Syllabus
CHEMISTRY
(UG courses)
Admitted Batch 2008 -2009

May, 2008
A.P. State Council of Higher Education

SUBJECT COMMITTEE

1. Prof.C.V.Chalapathi Rao, Coordinator	- Osmania University
2.Prof.M.Adinarayana	- Osmania University
3. Prof.A.V.Prasada Rao	- Andhra University
4.Prof.D.Gunasekhar	- Sri Venkateshwara University
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Co-opted Members

1.Dr.A.Veera Reddy	-Vice-President, Suven Life Science Ltd, Hyderabad
2.Dr.Rajender Reddy	- Scientist, IICT, Hyd.

B.Sc. Courses (Structure)

First year:

S.no.	Subject	Hrs per week
1.	English language including communication skills	6
2.	Second language	4
3.	Core1-I	4
4.	Core2-I	4
5.	Core3-I	4
6.	Core1-lab I	3
7.	Core2-lab I	3
8.	Core3-lab I	3
9.	Foundation course	3
10.	Computer skills	2
	Total	**36**

Second year:

S.no.	Subject	Hrs per week
1.	English language including communication skills	6
2.	Second language	4
3.	Core1-II	4
4.	Core2-II	4
5.	Core3-II	4
6.	Core1-lab II	3
7.	Core2-lab II	3
8.	Core3-lab II	3
9.	Environmental studies	4
10.	Computer skills	2
	Total	**37**

Third year:

S.no.	Subject	Hrs per week
1.	Core1-III	3
2.	Core1-IV	3
3.	Core2-III	3
4.	Core2-IV	3
5.	Core3-III	3
6.	Core3-IV	3
7.	Core1-lab III	3
8.	Core1-lab IV	3
9.	Core2-lab III	3
10.	Core2-lab IV	3
11.	Core3-lab III	3
12.	Core3-lab IV	3
13.	Foundation course	3
	Total	**39**

STRUCTURE - CURRICULUM

FOR CHEMISTRY IN UNDERGRADUATE DEGREE PROGRAMMES

YEAR	THEORY/ PRACTICAL	TITLE	WORKLOAD HRS/ WEEK
FIRST	Theory – I	Chemistry – I	4
	Practical – I	Qualitative analysis & Inorganic preparations	3
SECOND	Theory – II	Chemistry – II	4
	Practical – II	Titrimetric & Gravimetric analysis	3
THIRD	Theory – III	Chemistry – III	3
	Theory – IV	Chemistry and Industry	3
	Practical – III	Organic Chemistry	3
	Practical – IV	Physical Chemistry	3

ANDHRA UNIVERSITY
B.Sc. Chemistry Syllabus 2008-09

B.Sc. 1st Year Paper I **120 hrs (4 h / w)**

UNIT – I (Inorganic Chemistry – I) **30 hrs (1h / w)**

1. s-block elements: General characteristics of groups I & II elements, diagonal relationship between Li & Mg, Be & Al. **3 h**

2. p-block elements: **20 h**

General characteristics of elements of groups 13, 14, 15, 16 and 17

Group – 13: Synthesis and structure of diborane and higher boranes (B_4H_{10} and B_5H_9), boron-nitrogen compounds ($B_3N_3H_6$ and BN)
Group – 14: Preparation and applications of silanes and silicones, graphitic compounds.
Group – 15: Preparation and reactions of hydrazine, hydroxylamine, phosphazenes.
Group – 16: Classifications of oxides based on (i) Chemical behaviour and (ii) Oxygen content.
Group – 17: Inter halogen compounds and pseudo halogens

3. Organometallic Chemistry **7 h**

Definition and classification of organometallic compounds, nomenclature, preparation, properties and applications of alkyls of 1, 2 and 13 group elements.

UNIT-II (Organic Chemistry-I) **30hrs (1h /w)**

1. Structural theory in Organic Chemistry **10 h**

Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents including neutral molecules like H_2O, NH_3 & $AlCl_3$).
Bond polarization : Factors influencing the polarization of covalent bonds, electro negativity – inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acides (c) Stability of carbonium ions. Resonance or Mesomeric effect, application to (a) acidity of phenol, and (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes, carbanions, carbenes and nitrenes.

Types of Organic reactions : Addition – electrophilic, nucleophilic and free radical. Substitution – electrophilic, nucleophilic and free radical. Elimination- Examples (mechanism not required).

2. Acyclic Hydrocarbons **8 h**

Alkanes– IUPAC Nomenclature of Hydrocarbons. Methods of preparation: Hydrogenation of alkynes and alkenes, Wurtz reaction, Kolbe's electrolysis, Corey- House reaction. Chemical reactivity – inert nature, free radical substitution mechanism. Halogenation example- reactivity, selectivity and orientation.

Alkenes – Preparation of alkenes (a) by dehydration of alcohols (b) by dehydrohalogenation of alkyl halides (c) by dehalogenation of 1,2 dihalides (brief mechanism), Saytzev's rule. Properties: Addition of hydrogen – heat of hydrogenation and stability of alkenes. Addition of halogen and its mechanism. Addition of HX, Markonikov's rule, addition of H_2O, HOX, H_2SO_4 with mechanism and addition of HBr in the presence of peroxide (anti – Markonikov's addition). Oxidation – hydroxylation by $KMnO_4$, OsO_4, peracids (via epoxidation) hydroboration, Dienes – Types of dienes, reactions of conjugated dines – 1,2 and 1,4 addition of HBr to 1,3 – butadiene and Diel's – Alder reaction.

Alkynes – Preparation by dehydrohalogenation of dihalides, dehalogenation of tetrahalides, Properties; Acidity of acetylenic hydrogen (formation of Metal acedtylides). Preperation of higher acetylenes, Metal ammonia reductions Physical properties. Chemical reactivity – electrophilic addition of X_2, HX, H_2O (Tautomerism), Oxidation with $KMnO_4$, OsO_4, reduction and Polymerisation reaction of acetylene.

3. Alicyclic hydrocarbons (Cycloalkanes) 4 h

Nomenclature, Preparation by Freunds methods, heating dicarboxylic metal salts. Properties – reactivity of cyclopropane and cyclobutane by comparing with alkanes, Stability of cycloalkanes – Baeyer's strain theory, Sachse and Mohr predictions and Pitzer's strain theory. Conformational structures of cyclobutane, cyclopentane, cyclohexane.

4. Benzene and its reactivity 7 h

Concept of resonance, resonance energy. Heat of hydrogenation, heat of combustion of Benezene, mention of C-C bond lengths and orbital picture of Benzene.

Concept of aromaticity – aromaticity (definition), Huckel's rule – application to Benzenoid (Benzene, Napthalene) and Non – Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation)

Reactions – General mechanism of electrophilic substitution, mechanism of nitration. Friedel Craft's alkylation and acylation. Orientation of aromatic substitution – Definition of 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 Sulfonic acid groups. (iii). Halogens (Explanation by taking minimum of one example from each type).

5. Polynuclear Hydrocarbons – 2 h

Structure of naphthalene and anthracene (Molecular Orbital diagram and resonance energy) Any two methods of preparation of naphthalene and reactivity. Reactivity towards electrophilic substitution. Nitration and sulfonation as examples.

Unit-III – (Physical Chemistry – I) 30h (1h/w)

I Gaseous state 6 h

Compression factors, deviation of real gases from ideal behavior. Van der Waal's equation of state. P-V Isotherms of real gases, Andrew's isotherms of carbon dioxide, continuity of state. Critical phenomena. The van der Waal's equation and the critical state. Relationship between critical constants and van der Waal's constants. The law of corresponding states and reduced equation of states. Joule Thomson effect. Liquefaction of gases: i) Linde's method and ii) Claude's method.

II Liquid state 2 h

Intermolecular forces, structure of liquids (qualitative description). Structural differences between solids, liquids and gases. Liquid crystals, the mesomorphic state. Classification of liquid crystals into Smectic and Nematic. Differences between liquid crystal and solid/liquid. Application of liquid crystals as LCD devices.

III Solid state 10 h

Symmetry in crystals. Law of constancy of interfacial angles. The law of rationality of indices. The law of symmetry. Definition of lattice point, space lattice, unit cell. Bravis lattices and crystal systems. X-ray diffraction and crystal structure. Bragg's law. Determination of crystal structure by Bragg's method and the powder method. Indexing of planes and structure of NaCl and KCl crystals.

Defects in crystals. Stoichiometric and non-stoichiometric defects. Band theory of semoconductors. Extrinsic and intrinsic semiconductors, n- and p-type semiconductors and their applications in photo electrochemical cells.

IV Solutions 6 h

Liquid-liquid - ideal solutions, Raoult's law. Ideally dilute solutions, Henry's law. Non-ideal solutions. Vapour pressure – composition and vapour pressure-temperature curves. Azeotropes-HCl-H_2O, ethanol-water systems and fractional distillation. Partially miscible liquids-phenol-water, trimethylamine-water, nicotine-water systems. Effect of impurity on consulate temperature. Immiscible liquids and steam distillation.

Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law.

V Colloids and surface chemistry 6 h

Definition of colloids. Solids in liquids(sols), preparation, purification,properties - kinetic,optical,electrical. Stability of colloids, Hardy-Schulze law, protective colloid. Liquids in liquids (emulsions) preparation, properties, uses. Liquids in solids (gels) preparation, uses.

Adsorption: Physical adsoption, chemisorption. Freundlich, Langmuir adsorption isotherms. Applications of adsorption

UNIT – IV (General Chemistry-I) 30 h (1h / w)

1. Atomic Structure and elementary quantum mechanics 8 h

Blackbody radiation, Planck's radiation law, photoelectric effect, Compton effect, de Broglie's hypothesis, Heisenberg's uncertainty principle. Postulates of quantum mechanics. Schrodinger wave equation and a particle in a box, energy levels, wave functions and probability densities. Schrodinger wave equation for H-atom. Separation of variables, Radial and angular functions, hydrogen like wave functions, quantum numbers and their importance.

2. Chemical Bonding 8 h

Valence bond theory, hybridization, VB theory as applied to ClF_3, BrF_5, $Ni(CO)_4$, XeF_2. Dipole moment – orientation of dipoles in an electric field, dipole moment, induced dipole moment, dipole moment and structure of molecules. Molecular orbital theory – LCAO method, construction of M.O. diagrams for homo-nuclear and hetero-nuclear diatomic molecules (N_2, O_2, HCl, CO and NO). Comparision of VB and MO theories.

3. Stereochemistry of carbon compounds 10 h

Molecular representations- Wedge, Fischer, Newman and Saw-Horse formulae.
Stereoisomerism, Stereoisomers: enantiomers, diastereomers- definition and examples.Conformational and configurational isomerism- definition. Conformational isomerism of ethane and n-butane.
Enantiomers: Optical activity- wave nature of light, plane polarised light, interaction with molecules, optical rotation and specific rotation. Chiral molecules- definition and criteria- absence of plane, center, and Sn axis of symmetry- asymmetric and disymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and disymmetric molecules (trans -1,2-dichloro cyclopropane).
Chiral centers: definition- molecules with similar chiral carbon (Tartaric acid), definition of mesomers- molecules with dissimilar chiral carbons (2,3-dibromopentane). Number of enantiomers and mesomers- calculation.
D,L and R,S configuration for asymmetric and disymmetric molecules. Cahn-Ingold-Prelog rules. Racemic mixture- racemisation and resolution techniques.
Diastereomers: definition- geometrical isomerism with reference to alkenes- cis, trans and E,Z- configuration.

4. General Principles of Inorganic qualitative analysis 4 h

Solubility product, common ion effect, characteristic reactions of anions, elimination of interfering anions, separation of cations into groups, group reagents, testing of cations

LABORATORY COURSE- I **90 hrs (3 h / w)**

Practical Paper – I (Inorganic Chemistry)

Qualitative Analysis and Inorganic preparations:

Analysis of mixtures containing two anions (one simple and one interfering) and two cations (of different groups) from the following:

Anions: Carbonate, sulfide, sulphate, chloride, bromide, iodide, acetate, nitrate, oxalate, tartrate, borate, phosphate, arsenate* and chromate*.

Cations: Lead, copper, bismuth, cadmium, tin, antimony, iron, aluminum, zinc, manganese, nickel, cobalt, calcium, strontium, barium, potassium and ammonium.

*not to be given for examination.

Preparations: Any three of the following inorganic preparations:

1) Ferrous ammonium sulphate
2) Tetrammine copper (II) sulphate
3) Potassium trisoxalato chromate
4) Potash alum $KAl(SO_4)_2. 12H_2O$
5) Hexammine cobalt (III) chloride.

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B.Sc. Chemistry Syllabus 2009-10

B.Sc. II Year, Paper –II **120 hrs (4 h / w)**
UNIT – I (Inorganic Chemistry – II) **30 h (1h/w)**

I. **Chemistry of d-block elements:** 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 oxidation states and e.m.f. Comparative treatment of second and third transition series with their 3d analogues. Study of Ti, Cr and Cu traids in respect of electronic configuration and reactivity of different oxidation states.

9 h

II. **Chemistry of f-lock elements:** Chemistry of lanthanides – electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties, spectral properties and separation of lanthanides by ion exchange and solvent extraction methods. Chemistry of actinides – electronic configuration, oxidation states, actinide contraction, position of actinides in the periodic table, comparison with lanthanides in terms of magnetic properties, spectral properties and complex formation.

8 h

III. **Theories of bonding in metals:** Valence bond theory, Explanation of metallic properties and its limitations, Free electron theory, thermal and electrical conductivity of metals, limitations, Band theory, formation of bands, explanation of conductors, semiconductors and insulators.

6 h

IV. **Metal carbonyls and related compounds** – EAN rule, classification of metal carbonyls, structures and shapes of metal carbonyls of V, Cr, Mn, Fe, Co and Ni. Metal nitrosyls and metallocenes (only ferrocene).

7 h

UNIT-II (Organic Chemistry – II) **30hrs (1 h / w)**

1. Halogen compounds **4 h**

Nomenclature and classification of alkyl (into primary, secondary, tertiary), aryl, aralkyl, allyl, vinyl, benzyl halides.

Chemical Reactivity, formation of RMgX

Nucleophilic aliphatic substitution reaction- classification into S_N1 and S_N2.

Energy profile diagram of S_N1 and S_N2 reactions. Stereochemistry of S_N2 (Walden Inversion) S_N1 (Racemisation). Explanation of both by taking the example of optically active alkyl halide – 2bromobutane. Ease of hydrolysis – comparision of alkyl, benzyl, alkyl, vinyl and aryl halides

2. Hydroxy compounds **6 h**

Nomenclature and classification of hydroxy compounds.

Alcohols: Preparation with hydroboration reaction, Grignard synthesis of alcohols.

Phenols: Preparation i) from diazonium salt, ii) from aryl sulphonates, iii) from cumene.

Physical properties- Hydrogen bonding (intermolecular and intramolecular). Effect of hydrogen bonding on boiling point and solubilitiy in water.

Chemical properties:

a. acidic nature of phenols.
b. formation of alkoxides/phenoxides and their reaction with RX.
c. replacement of OH by X using PCl_5, PCl_3, PBr_3, $SOCl_2$ and with $HX/ZnCl_2$.
d. esterification by acids (mechanism).
e. dehydration of alcohols.
f. oxidation of alcohols by CrO_3, $KMnO_4$.
g. special reaction of phenols: Bromination, Kolb-Schmidt reaction, Riemer-Tiemann reaction, Fries rearrangement, azocoupling.

Identification of alcohols by oxidation with $KMnO_4$, ceric ammonium nitrate, lucas reagent and phenols by reaction with $FeCl_3$.

Polyhydroxy compounds: Pinacol-Pinacolone rearrangement.

3. Carbonyl compounds **10 h**

Nomenclature of aliphatic and aromatic carbonyl compounds, structure of the carbonyl group.

Synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids.

Physical properties: absence of hydrogen bonding, keto-enol tautomerism, reactivity of carbonyl group in aldehydes and ketones.

Nucleophilic addition reaction with a) $NaHSO_3$, b) HCN, c) RMgX, d) NH_2OH, e)$PhNHNH_2$, f) 2,4 DNPH, g) Alcohols-formation of hemiacetal and acetal.

Halogenation using PCl_5 with mechanism.

Base catalysed reactions: a) Aldol, b) Cannizzaro reaction, c) Perkin reaction, d) Benzoin condensation, e) Haloform reaction, f) Knoevenagel reaction.

Oxidation of aldehydes- Baeyer-Villiger oxidation of ketones.

Reduction: Clemmensen reduction, Wolf-Kishner reduction, MPV reduction, reduction with $LiAlH_4$ and $NaBH_4$.

Analysis of aldehydes and ketones with a) 2,4-DNT test, b) Tollen's test, c) Fehling text, d) Schiff test, e) Haloform test (with equation).

4. Carboxylic acids and derivatives **6 h.**

Nomenclature, classification and structure of carboxylic acids.

Methods of preparation by a) hydrolysis of nitriles, amides and esters.
b) carbonation of Grignard reagents.

Special methods of preparation of aromatic acids by a) oxidation of side chain.

b) hydrolysis by benzotrichlorides.
c) Kolbe reaction.

Physical properties: Hydrogen bonding, dimeric association, acidity- strength of acids with examples of trimethyl acetic acid and trichloroacetic acid. Relative differences in the acidities of aromatic and aliphatic acids.

Chemical properties: 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.

Derivatives of carboxylic acids: Reaction of acid chlorides, acid anhydrides, acid amides, esters (mechanism of the hydrolysis of esters by acids and bases).

5. Active methylene compounds **4 h**

Acetoacetic esters: preparation by Claisen condensation, keto-enol tautomerism. Acid hydrolysis and ketonic hydrolysis.

Preparation of a) monocarboxylic acids.
b) dicarboxylic acids.

Reaction with urea

Malonic ester: preparation from acetic acid.

Synthetic applications: Preparation of
a) monocarboxylic acids (propionic acid and n-butyric acid).
b) dicarboxylic acids (succinic acid and adipic acid).
c) α,ß-unsaturated carboxylic acids (crotonic acid).

Reaction with urea.

6. Exercises in interconversions specified with examples Alkyl halides to Carbonyl Compounds and Alcohols to carboxylic acids **2 h**

Unit - III (Physical chemistry – II) **30hrs (1h / w)**

1. Phase rule **5 h**

Concept of phase, components, degree of freedom. Derivation of Gibbs phase rule. Phase equilibrium of one component – water system. Phase equilibrium of two-component system, solid-liquid equilibrium. Simple eutectic diagram of Pb-Ag system, desilverisation of lead. Solid solutions- compound with congruent melting point- (Mg-Zn) system, compound with incongruent melting point – NaCl- water system. Freezing mixtures.

2. Dilute solutions **8 h**

Colligative properties. Raoult's law, relative lowering of vapour pressure, its relation to molecular weight of non-volatile solute. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods of determination. Osmosis, osmotic pressure, experimental determination. Theory of dilute solutions. Determination

of molecular weight of non-volatile solute from osmotic pressure. Abnormal Colligative properties. Van't Hoff factor, degree of dissociation and association.

3. Electrochemistry 17 h

Specific conductance, equivalent conductance, measurement of equivalent conductance. Variation of equivalent conductance with dilution. Migration of ions, Kohlrausch's law. Arrhenius theory of electrolyte dissociation and its limitations. Ostwald's dilution law. Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only). Definition of transport number, determination by Hittorf's method. Application of conductivity measurements-determination of dissociation constant (K_a) of an acid, determination of solubility product of sparingly soluble salt, conductometric titrations.

Types of reversible electrodes- the gas electrode, metal-metal ion, metal-insoluble salt and redox electrodes. Electrode reactions, Nernst equation, single electrode potential, standard Hydrogen electrode, reference electrodes, standard electrode potential, sign convention, electrochemical series and its significance. Reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurements. Computation of cell EMF. Applications of EMF measurements, Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Determination of pH using quinhydrone electrode, Solubility product of AgCl. Potentiometric titrations.

Unit IV (General chemistry-II) 30 hrs (1h/w)

1. Molecular symmetry 5h

Concept of symmetry in chemistry-symmetry operations, symmetry elements. Rotational axis of symmetry and types of rotational axes. Planes of symmetry and types of planes. Improper rotational axis of symmetry. Inversion centre. Identity element. The symmetry operations of a molecule form a group. Flow chart for the identification of molecular point group.

2. Theory of quantitative analysis 8 hrs

a) Principles of volumetric analysis. Theories of acid-base, redox, complexometric, iodometric and precipitation titrations, choice of indicators for these titrations.

b) Principles of gravimetric analysis: precipitation, coagulation, peptization, coprecipitation, post precipitation, digestion, filtration and washing of precipitate, drying and ignition, precipitation from homogenous solutions, requirements of gravimetric analysis.

3. Evaluation of analytical data. 4 h

Theory of errors, idea of significant figures and its importance, accuracy – methods of expressing accuracy, error analysis and minimization of errors, precision – methods of expressing precision, standard deviation and confidence limit.

4. Introductory treatment to:

a) Pericyclic Reactions **5 h**

Concerted reactions, Molecular orbitals, Symmetry properties HOMO, LUMO, Thermal and photochemical pericyclic reactions. Types of pericyclic reactions – electrocyclic, cycloaddition and sigmatropic reactions – one example each.

b) Synthetic strategies **4 h**

Terminology – Disconnection (dix), Symbol ( ), synthon, synthetic equivalent (SE), Functional group interconversion (FGI), Linear, Convergent and Combinatorial syntheses, Target molecule (TM). Retrosynthesis of the following molecules

1) acetophenone 2) cyclohexene 3) phenylethylbromide

c) Asymmetric (Chiral) synthesis **4 h**

Definitions-Asymmetric synthesis, enantiomeric excess, diastereomeric excess. stereospecific reaction, definition, example, dehalogenation of 1,2-dibromides by I^-. stereoselective reaction, definition, example, acid catalysed dehydration of 1-phenylproponol

LABORATORY COURSE – II **90 hrs (3 h / w)**

Practical Paper – II (Inorganic Chemistry)

I. Titrimetric analysis:

1) Determination of carbonate and bicarbonate in a mixture
2) Determination of Fe(II) using $K_2Cr_2O_7$
3) Determination of Fe(II) using $KMnO_4$ with oxalic acid as primary standard.
4) Determination of Cu(II) using $Na_2S_2O_3$ with $K_2Cr_2O_7$ as primary standard
5) Determination of Zinc using EDTA
6) Determination of hardness of water
7) Determination of Zinc by ferrocyanide

II. Gravimetric analysis (any three of the following)

1) Determination of barium as barium sulphate
2) Determination of sulphate as barium sulphate
3) Determination of lead as lead chromate
4) Determination of nickel as Ni-DMG complex
5) Determination of magnesium as magnesium pyrophosphate.

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B.Sc. III Year SYLLBUS 2010-2011

Paper – III **90 hrs (3h / w)**

Unit – I (Inorganic Chemistry-III) **30 hrs (1 h/w)**

1. **Coordination Chemistry:** IUPAC nomenclature, bonding theories – review of Werner's theory and Sidgwick's concept of coordination, Valence bond theory, geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations, crystal filed theory, splitting of d-orbitals in octahedral, tetrahedral and square-planar complexes – low spin and high spin complexes – factors affecting crystal-field splitting energy, merits and demerits of crystal-field theory. Isomerism in coordination compounds – structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers.

   10 h

2. **Spectral and magnetic properties of metal complexes:** Electronic absorption spectrum of $[Ti(H_2O)_6]^{3+}$ ion. Types of magnetic behavior, spin-only formula, calculation of magnetic moments, experimental determination of magnetic susceptibility – Gouy method.

   4 h

3. **Reactivity of metal complexes:** Labile and inert complexes, ligand substitution reactions – S_N1 and S_N2, substitution reactions of square planar complexes – Trans effect and applications of trans effect.

   4 h

4. **Stability of metal complexes:** 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.

   4 h

5. **Hard and soft acids bases (HSAB):** Classification, Pearson's concept of hardness and softness, application of HSAB principles – Stability of compounds / complexes, predicting the feasibility of a reaction.

   4 h

6. **Bioinorganic chemistry:** Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and chloride (Cl^-). Metalloporphyrins – hemoglobin, structure and function, Chlorophyll, structure and role in photosynthesis.

   4 h

UNIT – II (Organic Chemistry – III) 30 hrs (1h/w)

1. **Nitrogen compounds 9 h**

Nitro hydrocarbons: 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 Michael addition and reduction.

Amines (Aliphatic and Aromatic): Nomenclature, Classification into 1^0, 2^0, 3^0 Amines and Quarternary ammonium compounds. Preparative methods -1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman's bromamide reaction (mechanism).
4. Reduction of Amides and Schmidt reaction. Physical properties and basic character – Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline – comparative basic strength of aniline, N-methylaniline and N,N-dimethyl aniline (in aqueous and non-aqueous medium), steric effects and substituent effects. Use of amine salts as phase transfer catalysts. Chemical properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation e) Reaction with Nitrous acid of 1^0, 2^0, 3^0 (Aliphatic and aromatic amines). Electrophilic substitutions of Aromatic amines – Bromination and Nitration. oxidation of aryl and 3^0 Amines. Diazotization
Cyanides and isocyanides: Nomenclature (aliphatic and aromatic) structure. Preparation of cyanides from a) Alkyl halides b) from amides c) from aldoximes. Preparation of isocyanides from Alkyl halides and Amines. Properties of cyanides and isocyanides, a) hydrolysis b) addition of Grignard reagent iii) reduction iv) oxidation.

2. **Heterocyclic Compounds 5 h**

Introduction and definition: Simple 5 membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole. Importance of ring system – presence in important natural products like hemoglobin and chlorophyll. Numbering the ring systems as per Greek letter and Numbers. Aromatic character – 6- electron system (four-electrons from two double bonds and a pair of non-bonded electrons from the hetero atom). Tendency to undergo substitution reactions.
Resonance structures: Indicating electron surplus carbons and electron deficient hetero atom. Explanation of feebly acidic character of pyrrole, electrophillic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions. Reactivity of furan as 1,3-diene, Diels Alder reactions (one example). Sulphonation of thiophene purification of Benzene obtained from coal tar). Preparation of furan, Pyrrole and thiophene from 1,4,- dicarbonyl compounds only, Paul-Knorr synthesis, structure of pyridine, Basicity – Aromaticity – Comparison with pyrrole – one method of preparation and properties – Reactivity towards Nucleophilic substitution reaction – chichibabin reaction.

3. **Carbohydrates 6 h**

Monosaccharides: All discussion to be confined to (+) glucose as an example of aldo hexoses and (-) fructose as example of ketohexoses. Chemical properties and structureal elucidation: Evidences for straight chain pentahydroxy aldehyde structure (Acetylation, reduction to n-hexane, cyanohydrin formation, reduction of Tollen's and Fehling's

reagents and oxidation to gluconic and saccharic acid). Number of optically active isomers possible for the structure, configuration of glucose based on D-glyceraldehyde as primary standard (no proof for configuration is required). Evidence for cyclic structure of glucose (some negative aldehydes tests and mutarotation). Cyclic structure of glucose. Decomposition of cyclic structure (Pyranose structure, anomeric Carbon and anomers). Proof for the ring size (methylation, hydrolysis and oxidation reactions). Different ways of writing pyranose structure (Haworth formula and chair conformationa formula). Structure of fructose: Evidence of 2 – ketohexose structure (formation of penta acetate, formation of cyanohydrin its hydrolysis and reduction by HI to give 2-Carboxy-n-hexane). Same osazone formation from glucose and fructose, Hydrogen bonding in osazones, cyclic structure for fructose (Furanose structure and Haworth formula).
Interconversion of Monosaccharides: Aldopentose to aldo hexose – eg: Arabinose to D-Glucose, D-Mannose (Kiliani - Fischer method). Epimers, Epimerisation – Lobry de bruyn van Ekenstein rearrangement. Aldohexose to Aldopentose eg: D-glucose to D-arabinose by Ruff'f degradation. Aldohexose (+) (glucose) to ketohexose (-) (Fructose) and Ketohexose (fructose) to aldohexose (Glucose)

4. Amino acids and proteins **5 h**

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gama 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 leucene) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis.
Physical properties: Optical activity of naturally occurring amino acids: L-configuration, irrespective of sign rotation, Zwitterion 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.

5. Mass Spectrometry: **5 h**

Basic principles – Molecular ion / parent ion, fragment ions / daughter ions. Theory – formation of parent ions. Representation of mass spectrum. Identification of parent ion, (M+1), (M+2), base peaks (relative abundance 100%) Determination of molecular formula – Mass spectra of ethylbenzene, acetophenone, n-butyl amine and 1- proponal.

Unit-III (physical chemistry-III) 30hrs (1 h / w)

1. Chemical kinetics 9 h

Rate of reaction, factors influencing the rate of a reaction-concentration, temperature, pressure, solvent, light, catalyst. Experimental methods to determine the rate of reaction. Definition of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for time half change. Methods to determine the order of reactions. Kinetics of complex reactions (first order only): opposing reactions, parallel reactions, consecutive reactions and chain reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Theories of reaction rates- collision theory-derivation of rate constant for bimolecular reaction. The transition state theory (elementary treatment).

2. Photochemistry 5 h

Difference between thermal and photochemical processes. Laws of photochemistry-Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield. Ferrioxalate actinometry. Photochemical hydrogen- chlorine, hydrogen-bromine reaction. Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing). Photosensitized reactions- energy transfer processes (simple example)

3. Thermodynamics 16 h

The first law of thermodynamics-statement, definition of internal energy and enthalpy. Heat capacities and their relationship. Joule's law-Joule-Thomson coefficient. Calculation of w, q, dU and dH 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. Thermodynamic scale of temperature. Concept of entropy, entropy as a state function, entropy changes in cyclic, reversible, and irreversible processes and reversible phase change. Calculation of entropy changes with changes in V & T and P&T. Entropy of mixing inert perfect gases. Entropy changes in spontaneous and equilibrium processes.
The Gibbs (G) and Hlmholtz (A) energies. A & G as criteria for thermodynamic equilibrium and spontaneity-advantage over entropy change. Gibbs equations and the Maxwell relations. Variation of G with P, V and T.

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Paper-IV Chemistry and Industry 90 hrs (3 h / w)

Unit – I (Physico Chemical methods of analysis) 30 hrs (1 h / w)

1. Separation techniques 12 h

1. Solvent extraction: Principle and process, Batch extraction, continuous extraction and counter current extraction. Application – Determination of Iron (III)
2. Chromatography: Classification of chromatography methods, principles of differential migration adsorption phenomenon, Nature of adsorbents, solvent systems, Rf values, factors effecting Rf values.
    a. Paper Chromatography: Principles, Rf values, experimental procedures, choice of paper and solvent systems, developments of chromatogram – ascending, descending and radial. Two dimensional chromatography, applications.
    b. Thin layer Chromatography (TLC): Advantages. Principles, factors effecting Rf values. Experimental procedures. Adsorbents and solvents. Preparation of plates. Development of the chromatogram. Detection of the spots. Applications.
    c. Column Chromatography: Principles, experimental procedures, Stationary and mobile Phases, Separation technique. Applications
    d. High Performance Liquid Chromatography (HPLC): Principles and Applications.
    e. Gas Liquid Chromatography (GLC): Principles and Applications

2. Spectrophotometry 4 h

General features of absorption – spectroscopy, Beer-Lambert's law and its limitations, transmittance, Absorbance, and molar absorptivity. Single and double beam spectrophotometers. Application of Beer-Lambert law for quantitative analysis of

1. Chromium in $K_2Cr_2O_7$
2. Manganese in manganous sulphate
3. Iron (III) with thiocyanate.

3. Molecular sectorscopy 14 h

(i) Electronic spectroscopy:

Interaction of electromagnetic radiation with molecules and types of molecular spectra. Potential energy curves for bonding and antibonding molecular orbitals. Energy levels of molecules (σ,π, n) . Selection rules for electronic spectra. Types of electronic transitions in molecules effect of conjugation. Concept of chromophore.

(ii) Infra red spectroscopy

Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant. Qualitative relation of force constant to bond energies. Anharmonic motion of real molecules and energy levels. Modes of vibrations in polyatomic molecules. Characteristic absorption bands of various functional groups. Finger print nature of infrared spectrum.

(iii) Raman spectroscopy

Concept of polarizavility, selection rules, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

(iv) Proton magnetic resonance spectroscopy (^{1}H-NMR)

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.

(v) Spectral interpretation

Interpretation of IR, UV-Visible, ^{1}H-NMR and mass spectral data of the following compounds 1. Phenyl acetylene 2. Acetophenone 3.Cinnamic Acid 4. para-nitro aniline.

Unit – II (Drugs, formulations, pesticides and green chemistry) 30 hrs (1 h / w)

1. Drugs 17 h

1. Introduction: Drug, disease (definition), Historical evolution, Sources – Plant, Animal synthetic, Biotechnology and human gene therapy
2. Terminology: Pharmacy, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics (ADME, Receptors – brief teartment) Metabolites and Anti metabolites.
3. Nomenclature: Chemical name, Generic name and trade names with examples
4. Classification: Classification based on structures and therapeutic activity with one example each.
5. Synthesis: Synthesis and therapeutic activity of the following drugs., L-Dopa, Chloroquin, Omeprazole, Albuterol and ciprofloxacin.
6. Drug Development: Pencillin, Separation and isolation, structures of different pencillins
7. HIV-AIDS: Immunity – CD-4 cells, CD-8 cells Retrovirus, replication in human body. Investigation available, prevention of AIDS. Drugs available – examples with structures: PIS: Indinavir (Crixivan), Nelfinavir (Viracept), NNRTIS: Efavirenz (Susrtiva), Nevirapine (Viramune) NRTIs: Abacavir (Ziagen), Lamivudine (Epivir, 3TC) Zidovudine (Retravir, AZT, ZDV)
8. Monographs of drugs: Eg Paracetamol, Sulpha methoxazole (Tablets)

2. Formulations **3 h**

1. Need of conversion of drugs into medicine. Additives and their role (brief account only)
2. Different types of formulations

3. Pesticides **5 h**

1. Introduction to pesticides – types – Insecticides, Fungicides, Herbicides, Weedicides, Rodenticides plant growth regulators, Pheremones and Hormones. Brief discussion with examples, Structure and uses.
2. Synthesis and presnt status of the following.
   DDT, BHC, Malathion, Parathion, Endrin, Baygon, 2,4-D and Endo-sulphon

4. Green Chemistry **5h**

Introduction: Definition of green Chemistry, need of green chemistry, basic principles of green chemistry

Green synthesis: Evalution of the type of the reaction i) Rearrangements (100% atom economic), ii) Addition reaction (100% atom economic), Pericyclic reactions (no by-product).

Selection of solvent:

i) Aqueous phase reactions ii) Reactions in ionic liquids iii) Solid supported synthesis iv) Solvent free reactions (solid phase reactions)

ii) Green catalysts: i) Phase transfer catalysts (PTC) ii) Biocatalysts

Microwave and Ultrasound assisted green synthesis:

1. Aldol condensation
2. Cannizzaro reaction
3. Diels-Alder reactions
4. Strecker synthesis
5. Willaimson synthesis
6. Dieckmann condensation

Unit-III: (Macromolecules, materials Science and catalysis) **30 hrs (1 h / w)**

1. Macromolecules **10h**

Classification of polymers, chemistry of polymerization, chain polymerization, step polymerization, coordination polymerization – tacticity. Molecular weight of polymers-number average and weight average molecular weight, degree of polymerization, determination of molecular weight of polymers by viscometry, Osmometry and light scattering methods. Kinetics of free radical polymerization, derivation of rate law. Preparation and industrial application of polyethylene, PVC, Teflon, polyacrylonitrile, terelene and Nylon66. Introduction to biodegradability.

2. Materials science **8h**

Superconductivity, characteristics of superconductors, Meissner effect, types of superconductors and applications.

Nanomaterials- synthetic techniques, bottom-up-sol-gel method, top-down- electro deposition method. Properties and applications of nano-materials. Composites-definition, general characteristics, particle reinforce and fiber reinforce composites and their applications.

3. Catalysis 12h

Homogeneous and heterogeneous catalysis, comparision with examples. Kinetics of specific acid catalyzed reactions, inversion of cane sugar. Kinetics of specific base catalyzed reactions, base catalyzed conversion of acetone to diacetone alcohol. Acid and base catalyzed reactions- hydrolysis of esters, mutarotation of glucose. Catalytic activity at surfaces. Mechanisms of heterogeneous catalysis. Langmuir-Hinshelwood mechanism.
Enzyme catalysis: Classification, characteristics of enzyme catalysis. Kinetics of enzyme catalyzed reactions-Michaelis Menton law, significance of Michaelis constant (K_m) and maximum velocity (V_{max}). Factors affecting enzyme catalysis- effect of temperature, pH, concentration and inhibitor. Catalytic efficiency. Mechanism of oxidation of ethanol by alcohol dehydrogenase.

LABORATORY COURSE – III
Practical Paper – III (Organic Chemistry) **90 hrs (3 h / w)**

1. Synthesis of Organic Compounds

- **i.** Aromatic electrophilic substitution Nitration: Preparation of nitro benzene and p-nitro acetanilide, Halogenation: Preparation of p-bromo acetanilide – preparation of 2,4,6-tribromo phenol.
- **ii.** Diazotization and coupling: Preparation of pheyl azo β-napthol
- **iii.** Oxidation: Preparation of benzoic acid from benzoyl chloride
- **iv.** Reduction: Preparation of m-nitro aniline from m-dinitro benzene
- **v.** Esterfication: Preparation of methyl p-nitro benzoate from p-nitro benzoic acid.
- **vi.** Methylation: Preparation of β-napthyl methyl ether
  Condensation: Preparation of benzilidine aniline and Benzoyl aniline.

2. Thin layer Chromatography & Column Chromatography

- **i**. Preparation of the TLC plates. Checking the purity of the compounds by TLC: Acetylation of salicyclic acid, aniline, Benzoylation of Aniline and Phenol Determination of Rf values and identification of organic compounds by TLC: preparation and separation of 2,4-dinitrophenyl hydrazones of acetione and 2-butanone using toluene and light petroleum(40:60)
- **ii**. Separation of ortho & para nitro aniline mixture by column chromatography

3. Organic Qualitative Analysis:

- **i.** Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.
- **ii.** Separation of two component mixtures
  1) Aniline + Naphthalene 2) Benzoic acid + Benzophenone 3) p-Cresol + Chlorobenzene.

4. Demonstration experiments:

1. Steam distillation experiment: separation of ortho and para nitro phenols 2) Microwave assisted Green synthesis, two examples: 1. Hydrolysis of Benzamide 2. Oxidation of Toluene

LABORATORY COURSE - IV

Practical Paper IV (Physical Chemistry) 90hrs (3 h / w)

1. Chemical kinetics

- **i.** Determination of specific reaction rate of the hydrolysis of methyl acetate catalyzed by hydrogen ion at room temperature.
- **ii.** Determination of rate of decomposition of hydrogen peroxide.
- **iii.** Determination of overall order of saponification of ethyl acetate

2. Distribution law

- **i.** Determination of distribution coefficient of iodine between water and carbon Tetrachloride.
- **ii.** Determination of molecular status and partition coefficient of benzoic acid in Toluene and water.

3. Electrochemistry

- **i.** Determination of concentration of HCl conductometrically using standard NaOH solution.
- **ii.** Determination of concentration of acetic acid conductometrically using standard NaOH solution.
- **iii.** Determination of dissociation constant (K_a) of acetic acid by conductivity measurements.
- **iv.** Determination of solubility and solubility product of $BaSO_4$.
- **v.** Determination of redox potentials of $Fe^{2+}/Fe^{3+}$by potentiometric titration of ferrous ammonium sulphate vs. potassium dichromate.

4. pH metry

- **i.** Preparation phosphate buffer solutions
- **ii.** pH metric titration of weak acid, acetic acid with strong base NaOH and calculation of dissociation constant.

5. Colorimetry

- **i.** Verification of Beer-Lambert law for $KMnO_4$, $K_2Cr_2O_7$ and determination of concentration of the given solution.
- **ii.** Verification of Beer-Lambert law for $CuSO_4$ and determination of concentration of the given solution.
- **iii.** Composition of complex of Cu^{2+} - EDTA disodium salt

6. Adsorption

i. Surface tension and viscosity of liquids.
ii. Adsorption of acetic acid on animal charcoal, verification of Freundlich isotherm.

7. Project Work:

Collection of spectral data of a minimum of six compounds belonging to different functional groups (other than those included in the syllabus) and submission of the report.

NOTE: Apart from the experiments (1 to 6) the project work (7) shall also be included in the University Examination.

Recommended Text Books and Reference Books

Inorganic Chemistry

1. Concise Inorganic Chemistry by J.D.Lee
2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
4. Inorganic Chemistry by R R Heslop and P.L. Robinson
5. Modern Inorganic Chemistry by C F Bell and K A K Lott
6. University Chemistry by Bruce Mahan
7. Qualitative Inorganic analysis by A.I.Vogel
8. A textbook of qualitative inorganic analysis by A.I. Vogel
9. Inorganic Chemistry by J.E.Huheey
10. Inorganic Chemistry by Chopra and Kapoor
11. Coordination Chemistry by Basalo and Johnson
12. Organometallic Chemistry – An introduction by R.C.Mehrotra and A.Singh
13. Inorganic Chemistry by D.F.Shriver, P.W.Atkins and C.H.Langford
14. Inorganic Chemistry by Philips and Williams, Lab Manuals
15. Introduction to inorganic reactions mechanisms by A.C.Lockhart
16. Theoretical inorganic chemistry by McDay and J.Selbin
17. Chemical bonding and molecular geometry by R.J.Gillepsy and P.L.Popelier
18. Advanced Inorganic Chemistry By Gurudeep Raj
19. Analytical chemistry by Gary D Christian, Wiley India
20. Analytical Chemistry by G.L.David Krupadanam, et al, Univ. Press
21. Selected topics in inorganic chemistry by W.D.Malik, G..D.Tuli, R.D.Madan
22. Concepts and models of Inorganic Chemistry by Bodie Douglas, D.McDaniel and J.Alexander
23. Modern Inorganic Chemistry by William L. Jolly
24. Concise coordination chemistry by Gopalan and Ramalingam
25. Satyaprakash's modern inorganic chemistry by R.D.Madan.

Recommended Text Books and Reference Books

Organic Chemistry

1. Organic Chemistry By R T Morrison and R.N.Boyd
2. Organic Chemistry by T.J.Solomons
3. Organic Chemistry by L.G.Wade Sr
4. Organic Chemistry by D.Cram, G.S.Hammond and Herdricks
5. Modern Organic Chemistry by J.D.Roberts and M.C.Caserio
6. Text book of Organic Chemistry by Ferguson
7. Problems and their solutions in organic Chemistry by I.L.Finar
8. Reaction mechanisms in Organic Chemistry by S.M.Mukherji and S.P.Singh
9. A guide book to mechanisms in Organic Chemistry by Peter Sykes
10. Organic spectroscopy by J.R.Dyer
11. Organic Spectroscopy by William Kemp
12. Fundamentals of organic synthesis amd retrosynthetic analysis by Ratna Kumar Kar
13. Comprehensive practical organic qualitative analysis by V.K.Ahluwalia & Sumta Dhingra
14. Comprehensive practical organic chemistry: Preparation and quantitative analysis by V.K.Ahluwalia and Reena Agarwal.
15. Organic Chemistry by Janice Gorzynski
16. Organic Chemistry by Stanley H Pine
17. Fundamentals of Organic Chemistry by John Mc Murray, Eric Simanek
18. Organic Chemistry by Francis A Carey
19. Text book of Organic Chemistry by K.S.Mukherjee
20. Organic Chemistry by Bhupinder Meha & Manju Mehta
21. Organic Chemistry by L.G.Wade Jr, Maya Shankar Singh
22. Elementary organic spectroscopy by Y.R. Sharma
23. Chemistry & Industry by Gurdeep R. Chatwal
24. Applied Chemistry by Jayashree Ghosh
25. Drugs by David Krupadanam
26. Pharmacodynamics by R.C.Srivastava, Subit Ghosh
27. Analytical Chemistry by David Krupadanam
28. Green Chemistry – V.K.Ahluwalia
29. Organic Synthesis by V.K.Ahluwalia and R.Agarwal
30. New trends in Green Chemistry –by V.K.Ahluwalia & M.Kidwai
31. Industrial Chemistry by B.K.Sharma
32. Industrial Chemistry by Banerji
33. Industrial Chemistry byM.G.Arora
34. Industrial Chemistry by O.P.Veramani & A.K.Narula
35. Synthetic Drugs by O.D.Tyagi & M.Yadav
36. Medicinal Chemistry by Ashutoshkar
37. Medicinal Chemistry by P.Parimoo
38. Pharmacology & Pharmacotherapeutics by R.S Satoshkar & S.D.Bhandenkar
39. Medicinal Chemistry by Kadametal P-I & P.II
40. European Pharmacopoeia
41. Vogel's Qualitative organic analysis.
42. Laboratory manual of Organic Chemistry by Raj K Bansal

Physical chemistry books.

1. Physical chemistry A molecular approach by Donald A. Mcquarrie and John D. Simon.
2. Physical chemistry by G M Barrow
3. Principles of physical chemistry by Prutton and Marron
4. Physical chemistry by Peter Atkins, Julio D. Paula
5. Physical Chemistry by Ira N Levine
6. Elements of Physical Chemistry by Peter Atkins, Julio D. Paula
7. Text book of Physical Chemistry by P.L.Soni, O.P.Dharmarha and Q.N.Dash
8. Solid State Chemistry and its applications by Anthony R. West
9 Text book of physical chemistry by K L Kapoor
10. Thermodynamics for Chemists by S Glasston
11. Chemical Kinetics by K J Laidler
12. An Introduction to Electrochemistry by S Glasston
13. Physical chemistry through problems By S K Dogra
14. Thermodynamics by J Jayaram and J C Kuriakose
15. Introductory Quantum Chemistry by A K Chandra
16. Physical Chemistry by J W Moore
17. Kinetics and mechanism by J W Moore and R G Pearson
18. Fundamentals of photochemistry by K K Rohtagi Mukharjee
19. Chemical thermodynamics by R P Rastogi and S S Misra
20. Advanced physical chemistry by Gurudeep Raj
21. Physical chemistry by G W castellan
22. Physical chemistry by Silbey, Alberty and Bawendi.
23. Elements of physical chemistry by Glasstone and Lewis
24. Text book of physical chemistry by S Glasstone
25. Fundamentals of Molecular spectroscopy by C.N.Banwell and E.M.McCash
26. Nanochemistry by Geoffrey Ozin and Andre Arsenault
27. Catalysis: Concepts and green applications by Gadi Rotherberg
28. Green Chemistry: Theory and practice by P.T.Anastas and J.C.Warner
29. Polymer Science by Gowriker, Viswanathan and Jayadev Sridhar
30. Introduction polymer Chemistry By G.S.Misra
31. Polymer Chemistry by Bilmayer
32. Kinetics and Mechanism of Chemical Transformations by Rajaram and Kuriacose.
33. Senior practical physical chemistry by Khosla

Modification as follows:-

Paper – I

Alkyls of Lithium magnesium and aluminum (in place of 1,2 and 13 group elements).

Paper – II

Unit – II Item 6 Exercises in Interconversion specified with examples Alkycalides to carbon compounds Alcohols to carbonic acids.

Paper – IV

Unit – II Nominclature Chemical name and generic names (instead of chemical, generic and trade names)

ANDHRA UNIVERSITY
B.Sc. CHEMISTRY

MODEL CURRICULUM – COURSE STRUCTURE

B.Sc. I Year – Paper-I **120 hrs (30 weeks)**

UNIT – I (Inorganic Chemistry-I)		**30 hrs (1 h / w)**
1. s-Block elements	3 h	
2. p-Block elements	20 h	
3. Organo metallic Chemistry	7 h	
UNIT – II (Organic Chemistry-I)		**30 hrs (1 h / w)**
1. Structural theory in Organic Chemistry	10 h	
2. Acyclic hydrocarbons	8 h	
3. Alicyclic hydrocarbons	4 h	
4. Benzene and its reactivity	6 h	
5. Polynuclear hydrocarbons	2 h	
UNIT – III (Physical Chemistry-I)		**30 hrs (1 h / w)**
1. Gaseous State	6 h	
2. Liquid State	2 h	
3. Solid State	10 h	
4. Solutions	6 h	
5. Colloids and Surface Chemistry	6 h	
UNIT – IV (General Chemistry-I)		**30 hrs (1 h / w)**
1. Atomic structure and Elementary quantum mechanics	8 h	
2. Chemical Bonding	8 h	
3. Stereochemistry of carbon compounds	10 h	
4. General principles of Inorganic qualitative analysis	4 h	

LABORATORY COURSE – I

Practical Paper – I (Inorganic Chemistry)

Qualitative analysis and Inorganic preparations **90 hrs (3 h / w)**

B.Sc. II Year – Paper-II **120 hrs (30 weeks)**

UNIT-I (Inorganic Chemistry – II) **30 hrs (1 h /w)**

1. Chemistry of d-block elements	9 h
2. Chemistry of f-block elements	8 h
3. Theories of bonding in metals	6 h
4. Metal carbonyls and related compounds	7 h

UNIT-II (Organic Chemistry – II) **30 hrs (1 h /w)**

1. Halogen compounds	4 h
2. Hydroxy compounds	6 h
3. Carbonyl compounds	10 h
4. Carboxylic acids and derivatives	5 h
5. Active methylene compounds	3 h
6. Exercises in interconversions	2 h

UNIT-III (Physical Chemistry – II) **30 hrs (1 h /w)**

1. Phase Rule	5 h
2. Dilute solutions	8 h
3. Electrochemistry	17 h

UNIT-IV (General Chemistry – II) **30 hrs (1 h /w)**

1. Molecular symmetry	5 h
2. Theory of quantitative analysis	8 h
3. Evaluation of analytical data	4 h
4. Introductory treatment to	
a. Pericyclic reactions	5 h
b. Synthetic strategies	4 h
c. Asymmetric synthesis	4 h

LABORATORY COURSE – II **90 hrs (3 h /w)**

Practical Paper- - II (Inorganic Chemistry)

Titrimetric analysis and Gravimetric analysis

B.Sc. III Year – Paper-III **90 hrs (30 weeks)**

UNIT – I (Inorganic Chemistry – III) **30 hrs (1 h / w)**

1. Coordination Chemistry	10 h
2. Spectral and magnetic properties of metal complexes	4 h
3. Reactivity of metal complexes	4 h
4. Stability of metal complexes	4 h
5. Hard and soft acids and bases	4 h
6. Bioinorganic Chemistry	4 h

UNIT – II (Organic Chemistry – III) **30 hrs (1 h / w)**

1. Nitrogen compounds	9 h
2. Heterocyclic compounds	5 h
3. Carbohydrates	6 h
4. Amino acids and Proteins	5 h
5. Mass spectrometry	5 h

UNIT – III (Physical Chemistry – III) **30 hrs (1 h / w)**

1. Chemical kinetics	9 h
2. Photochemistry	5 h
3. Thermodynamics	16 h

Paper-IV **90 hrs (30 weeks)**

Chemistry and Industry

UNIT – I (Physico chemical methods of Analysis) **30 hrs (1 h / w)**

1. Separation techniques	12 h
2. Spectrophotometry	4 h
3. Molecular spectroscopy	14 h

UNIT – II (Drugs, Formulation, Pesticides & Green Chemistry) **30 hrs (1 h / w)**

1. Drugs	17 h
2. Formulations	3 h
3. Pesticides	5 h
4. Green Chemistry	5 h

UNIT – III (Macromolecules, materials science and catalysis) **30 hrs (1 h / w)**

1. Macromolecules	10 h
2. Materials Science	8 h
3. Catalysis	12 h

LABORATORY COURSE – III **90 hrs (3 h / w)**

Practical Paper – III (Organic Chemistry)

1. Synthesis of organic compounds
2. Thin layer and Column chromatography
3. Organic qualitative analysis
    a. Identification of Individual organic compounds
    b. Separation of two component mixtures
4. Demonstration experiments
    a. Microwave assisted Green synthesis
    b. Steam distillation experiment

LABORATORY COURSE – IV **90 hrs (3 h / w)**

Practical Paper – IV (Physical Chemistry)

1. Chemical kinetics
2. Distribution Law
3. Electrochemistry
4. pH metry
5. Colorimetry
6. Adsorption
7. Project work

Note: Apart from the experiments (1 to 6) the project work (7) shall also be included in the University examination.