ANDHRA KESARI UNIVERSITY ::ONGOLE

Model Syllabus for Chemistry (Minor) in consonance with Curriculum framework w.e.f. AY 2025-26

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	III	1	General Chemistry	3	3
			Qualitative Analysis of Simple Salt	2	1
	IV	2	Organic Chemistry	3	3
			Organic Qualitative Analysis	2	1
III	V	3	Inorganic Chemistry	3	3
			Inorganic Preparations	2	1
		4	Organic Chemistry and Spectroscopy	3	3
			Organic Preparations	2	1
	VI	5	Physical Chemistry	3	3
			Physical Chemistry Practical	2	1
		6	Analytical Chemistry	3	3
			Volumetric Analysis	2	1

SEMESTER-III

COURSE 1: GENERAL CHEMISTRY

Theory **Credits: 3** **3 hrs/week**

I. LEARNING OBJECTIVES:

1. To understand the structure of the atom and its relation to periodic properties.
2. To explain different types of chemical bonding-ionic, covalent, metallic, hydrogen bonding.
3. To apply bonding theories to predict molecular structure and bonding nature.
4. To correlate periodic trends with physical and chemical properties of elements.
5. To evaluate acid-base behaviour using various theories and apply the HSAB principle.

II. COURSE OUTCOMES:

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

1. Describe the electronic configuration of elements and periodic trends.
2. Analyze the formation and properties of ionic and covalent compounds.
3. Apply VSEPR, hybridization, and MOT to predict molecular geometry and bonding.
4. Explain metallic bonding, hydrogen bonding, and intermolecular forces and relate them to physical properties.
5. Compare and evaluate acid-base theories and explain HSAB applications in predicting chemical reactivity.

III. SYLLABUS:

UNIT-1: ATOMIC STRUCTURE AND PERIODIC TABLE (9h)

Electronic configuration-Aufbau principle, Hund's rule and Pauli's exclusion principle. Periodic lawand arrangement of elements in the periodic table, horizontal, vertical, and diagonal relationships in the periodic table. Definition and periodic trends of atomic radii, ionic radii, covalent radii, ionization potential, electron affinity, and electro negativity, Pauling scale, variable valency, inert-pair effect.

UNIT-2: IONIC BOND (9h)

Properties of ionic compounds, factors favouring the formation of ionic compounds, Lattice energy: definition, factors affecting lattice energy, Born-Haber cycle - enthalpy of formation of ionic compound and stability, Covalent character in ionic compounds - polarization and Fajan's rules, effects of polarization.

UNIT-3:COVALENT BOND (9 h)

Valence Bond theory: Hybridization of atomic orbitals and geometry of molecules-$BeCl_2$, BF_3, CH_4, PCl_5, and SF_6 .

VSEPR model: Effect of bonding and nonbonding electrons on the structure of molecules- NH_3,H_2O,SF_4, $ICl_2^-$and XeF_4

Molecular orbital theory: LCAO method, construction of M.O. diagrams for homo nuclear and heteronuclear diatomic molecules (N_2, O_2, CO and NO)

UNIT -4: METALLICANDHYDROGENBONDS **(9 h)**

Metallic bond: Metallic properties, free electron theory, band theory of metals. Explanation of conductors, semiconductors and insulators.

Hydrogen bonding: Intra- and Inter molecular hydrogen bonding, influence on the physical properties of molecules, Vanderwaals forces, dipole-dipole interactions.

UNIT -5: ACIDS, BASESAND HSAB PRINCIPLE **(9h)**

Definition of Acid and base- Arrhenius, Bronsted-Lowry, Lewis theories, the solvent system, Classification of solvents, pH, Types of salts, Salt hydrolysis.

Pearson's concept, HSAB principle and its application.

IV. REFERENCES:

1. J.D.Lee, Concise InorganicChemistry,5th ed.,BlackwellScience,London,1996.
2. B.R.Puri, L.R.Sharma, K.C.Kalia, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand and Co.,1996.
3. D.F.ShriverandP.W.Atkins,InorganicChemistry,3rd ed., W.H.Freeman and Co, London,
4. James E. Huheey, **Inorganic Chemistry: Principles of Structure and Reactivity**, 4thed., 2017.
5. W.U. Malik, G.D Tuli, R.D Madan, Selected Topics in Inorganic Chemistry, S. Chand Publishing, 1998.

V. PROPOSED ACTIVITIES:

1. Chart on periodic trends like radii, ionization energy, electro negativity across groups/periods.
2. Worksheet solving- MOT diagrams, hybridization problems, salt hydrolysis calculations.
3. Case study- Analyze real-life use of acids and bases,
4. Model Building-Build 3D structures using kits/software for CH_4, PCl_5, XeF_4 etc.

VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning.
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

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SEMESTER-III

COURSE 1: QUALITATIVE ANALYSIS OF SIMPLE SALT

Practical **Credits: 1** **2 hrs/week**

I.LEARNING OBJECTIVES:

1. To understand the theoretical principles behind classical qualitative analysis of cations and anions.
2. To develop the ability to identify common cations and anions in inorganic salts.
3. To practice laboratory safety and correct handling of reagents.
4. To record and interpret observations accurately in systematic salt analysis.

II. COURSE OUTCOMES:

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

1. Proper use of glassware, equipment and chemicals in the laboratory
2. Apply systematic procedures to identify one cation and one anion in a given inorganic salt.
3. Analyze reactions based on solubility, color changes, and precipitate formation.
4. Interpret results to draw conclusions and confirm the identity of ions.

III. SYLLABUS:

Analysis of simple salt containing **one anion and one cation** from the following:

Anions: Carbonate, sulphate, chloride, bromide, acetate, nitrate, borate, phosphate.

Cations: Lead, copper, iron, aluminium, zinc, nickel, manganese, calcium, strontium, barium, ammonium.

IV. REFERENCES

1. G. Svehla, Vogel's Textbook of Qualitative Inorganic Analysis, Pearson Education, 2008.
2. K. Nagaraj, S. Kamalesu, S. Lokhandwala, N.M. Parekh, Textbook of Semi-micro Inorganic Qualitative Analysis, Notion Press,2023.
3. G. Pass, H. Sutcliff, Practical Inorganic Chemistry. 2nd edition, John-Wiley & Sons, 2020.

V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce

SEMESTER-IV

COURSE 2: ORGANIC CHEMISTRY

Theory	Credits: 3	3 hrs/week

I. LEARNING OBJECTIVES:

1. To understand the structural theory behind reactivity in organic chemistry.
2. To classify hydrocarbons and understand the preparation and reactions of alkenes and alkynes.
3. To explain aromaticity and interpret mechanisms of key organic reactions.
4. To explore the structure, preparation, and substitution reactions of benzene.
5. Tounderstand the structure, reactivity, and mechanisms of halogenated organic compounds, alcohols and phenols

II. COURSE OUTCOMES:

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

1. Study Inductive effect, Mesomeric effect, hyper conjugation and its applications.
2. Explain the preparation and chemical properties of alkenes, alkynes and benzene.
3. Analyze and apply Huckel's rule to benzenoid and non-benzenoid aromatic compounds.
4. Analyze the reactivity and reaction mechanisms of alkyl halides, alcohols and phenols.
5. Differentiate betweenMarkownikoff and Antimarkownikoff addition, SN1 and SN2 mechanisms.

III. SYLLABUS:

UNIT-1: STRUCTURAL THEORY IN ORGANIC CHEMISTRY (9 h)

Functional groups in organic chemistry, Types of bond fission, Electrophiles, Nucleophiles, Reactive intermediates-carbocations, carbanions & free radicals. Inductive effect and its application: (a) Basicity of amines and (b) Acidity of carboxylic acids, Resonance or Mesomeric effect and its application: (a) Acidity of phenol, and (b) Acidity of carboxylic acids. Hyper conjugation and its application to the stability of carbonium ions.

UNIT-2: UNSATURATED HYDROCARBONS (ALKENES &ALKYNES) (9 h)

Alkenes: Preparation of alkenes by dehydration of alcohols, Saytzeffand Hofmann eliminations, Electrophilic Additions of X_2, H_2O, HX to alkene, Markownikoff and Anti-markownikoff addition, Ozonolysis, Diels-Alder reaction, 1,2- and1,4-addition reactions in conjugated dienes.

Alkynes: Additions of X_2, H_2O, HX to alkynes, acidity and alkylation of terminal alkynes.

UNIT-3: BENZENE AND ITS REACTIVITY (9 h)

Structure of Benzene, Preparation: polymerisation of acetylene and decarboxylation, Properties: Electrophilic aromatic substitution- Halogenation, Nitration, Friedel-Craft's alkylation and Friedel- Craft's acylation.

UNIT-4: AROMATICITY AND ALKYL HALIDES (9h)

Aromaticity: Concept of aromaticity, Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non-Benzenoid compounds (cyclopropenylcation, cyclopentadienyl anion and tropylium cation).

Alkyl halides: Nucleophilic substitution reactions – SN1 and SN2 mechanisms with energy profile diagrams, Comparison of SN1 and SN2 reactions.

UNIT-5: ALCOHOLS AND PHENOLS (9 h)

Alcohols: Preparation of 1°,2°,3°-alcohols from Grignard's reagent, Chemical properties: substitution of –OH by using PCl_5, PCl_3, $SOCl_2$ and HX / $ZnCl_2$, Oxidation of alcohols with PCC and PDC, Pinacol-Pinacolone rearrangement with mechanism.

Phenols: Preparation from diazonium salt, Reimer-Tiemannand Kolbe–Schmidt reactionwith mechanism.

IV. REFERENCES:

1. R.N. Morrison, R.N. Boyd, Organic Chemistry, Pearson Education, 7th edition, 2010.
2. Peter Sykes, Guidebook to Mechanism in Organic Chemistry, 6thedition,1985.
3. S.P. Singh, O. Prakash, Reaction mechanism in organic chemistry, Laxmi Publications, 2017.
4. P.Y. Bruice, Organic Chemistry, 8thEdition, Pearson, 2017.
5. V.K. Ahluwalia, P. Bhagat, R. Aggarwal, R. Chandra, Intermediate for Organic Synthesis, I.K.International. 2005.
6. T.W.G. Solomons, C.B. Fryhle, S.A. Snyder, Organic Chemistry, 12th Edition, Wiley, 2016.

V. PROPOSED ACTIVITIES:

1. Mechanism writing exercises- Electrophilic aromatic substitution, electrophilic additions.
2. Group quiz on aromaticity and reactive intermediates.
3. Concept mapping-Properties of alkane, alkene, alkyne, benzene.

VI. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Continuous Internal Evaluation (CIA): Monitoring the progress of student's learning
2. Class Tests, Worksheets, Quizzes, Industrial/Field visits, Student seminars, Poster and PPT presentations, Peer learning, Project-based learning, Assignments, Debates, Group Discussions: Enhances critical thinking skills.
3. Semester End Examination (SEE): Critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

SEMESTER-IV

COURSE 2: ORGANIC QUALITATIVE ANALYSIS

Practical **Credits: 1** **2 hrs/week**

I. LEARNING OBJECTIVES:

1. To identify functional groups in unknown organic compounds using systematic analysis.
2. To determine the physical constants of organic compounds accurately.
3. To prepare suitable solid derivatives to confirm the presence of functional groups.
4. To apply laboratory safety protocols and precise techniques during analysis.

II. COURSE OUTCOMES:

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

1. Proper use of glassware, equipment and chemicals in the laboratory.
2. Systematically analyze unknown organic compounds to identify functional groups.
3. Determine melting point or boiling point of organic compounds to assess purity.
4. Prepare derivatives for confirmation of functional groups.

III. SYLLABUS:

Systematic Qualitative Analysis of an organic compounds 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.***

IV. REFERENCES:

1. F.G. Mann, B.C. Saunders,Practical Organic Chemistry, Pearson Education, 2009.
2. B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, Vogel's Textbook ofPractical Organic Chemistry, Pearson, 2012.
3. V.K. Ahluwalia, R. Aggarwal,(2004),Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press, 2004
4. V.K. Ahluwalia, S. Dhingra, (2004),Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press, 2004.

V. CO-CURRICULAR ACTIVITIES AND ASSESSMENT METHODS:

1. Internal Practical Assessment
2. Lab Record Evaluation
3. Final Practical Examination
4. Oral/Viva Voce.

SEMESTER-V

COURSE 3: INORGANIC CHEMISTRY

Theory **Credits: 3** **3 hrs/week**

I. LEARNING OBJECTIVES:

1. To understand the structural and chemical properties of selected p-block compounds.
2. To classify and analyze the characteristics of d-block elements.
3. Understand the nomenclature, structure and isomerism of coordination compounds.
4. Apply VBT and CFT to explain bonding, geometry, magnetism, and reactivity in coordination complexes.

II. COURSE OUTCOMES:

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

1. Explain the structures and preparation of key p-block compounds.
2. Classify d-block elements and discuss their properties and oxidation states.
3. Analyze magnetic, catalytic, and color properties of transition metals.
4. Classify ligands and write IUPAC names of coordination compounds.
5. Explain VBT and CFT concepts to predict structures of complexes.

III. SYLLABUS:

UNIT-1: CHEMISTRY OF p-BLOCKELEMENTS – I (9 h)

Group 13: Preparation and structure of Diborane, Borazine and$(BN)_x$.

Group 14: Preparation, classification and uses of silicones.

Group 15: Preparation and structure of Phosphonitrilic Chloride $P_3N_3Cl_6$.

UNIT-2: CHEMISTRY OFp-BLOCK ELEMENTS –II (9 h)

Group 16: Classification of oxides, structures of oxides and oxoacids of sulphur.

Group 17: Preparation and structures of Interhalogen compounds, Pseudohalogens.

UNIT-3:CHEMISTRYOFd-BLOCK ELEMENTS (9 h)

Characteristicsofd-blockelementswithspecialreferencetoelectronicconfiguration, variable valency, colour, magnetic properties, catalytic properties and ability to form complexes. Stability of various oxidation states of 3d-series.