Spin – Spin coupling and CouplingConstant.
8. Explain types of electronic transitions in UVspectroscopy.

PART-B 5 X 10 = 50Marks

Answer **ALL** the questions. Each carries **TEN** marks

9 (a). Give the mechanism & stereochemistry of SN^1& SN^2 reactions of alkyl halides with suitableexample.

(or)

(b). Explain the following reactions withmechanism.
(i) Reimer-Tiemann reaction (ii) Friesrearrangement.

10 (a). Discuss the mechanism for followingreactions.
(i) Perkinreaction. (ii) Cannizaroreaction

(or)

(b). Write the preparation and any three synthetic applications of diethyl malonate.

11.(a). Explain acid and base hydrolysis reaction of esters with mechanism.

(or)

(b). Explain the mechanisms of Curtius rearrangement & Arndt –Eistert reaction.

12.(a). (i) Write a note on vibrational degrees of freedom for polyatomicmolecules.
(i) Explain different modes of vibrations & selection rules in IR spectroscopy.

(or)

(b).(i) Define Bathochromic shift. Explain the effect of conjugation in U.V. spectroscopy.
(ii) Discuss the principle of NMR spectroscopy.

13.(a). Write Woodward-Fieser rules for calculating λmax for conjugated dienes and α,β – unsaturated carbonyl compounds , and apply them for one example each.

(or)

(b).(i) What is Fingerprint region. Explain its significance with an example.
(ii) Write IR spectral data for any one alcohol, aldehyde and ketone

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. To learn about the laws of absorption of light energy by molecules and the subsequent photochemicalreactions.
2. To understand the concept of quantum efficiency and mechanisms of photochemical reactions.

UNIT -I

Organometallic Compounds **8h**

Definition and classification of organometallic

Compounds on the basis of bond type, Concept of hapticity of organic ligands. Metal carbonyls: 18electronrule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation of mono and binuclear carbonyls of 3d series. P-acceptor behaviour of carbon monoxide. Synergic effects (VB approach) - (MO diagram of CO can be referred to for synergic effect to IR frequencies).

UNIT – II

Carbohydrates **8h**

Occurrence, classification and the its biological importance, Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides– Elementary treatment of maltose, lactose and sucrose. Polysaccharides–Elementary treatment of starch.

UNIT- III

Amino acidsandproteins **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). Structure and nomenclature of peptides and proteins.

HeterocyclicCompounds 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 - electrophilic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions - Diels Alder reaction in furan.

Pyridine – Structure - Basicity - Aromaticity- Comparison with pyrrole- one method of preparation and properties - Reactivity towards Nucleophilic substitution reaction.

UNIT- IV

Nitrogen Containing Functional Groups

Preparation, properties and important reactions of nitro compounds, amines and diazonium salts.

1. Nitrohydrocarbons 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, chirality in amines (pyramidal inversion), importance and general methods of preparation.Properties: Physical properties, Basicity of amines: Effect of substituent, solvent and steric effects.

Distinction between Primary, Secondary and tertiary amines using Hinsberg's method and nitrous acid. Discussion of the following reactions with emphasis on the mechanistic pathway: Gabriel Phthalimide synthesis, Hoffmann- Bromamide reaction, Carbylamine reaction, Mannichreaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction and Cope elimination.

Diazonium Salts: Preparation and Synthetic applications of diazonium salts including preparation of arenes, haloarenes, phenols, cyano and nitro compounds. Coupling reactions

of diazonium salts (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, Photosensitized reactions- energy transfer processes (simple example).

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. Third law of thermodynamics, Nernst heat theorem, Spontaneous and non- spontaneous processes, Helmholtz and Gibbs energies-Criteria forspontaneity.

Co-curricular activities and Assessment Methods Continuous Evaluation: Monitoring the progress of student’s learning Class Tests, Worksheets and Quizzes Presentations, Projects and Assignments and Group Discussions:Enhances critical thinking skills and personality Semester-end Examination: critical indicator of student’s learning and teaching methods adopted by teachers throughout the semester.

List of Reference Books

1. Concise coordination chemistry by Gopalan andRamalingam
2. Coordination Chemistry by Basalo andJohnson
3. Organic Chemistry by G.Mareloudan, PurdueUniv
4. Text book of physical chemistry by SGlasstone
6. Concise Inorganic Chemistry byJ.D.Lee
7. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu andMadan
8. A Text Book of Organic Chemistry by Bahl andArunbahl
9. A Text Book of Organic chemistry by I L FinarVolI
10. A Text Book of Organic chemistry by I L FinarVolII
11. Advanced physical chemistry by GurudeepRaj

LABORATORYCOURSE-IV 30hrs (2 h /w)
Practical Course-IV OrganicQualitativeanalysis 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 organiccompounds
3. Understand the applicationofconceptsofdifferentorganicreactionsstudiedintheorypart of organicchemistry.

OrganicQualitativeanalysis 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 & PHYSICALCHEMISTRY

Time: 3 hours Maximum Marks: 75

PART-A 5 X 5 = 25Marks

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 suitableexamples.
2. What are epimers and anomers. Giveexamples.
3. Discuss about iso electric point and zwitterion.
4. Discuss the Paul-Knorr synthesis of five membered heterocycliccompounds.
5. Explain Tautomerism shown by nitroalkanes
6. Discuss the basic nature ofamines.
7. Write the differences between thermal and photochemicalreactions.
8. Derive heat capacities and derive $C_p - C_v = R$

PART-B 5 X 10 = 50Marks

Answer **ALL** the questions. Each carries **TEN** marks

9 (a). What are organometallic compounds? Discuss their Classification on the basis of type of bonds withexamples.

(or)

(b). Discuss the general methods of preparations of mono & bi-nuclear carbonyls of 3dseries.

10 (a). Discuss the constitution, configuration and ring size of glucose. Draw the Haworth and Conformational structure ofglucose.

(or)

(b). (i) Explain Ruff's degradation.
(ii) Explain Kiliani- Fischer synthesis.

11.(a). What are amino acids? Write any three general methods of preparation of amino acids.

(or)

(b). Discuss the aromatic character of Furan, Thiophene andPyrrole.

12.(a). Write the mechanism for thefollowing.
(i) Nefreaction (ii) Mannichreaction

(or)

(b).(i) Explain Hinsberg separation of amines.
(ii) Discuss any three synthetic applications of diazoniumsalts.

13.(a). What is quantum yield? Explain the photochemical combination of Hydrogen-Chlorine and Hydrogen -Bromine.

(or)

(b).Define entropy. Describe entropy changes in the reversible and irreversible process.

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SEMESTER - IV

Course V (INORGANIC&PHYSICALCHEMISTRY) 60 hrs (4 h /w)

Course outcomes:

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

1. Understand concepts Of boundary conditions and quantization, probability distribution, most probable values, uncertainty and expectation values
2. Application of quantization to spectroscopy.
3. Various types of spectra and its use in structure determination.

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. Tetrahedral symmetry, Factors affecting the magnitude of crystal field splitting energy, Spectrochemical series, Comparison of CFSE for Octahedral and Tetrahedral complexes, Tetragonal distortion of octahedral geometry, Jahn-Teller distortion, square planar coordination.

UNIT –II

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

Introduction to inorganic reaction mechanisms. Concept of reaction pathways, transition state, intermediate and activated complex. Labile and inert complexes, ligand substitution reaction SN^1 and SN^2, Substitution reactions in square planar complexes, Trans-effect, theories of trans effect and itsapplications

2. Stability ofmetalcomplexes: 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.

Bioinorganic Chemistry: 8h

Metal ions present in biological systems, classification of elements according to the ir action in biological system. Geochemicaleffect on the distribution of metals, Sodium/K- pump, carbonicanhydrase and carboxypeptidase.

Excess and deficiency of some trace metals. Toxicity of metal ions (Hg,Pb,Cd and As), reasons for toxicity, Use of chelating agents in medicine, Cisplatin as an anti-cancer drug. Iron and its application in bio systems, Haemoglobin, Myoglobin. Storage and transfer of iron.

PHYSICALCHEMISTRY 34 h

UNIT-III

1 .Phase rule 6h

Concept of phase, components, degrees of freedom. Thermodynamic derivation of Gibbs phase rule. Phasediagram of one component system - water system, Study of Phase diagrams of Simple eutectic systems i) Pb-Agsystem, desilverisation of lead ii) NaCl-Water system, Congruent and incongruent melting point- Definition andexamples 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- conductometrictitrations.

Electrochemical Cells- Single electrode potential, Types of electrodes with examples: Metal-metal ion, Gas electrode, Inert electrode, Redox electrode, Metal-metal insoluble salt- salt anion. Determination of EMF of a cell, Nernst equation, Applications of EMF measurements - Potentiometric titrations.

Fuel cells- Basic concepts, examples, and applications

UNIT-V

Chemical Kinetics: 14h

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.

Comparison of the two theories (qualitative treatment only). Enzyme catalysis- Specificity, factors affecting enzyme catalysis, Inhibitors and Lock & key model. Michaels- Menten equation- derivation, significance of Michaelis-Menten constant.

Co-curricular activities and Assessment Methods Continuous Evaluation: Monitoring the progress of student's learning Class Tests, Worksheets and Quizzes Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality Semester-end Examination: critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

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4. Advanced physical chemistry by GurudeepRaj
5. Principles of physical chemistry by Prutton andMarron
6. Advanced physical chemistry by Bahl andTuli
7. Inorganic Chemistry byJ.E.Huheey
8. Basic Inorganic Chemistry by Cotton andWilkinson
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

Course V **LABORATORYCOURSE** **30**hrs (2 h /w)

Practical-Course -V

Conductometric andPotentiometric 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 concepts of electrochemistry inexperiments.
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 theanalyte

Conductometric andPotentiometricTitrimetry **50 M**

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

MODEL PAPER

SECOND YEAR B.Sc., DEGREE EXAMINATION

SEMESTER-IV

CHEMISTRY COURSE V: INORGANIC & PHYSICAL CHEMISTRY

Time: 3 hours Maximum Marks: 75

PART- A5 X 5 = 25 Marks

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

1. Write note on Jahn-Tellerdistortion.
2. Explain Labile & inertcomplexes.
3. Explain Job's method for determination of composition ofcomplex.
4. Explain Thermodynamic derivation of Gibb's phaserule.
5. Explain any two conductometrictitrations.
6. Write note on Fuel Cells with examples andapplications.
7. What is enzyme catalysis? Write any three factors effecting enzymecatalysis.
8. Derive Michaels- Mentenequation.

PART-B 5 X 10 =50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

9 (a). Explain Valence Bond theory with Inner and Outer orbital complexes. Write limitations ofVBT.

(or)

(b). Define CFSE. Explain the factors effecting the magnitude of crystalfield splittingenergy.

10 (a). Explain Trans effect. Explain the theories of trans effect and write any two applications of trans effect.

(or)

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

11.(a). Define Phase rule and terms involved in it. Explain phase diagram of Pb-Ag system.

(or)

(b). (i) Explain phase diagram for NaCl-watersystem.
(ii) Explain briefly about Freezing mixtures.

12.(a). Define Transport number. Write experimental method for the determination of transport number by Hittorf method.

(or)

(b).(i) Define single electrode potential.
(ii) Explain four types of electrodes with examples.

13.(a). Explain general methods for determination of order of a reaction.

(or)

(b).Explain Collision theory and Activated complex theory of bimolecular reactions.

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SUBJECT EXPERTS

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