RTM NAGPUR UNIVERSITY NAGPUR

PROPOSED SEMISTER PATTERN (CBS) SYLLABUS

(Implemention from session 2021-22)

B.Sc. –II, Semester - III

CH – 301: Paper- I (Inorganic Chemistry)

Unit- I: **(7.5 Hrs)**

(A) Valence Shell Electron Pair Repulsion (VSEPR) Theory: Structure with respect to H_2O, NH_3, NH_4^+, ClF_3, SF_4, ICl_4^-.

Preparation properties and structure of Interhalogen compounds.

Polyhalides (Structure of I_3^-, I_5^-, ICl_4^-)

(B) MO theory: LCAO approximation, wave equation for molecular orbitals. Differencebetween bonding and anti bonding MO in terms of energy and electron density distributioncurves, order of energy levels in MO. Molecular Orbital diagrams for homonuclear diatomicmolecules of elements (with Z = 1 to 9). Concepts of nonbonding MO in HF molecule.Coulson'sMO diagram of CO and NO diatomic molecule.

Unit- II: **(7.5 Hrs.)**

A) Chemistry of elements of first transition series:

Characteristic properties of the elementsof first transition series with reference to their:Electronic configuration, Atomic and ionic radii, Ionization potential, Variable oxidation states,Magnetic properties, Colour, Complex formation tendency and catalytic activity.

(B) Chemistry of elements of second and third transition series:

Electronic configuration of 4d and 5d transition series.Comparative treatment with their 3danalogous (Group Cr-Mo-W, Co-Rh-Ir,) in respect of oxidation states and magnetic behaviour.

Unit – III: **(7.5 Hrs)**

A) Chemistry of Lanthanides:

Position in periodic table, electronic configuration, Oxidation states, Atomic and ionic radii,Lanthanide contraction and its consequences, Complex forming tendency.

Occurrence andSeparation of lanthanides (ion exchange and solvent extraction).

B) Chemistry of Actinides:

Position in periodic table, electronic configuration, Oxidation states, Atomic and ionic radii.Actinide contraction.

Unit IV: **(7.5 Hrs)**

A) Errors in Chemical Analysis:

i) Random and Systematic errors, Explanation of terms: Accuracy and Precision, Uncertainty,Absolute and Relative errors, Mean, Median, Average and Standard deviations, Significantfigures, numerical problems.

ii) Statistical Test of Data: Q-test, 2.5d and 4d Rules for rejection of data. Numerical problems.

B) Soil Chemistry: Types of soil, Components of soil, Introduction to soil analysis. Analysis of moisture, pH, salinity, nutrients (N, P, K) and micronutrients.

B.Sc. –II, Semester - III
CH-302: Paper- II (Organic Chemistry)

Unit–I **(7.5 Hrs)**

(A) Orientation: Activating (– OH, – NH_2) & deactivating (–Cl, –NO_2, –COOH) substituent's, their orientation and directive influence on further electrophilic substitution, o/p ratio. Methods of formation and chemical reactions of alkyl benzene (Toluene) and biphenyl.

(B) Alkyl and Aryl halides: Nomenclature, classification, methods of formation, chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides SN^1 and SN^2 with energy profile diagrams. Chlorobenzene and benzyl chloride: Method of formations and chemical reactions

Polyhalogen compounds: Chloroform and carbon tetrachloride: formation and chemical reactions.

Unit–II **(7.5 Hrs)**

(A) Alcohols: Classification and nomenclature.

Dihydric alcohols: Nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage ($Pb(Oac)_4$ and HIO_4) and Pinacol – pinacolone rearrangement with mechanism.

Trihydric alcohols : Nomenclature and methods of formation of Glycerol from (i) Propene and (ii) Hydrolysis of oils and fats, chemical reactions of glycerol - with oxalic acid at two different temperatures, HI, HNO_3, dehydration.

(B)Phenols: Nomenclature, structure and bonding. Preparation of phenols from cumene, Chlorobenzene (Dows and Raschig process) and diazonium salts. Acidic character, Resonance stabilization of phenoxide ion, Reactions of phenols, Electrophilic aromatic substitution, acetylation and carboxylation, Claisen rearrangement, Gatterman synthesis, Reaction Mechanism of (i) Fries Rearrangement, (ii) Reimer-Tiemann reaction.

Unit–III **(7.5 Hrs)**

(A) Aldehydes and Ketones: Nomenclature, structure of the carbonyl group, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides and ketones from nitriles. oxidation of aldehydes by $KMnO_4$, Tollen's reagent and Fehlings solution. Reduction by $LiAlH_4$ and $NaBH_4$.

(B) Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensation. Wittig reaction, Mannich reaction, Baeyer-Villiger oxidation of Ketones, Cannizaro reaction, (with mechanism), MPV, Clemmensen and Wolf-Kishner reaction.

Unit–IV **(7.5 Hrs)**

(A) Carboxylic Acids: Nomenclature, structure and bonding.Acidity of carboxylic acids, effect of substituent's on acid strengths, preparation of carboxylic acids from Grignard Reagent and cyanides. Chemical reactions of carboxylic acids, Hell-Volhard-Zelinsky reactions, Mechanism of decarboxylation with soda lime.

Dicarboxylic acids: Methods of formation of succinic acid from ethylene dibromide and Phthalic acid from *o*-xylene. Effect of heat and dehydrating agents (Succinic acid, Phthalic acid).

Carboxylic acid derivatives: Structure, preparation and chemical reactions of acid chlorides, esters, amides and acid anhydrides.

(B) Agrochemicals: Introduction and examples of insecticides, herbicides, fungicide, rodenticides. Advantages and disadvantages of agrochemicals. Synthesis and applications of DDT, BHC, Aldrin, Endosulphan, Atrazine

Bio pesticides: Neem oil and Karanj oil.

CH- 303: Laboratory Course

Practical-I (Inorganic Chemistry):

A) Volumetric Analysis (All Experiments to be performed). Preparation of standard solution by weighing is compulsory

1) Estimation of Fe (II) by dichromate using internal indicator.
2) Determination of acetic acid in commercial vinegar using NaOH
3) Determination of alkali content in antacid tablet using HCl

B) **Short experiments on soil analysis**.

1. Determination of percentage of moisture in a given soil sample.
2. Determination of pH of a given soil sample.
3. Determination of Electrical conductivity of a given soil sample.
4. Determination of free lime ($CaCO_3$) in a given soil sample.

Practical- II (Organic Chemistry):

Complete analysis of simple organic compound involving following steps:-

(i) Preliminary examination (ii) Detection of elements (iii) Detection of functional group (iv) Determination of M.P. / B.P. (v) Preparation of derivative and its M.P./B.P. (vi) Performance of specific test if any.

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PROPOSED SEMISTER PATTERN (CBS) SYLLABUS

(Implementation from session 2021-22)

B.Sc. –II, Semester – IV

CH – 401: Paper- I (Inorganic Chemistry)

Unit-I: **(7.5 Hrs)**

Coordination compounds: Distinction among simple salts, double salts and coordination compounds. Werner's Coordination theory and its experimental verification. Sidgwick's electronic interpretation, EAN rule with examples, Nomenclature of Coordination compounds. Chelates: Classification and their applications, Valence Bond Theory of transition metal complexes.

Unit- II: **(7.5 Hrs)**

A)Isomerism in coordination compounds: Structural isomerism and Stereoisomerism in coordination compounds with respect to C.N. 4 & 6

B)Oxidation and reduction: Concept of oxidation and reduction. Methods of balancing redox reactions by Ion-Electron methodand oxidation number method, (numericals.) EMF series and its applications. Use of redox potential data: Analysis of Redox cycle, redox stability in water, Latimer diagram of Chlorine and Oxygen, Construction and explanation of Frost diagram. Frost diagram of Nitrogen and Oxygen. Pourbaix diagram of Iron.

Unit- III: **(7.5 Hrs)**

A) Colorimetry and Spectrophotometry: Principles of photometry: Beer-Lamberts Law, derivation and deviation (Numericals). Types of colorimeter and spectrophotometer with simple schematic diagrams. Application of colorimeter and spectrophotometer in quantitative analysis with reference to estimation of Cu(II) as Cu-ammonia complex.

B) Separation Techniques: a) Chromatography: Classification, Principle, Technique and Application of Paper and Column Chromatography. b) Ion- Exchange: Types of ion exchange resins, Equilibria and ion exchange capacity, Application in separation of binary mixtures. c) Solvent Extraction: Principle and Classification, Factors influencing extraction and application in chemistry.

Unit- IV: **(7.5 Hrs)**

(A)Inorganic Polymers: Silicones: Introduction, Nomenclature, preparation, properties and uses, Phosphonitrilic halide polymers: Introduction, Preparation, properties and uses. Structure and bonding in $(NPCl_2)_3$

(B)Water Analysis: Water and its quality parameters, Physical and chemical quality parameters of drinking water. Analysis of water quality parameters (pH, conductance, TDS, Turbidity, Temporary and permanent Hardness, BOD, COD, DO, alkalinity, Chloride, Fluorides, Sulphate)

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B.Sc.Semester-IV

CH-402,CHEMISTRY-II(PhysicalChemistry)

UNIT-I:SOLIDSTATE **(7.5 Hrs)**

(A) Solidandtheirclassification,differencebetweencrystallineandamorphoussolids,crystallography: some terms used in crystallography, Laws of crystallography: Law ofconstancyofinterfacialangles,Lawofrationalityofindices,Lawofsymmetry,Elementsof symmetry of a crystal, space lattice and unit cell, Bravais lattices, crystal systems,identification of crystal planes, Weiss indices and Miller indices, interplanar distances incubic systems.

(B) X-ray diffraction by crystal, derivation of Bragg's equation, experimental methods ofdeterminationofcrystalstructure:Powder method,Laue's method, determinationofcrystal structure of NaCl, KCl and CsCl, types of crystals, characteristics of various typesof crystals, characteristic structures of ionic crystals, zinc blende structure and Rutilestructure,numericalproblems.

UNIT-II:ELECTROCHEMISTRY **(7.5Hrs)**

(A) Electrical transport: Electrolytic and metallic conductance, difference between metallicandElectrolyticconductors,electricalresistanceandconductance,specific,equivalentandmolar conductance, measurement of Electrolytic conductance, variation of conductance,specific,equivalentandmolarconductancewith concentration.
Kohlrausch's law, Arrhenius theory of Electrolytic dissociation, limitations of Arrheniustheory,Ostwald'sdilutionlaw,validityandimportanceofOstwald'sdilutionlaw,Debye-Huckel theory (elementary treatment), relaxation effect, electrophoretic effect, Debye-Huckel-Onsagarequation.

(B) Transportnumber,determinationoftransportnumber:Hittorf'smethod,Movingboundarymethod,relationbetweenionicconductanceandtransportnumber,applicationsofKohlrausch's law, applications of conductance measurement: determination of equivalentconductance at infinite dilution (λ_∞) for weak electrolytes, determination of degree ofdissociation, determination of solubility and solubility product of sparingly soluble salts,conductometrictitrations:acid-baseandprecipitationtitrations,numericalproblems.

UNIT-III:MOLECULARSPECTROSCOPY **(7.5Hrs)**

(A) Rotational spectra: Introduction, electromagnetic radiation, regions of electromagneticspectrum, types of molecular spectra, rotational spectra of diatomic molecules, energylevels of rigid rotors, selection rules, expression for wave numbers of spectral lines interms of rotational constant and rotational Quantum number, intensity of spectral lines,types of molecules showing rotational spectra, Applications of rotational spectra fordeterminationofmomentofinertia and bondlength, introductionto non-rigidrotor.

(B) Vibrational spectra: Vibrational energy levels of simple harmonic oscillator, selectionrules,typesofmoleculesshowingvibrationalspectra,vibrationalenergylevelsofanharmonic oscillator, selection rules, Idea of overtones, Vibrational-Rotational spectra,P,QandRbranchesofvibrational-rotationalspectra,structuralinformationfromInfraredspectra,momentofinertiaandbondlength,force constant,normalmodesofvibrationsinpolyatomicmolecules,numericalproblems.

UNIT-IV:QUANTUMCHEMISTRY(7.5Hrs)

(A) Failure of classical mechanics, explanation of black body radiation, photoelectric effect,heat capacity of solids, de-Broglie's hypothesis (derivation and experimental proof),Heisenberguncertaintyprinciple(explanationandexperimentalproof),Schrodingerwaveequation,Eigenvaluesand Eigenfunctions,normalisedandorthogonal wavefunctions,operators,algebraofoperators,Laplacianoperator,Hermitianoperator,postulates of quantum mechanics, derivation of Schrodinger wave equation on the basisof postulatesofquantummechanics.

(B) Dielectric and Magnetic properties of molecules: polarization of molecules in an electricfield, Clausius-Mosotti equation, effect of temperature on polarization, dipole momentandchemicalConstitution(applicationsofdipolemoment),Magneticpermeability,diamagnetic,paramagneticandferromagneticsubstances,magneticsusceptibility,measurementofmagneticsusceptibility(Gouy'smethod),applicationsofmagneticsusceptibility, numericalproblems.

Reference Books:

1. WestAR,SolidstatechemistryandIt'sapplications,Wiley (1984)
2. Castellan GW,Physicalchemistry,Narosa(2004).
3. BanwellCNandMccash,FundamentalsofMolecularspectroscopy,McGraw-Hill(1994)
4. PrasadRK, QuantumChemistry,Wiley-EasternLtd,NewDelhi(1992)
5. KapoorKL,PhysicalChemistry,Vols.I,II,IIIandIV,McMillan(India)Ltd.NewDelhi (1984)

CH-403,Laboratory Course.

Practical-I (Inorganic Chemistry):

A) Preparation of following complexes and Comments on its VBT structure, magnetic Properties and colours: a) $[Cu\ NH_3)_4(H_2O)_2]SO_4$ b) $[Ni(NH_3)_6]SO_4$

c) Trans $[Co\ (NH_3)_4Cl_2]Cl$ d) $K_3[Fe(C_2O_4)_3].H_2O$

B) Chromatographic separation of binary mixtures (at least Two) containing Cu(II), Co(II) and Ni(II) ions by paper chromatography and determination of Rf values.

C) Determination of Zn by complexometric titration with EDTA

D) Determination of total Hardness of water (permanent and Temporary) by EDTA

E) Determination of following parameters of drinking water

a) pH b) Conductance c) Turbidity d) alkalinity and d) TDS

Practical-II,(PhysicalChemistry)

1. Toconstructvariouscrystallattices.
2. Todeterminethestrengthofgivenacid(HClorCH$_3$COOH)conductometricallybyusingstandardalkali(NaOH)solution.
3. To determine the strength of strong acid and weak acidin a mixtureConductometrically by usingstandard alkali(NaOH)solution.
4. Todeterminesolubilityandsolubilityproductofasparinglysolublesaltconductometrically.
5. Todetermineionizationconstantofweakacidconductometrically.
6. To determine electron polarization and electron polarizabilityof aliquidrefractometrically.
7. Todeterminethemolarvolumeofethanolandit'spartialmolalvolumeatroomtemperaturein dilute solution.
8. Todeterminetheequilibriumconstantofthereaction,$KI+I_2=KI_3$bythedistributionmethod.