ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

REVISED UG SYLLABUS UNDER CBCS
(Implemented from Academic Year 2020-21)
PROGRAMME: FOUR YEAR B.Sc. (Hons)

Domain Subject: **CHEMISTRY**

Courses for Semesters VII & VIII

(Syllabus with Learning Outcomes, References, & Co-curricular Activities)

Structure of Courses for Semester–VII

(Choose A or B from the Two alternate courses)

Univ. Code	Course NO.	Name of Course	Theory Internal exam Marks	Theory External Exam Marks	Theory exam Credits	Practical Marks	Practical Credits
	8A	Inorganic Chemistry: Advance Studies in Complexes and Group theory	25	75	4	50	1
	8B	Inorganic Materials of Industrial importance	25	75	4	50	1
	9A	Spectroscopy of Organic compounds	25	75	4	50	1
	9B	Stereo Chemistry and Natural Products	25	75	4	50	1
	10A	Physical Chemistry: Thermodynamics, Electrochemistry and Chemical Kinetics	25	75	4	50	1
	10B	Instrumental Methods of Chemical Analysis	25	75	4	50	1
	11A	Green Chemistry	25	75	4	50	1
	11B	Analysis of Drugs, Foods, Dairy Products &Bio Chemical Analysis	25	75	4	50	1
	12A	Polymer Chemistry	25	75	4	50	1
	12B	Industrial Chemicals and Environment	25	75	4	50	1
	13	Online course			5		

Structure of Courses for Semester–VIII

(Choose A or B from the Two alternate courses)

Univ. Code	Course NO.	Name of Course	Theory Internal Exam Marks	Theory External Exam Marks	Theory Exam Credits	Practical Exam Marks	Practical Exam Credits
	14A	Inorganic Chemistry: Metal Cluster, Electronic spectra of Complex compounds and Bio-inorganic chemistry	25	75	4	50	1
	14B	Organometallic Chemistry	25	75	4	50	1
	15A	Modern Organic synthesis and Natural Products	25	75	4	50	1
	15B	Chemistry of Natural products	25	75	4	50	1
	16A	Physical Chemistry: Quantum and Molecular Spectroscopy	25	75	4	50	1
	16B	Analytical Methods of Analysis	25	75	4	50	1
	17A	Pharmaceutical and Medicinal Chemistry	25	75	4	50	1
	17B	Pesticides and Green Chemistry	25	75	4	50	1
	18A	Corrosion and Its Prevention	25	75	4	50	1
	18B	Material & Energy Balancesand Utilities in Chemical Industry	25	75	4	50	1
	19	Online course			5		

Note-1: For Semester–VII&VIII, for the domain subject Chemistry, Three Core courses and Two Skill Enhanced Courses shall be chosen course A or B from the list of Courses in each Semester. Three pairs of Core Courses are 8A&8B, 9A&9B, 10A&10B for Sem- VII and 14A&14B, 15A&15B, 16A&16B for Sem-VII. Two Pairs of Skill Enhanced Courses are11A&11B, 12A&12B for Sem-VII and 17A&17B, 18A&18B from Sem-VIII. One Online Course chosen from Swayam/NPTEL/Any other courses recognized by universities per semester-VII and VIII.

Note-2: *One of the main objectives of Skill Enhancement Courses (SEC) is to inculcate skills related to the domain subject in students. The syllabus of SEC will be partially skill oriented. Hence, teachers shall also impart practical training to students on the skills embedded in syllabus citing related real field situations.*

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Course 8A: Inorganic Chemistry-I: Advance Studies in Complexes and Group theory

I. Course Learning Outcomes:

1) The student will understand the VSPER theory, symmetric and unsymmetric Hydrogen bonds in inorganic molecules.
2) Understanding the Crystal field theory and Jahn Teller Effects.
3) The students will be able to understand the basics of molecular orbital theory and energetic of hybridization.
4) The students are able to understand the Jobs method, hard and soft acids and bases.
5) The students will acquire the knowledge of symmetry

II. Syllabus: (Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Total: 60hours(4hr/Week)

Unit-I:

Chemistry of non- transition elements: 12Hours

Inter halogen compounds, Halogen oxides and oxyfluorides, Clathrate compounds, Spectral and Magnetic properties of Lanthanides and Actinides. Analytical applications of Lanthanides and Actinides. Synthesis, properties and structure of B-N, S-N,P-N cyclic compounds. Intercalation compounds.

Metal π- complexes: preparation, structure and bonding in Nitrosyl, Dinitrogen and Dioxygen complexes.

Unit-II: Structure and Bonding: 12Hours

pπ-dπ bonding, Bent's rule, Non-valence cohesive forces, VSEPR theory. Molecular Orbital theory, Symmetry of Molecular orbitals, Molecular orbitals in triatomic (BeH_2) molecules and ions (NO_2^-) and energy level diagrams. Application of MO theory to square planar ($PtCl_4^{2-}$) and octahedral complexes (CoF_6^{3-},$Co(NH_3)_6^{3+}$).Walsh diagrams for linear (BeH_2) and bent(H_2O)molecules.

Unit-III: Metal–ligand bonding: 12Hours

Crystal Field Theory of bonding in transition metal complexes-Splitting of d-orbitals in octahedral, tetrahedral, square planar and Trigonal bipyramidal and Square pyramidal fields. Tetragonal distortions - Jahn-Teller effect. Applications and limitations of CFT. Experimental evidences for covalence in complexes. Molecular Orbital Theory of bonding for Octahedral, tetrahedral and square planar complexes. π-bonding and MOT - Effect of π - donor andπ – acceptor ligands on Δo. Experimental evidence for π-bonding in complexes.

Unit-IV: Metal–ligand Equilibriain solutions: 12Hours

Step wise and overall formation constants. Trends in stepwise constants (statistical effect

and statistical ratio). Determination of formation constantsby Spectrophotometric method (Job's method) and Ph metric method (Bjerrum's). Stability correlations -Irwing-William's series. Hard and soft acids and bases (HSAB), Acid-base strengths.

Unit- V: Group theory **12Hours**

Basic concepts of Symmetry and Group theory – Symmetry elements, symmetryoperations and point groups – Schoen flies symbols –Classification of molecules into point groups–Axioms of Group theory– Groupmultiplication tables for C_2V andC_3V point groups –SimilarityTransformationand classes – Representations – reducible and irreduciblerepresentations, Mulliken symbols, Orthogonality theorem and its implications,character table and its anatomy.

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/ industrial experts.

IV. Text books:

1. Inorganic Chemistry Huheey, Harper and Row.
2. Physical methods in inorganic chemistry, R.S.Drago. Affliated East-West Pvt. Ltd.
3. Concise inorganic chemistry, J.D. Lee, ELBS.
4. Modern Inorganic Chemistry, W.L. Jolly, Mc Graw Hill.
5. Inorganic Chemistry, K.F. Purcelland J.C .Kotz Holt Saunders international.
6. Concepts and methods of inorganic chemistry, B.E. Douglas and D.H.M.C. Daniel, oxford Press.
7. Introductory quantum Mechanics, A.K. Chandra.
8. Quantum Chemistry, R.K. Prasad.

V. Reference books:

1. In organic Chemistry, Atkins, ELBS**.**
2. Advanced Inorganic Chemistry, Cotton and Wilkinson, Wiley Eastern**.**
3. Text book of Coordination chemistry, K. Soma Sekhara Rao and K.N.K. Vani, Kalyani Publishers.
4. Group Theory and its Applications to Chemistry, K.V. Raman, Tata Mc Graw– Hill Publishing Company Ltd. New Delhi.
5. Chemical Applications of Group Theory, F.A. Cotton Wiley Eastern Limited New Delhi.

Course 8A: Inorganic Chemistry-I: Advance Studies in Complexes and Group theory practical Syllabus:

VI. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. List out, identify and handle various equipment in Chemistry lab.
2. Understand the basic concepts of qualitative analysis of inorganic mixture.
3. Apply the concepts of common ion effect, solubility product and concepts related to qualitative analysis.
4. Acquire skills in elimination interfering anion.
5. Identification of less familiar cation.

VII. Syllabus: *Total* Hours: 30h (2h/week)

I. Synthesis of Inorganic Metal Complexes:

Synthesis of 3d transition metal complexes of tetrahedral, square planar and octahedral geometries.

(i) Tetra ammine copper (II) sulphate monohydrate
(ii) Potassium tris(oxalato) ferrate (III) trihydrate
(iii) Tris(thiourea)copper(I) sulphate

II. Systematic Semimicro Qualitative Analysis of Inorganic six radical mixtures

In systematic Semi micro qualitative inorganic analysis, inorganic mixture contains three cations and three anions. The analysis involves identification and conformation ofcations and anions containingone less familiar cation (Tungsten, Molybdenum, Zirconium, Thorium, Titanium, Uranium, Cerium, Vanadium, Lithium, Berkelium etc.,) and one interfering anion. **Anions:**

CO_3^{2-}, S^{2-}, SO_3^{2-}, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, CH_3COO^-, $C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, PO_4^{3-}, CrO_4^{2-}, AsO_4^{3-}, F^-, BO_3^{3-}

Cations:
Ammonium ($NH_4^{+)}$
1st group: Hg, Ag, Pb, Tl, W
2nd group: Hg, Pb, Bi, Cu, Cd, As, Sb, Sn, Mo
3rd group: Fe, Al, Cr, Ce, Th, Ti, Zr, V, U, Be
4th group: Zn, Mn, Co, Ni
5th group: Ca, Ba, Sr
6th group: Mg, K, Li

Note: A minimum of 4 inorganic mixtures must be analysed in this Semester.

VIII. Co-Curricular Activities

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1. **For Teacher**: Training of students by the teacher in laboratory and field for not lessthan15 hours on the field techniques/skills of involves identification and conformation of cationsand anions containing one less familiar cation and one interfering anion.
2. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the synthetic reactions. Write their observations and submit a hand written fieldwork/project workreportnotexceeding10 pagesin the given format to the teacher.
3. Max marks for Field work/projectworkReport:05.
4. Suggested Format for Fieldwork/project work**:** Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.
5. Unit tests (IE).

IX. Reference Books:

1. Practical Inorganic Chemistry, G. Marrand B. W. Rockett.
2. Practical Inorganic Chemistry by G.Pass H.Sutchiffe, 2ndednJohnWiley&Sons.
3. Experimental Inorganic/Physical Chemistry, M.A.Malati, Horwood Publishing ,Chichester, UK(1999)
4. Vogel's textbook of semimicro qualitative analysis, 5th Edition by G. Svehla.

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Course 8B: Inorganic Materials of Industrial importance

I. Course learning Outcomes:

By the end of the course, the students will be able to:

1. Learn the composition and applications of the different kinds of glass.
2. Understand glazing of ceramics and the factors affecting their porosity.
3. Give the composition of cement and discuss the mechanism of setting of cement.
4. Explain the suitability of fertilizers for different kinds of crops and soil.
5. Explain the process of formulation of paints and the basic principle behind the protection offered by the surface coatings.
6. Explain the principle, working and applications of different batteries.
7. List and explain the properties of engineering materials for mechanical construction used in day today life.
8. Explain the synthesis and properties of nano-dimensional materials, various semiconductor and superconductor oxides

II. Syllabus

Total: 60hours(4hr/Week)

Unit I:

Silicate Industries **14 hours**

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armored glass, different types of safety glass, borosilicate glass, fluorosilicate glass, coloured glass, photosensitive glass, photochromic glass, glass wool and optical fiber.

Ceramics: Brief introduction to types of ceramics. glazing of ceramics.

Cement: Manufacture of Portland cement and the setting process, Different types of cements: quick setting cements, eco-friendly cement (slag cement), pozzolana cement

Unit II:

Fertilizers: **12 hours**

Different types of fertilizers (N, P and K). Importance of fertilizers, chemistry involved in the manufacture of the following fertilizers: urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates, superphosphate of lime, potassium chloride and potassium nitrate.

Unit III:

Batteries: **12 hours**

Primary and secondary batteries, characteristics of an Ideal Battery, principle, working, applications and comparison of the following batteries: Pb- acid battery, Li-metal batteries, Li - ion batteries, Li-polymer batteries, solid state electrolyte batteries, fuel cells, solar cells and polymer cells.

Unit IV:

Synthesis of inorganic solids: 10 hours

Conventional heat and beat method, Co-precipitation method, Sol-gel method, Hydrothermal method, Chemical vapor deposition (CVD), Ion-exchange and Intercalation method.

Unit V:

Nanomaterials: 12 hours

Overview of nanostructures and nanomaterial's, classification, preparation and optical properties of gold and silver metallic nanoparticles, concept of surface Plasmon resonance, carbon nano tubes, inorganic nanowires, Bioinorganic nanomaterial's natural and artificial nanomaterial's, self-assembled nanostructures, control of Nano architecture, one dimensional control.

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts

IV. Suggested Text Books:

1. Poole Jr.; Charles P.; Owens, Frank J. (2003), **Introduction to Nanotechnology**, John Wiley and Sons

2. West, A. R. (2014), **Solid State Chemistry and Its Application**, Wiley

3. Smart, L. E.; Moore, E. A. (2012), **Solid State Chemistry An Introduction**, CRC PresTaylor&Francis.

4. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A.(2010),**Shriver and**

Atkins Inorganic Chemistry, W. H. Freeman and Company.

5. Kent, J. A. (ed**)** (1997), **Riegel's Handbook of Industrial Chemistry**, CBS Publishers, NewDelhi.

V. References:

1.Svehla, G. (1996), Vogel's Qualitative Inorganic Analysis, Prentice Hall.

2. Banewicz, J. J.; Kenner, C.T. Determination of Calcium and Magnesium in Limestones and Dolomites, Anal. Chem., 1952, 24 (7), 1186–1187.

Course 8B: Inorganic Materials of Industrial importance-Practical syllabus

VI. Learning outcomes:

By the end of the course students will be able to:

1. Identify sulphate and ammonium ion present in ammonium sulphate fertilizer
2. Estimate the amount of calcium present in a fertilizer
3. Synthesize nanoparticles by chemical method
4. Synthesize metal doped metal oxide nanoparticles
5. Prepare and characterize silver nanoparticles.

VII. Practical Syllabus:

***Total* Hours: 30h (2h/week)**

1. Detection of constituents of Ammonium Sulphate fertilizer (Ammonium and Sulphate ions) by qualitative analysis and determine its free acidity.
2. Detection of constituents of CAN fertilizer (Calcium, Ammonium and Nitrate ions) fertilizer and estimation of Calcium content.
3. Synthesis of ZnO nanoparticles by chemical method and its characterization using UV-visible Spectrophotometer.
4. Cu doped ZnO nanoparticles
5. Synthesis of silver nanoparticles by green methods and its characterization using UV-visibleSpectrophotometer.
6. Detection of constituents of Dolomite (Calcium, Magnesium and carbonate ions) and Determination of composition of Dolomite (Complexometric titration).

VIII. Co-Curricular Activities:

Mandatory: *(Lab/field training of students by teacher :(lab:10+field:05*):

1. For Teacher: Training of students by the teacher in laboratory and field for not less than 15 hours on the field techniques/skills of synthesis of nanoparticles and its characterization using various techniques.

2. For Students: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the stages in cement preparation. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

3. Max. Marks for Fieldwork/project work Report: 05.

4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

5. Unit tests (IE).

IX. References:

1. Ghorbani, H. R.; Mehr, F.P.; Pazoki, H.; Rahmani B. M. Synthesis of ZnO Nanoparticles by Precipitation Method. Orient J Chem. 2015;31(2).

2. Orbaek, W.; McHale, M.M.; Barron, A.R. Synthesis and characterization of silver nanoparticles for an undergraduate laboratory, J. Chem. Educ. 2015, 92, 339−344.

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Course 9A: Spectroscopy of Organic compounds

I. Learning Outcomes:

By the end of the course, the students will be able to:

1) Gain insight into the basic fundamental principles of IR and UV-Vis spectroscopic techniques.
2) Use basic theoretical principles underlying UV-visible and IR spectroscopy as a tool for functional group identification in organic molecules
3) Interpret of IR, UV-visible spectra and their applications
4) Interpret of NMR, Mass spectra and their applications
5) Interpret the spectra in identifying the organic compounds

II. Syllabus

Total: 60hours(4hr/Week)

Unit-I **12 hours**

UV-Vis Spectroscopy

UV Spectroscopy: Energy transitions – Simple chromophores – UV absorption of Alkenes – polyenes unsaturated cyclic systems – Carbonyl compounds, α, β-unsaturated carbonyl systems - Woodward Fieser rules – aromatic systems – solvent effects – geometrical isomerism – acidand base effects – typical examples – calculation of λ_{max} values using Woodward - Fieser rules.

b) **ORD:** Theory of optical rotatory dispersion, α-Axial halo ketone rule and octant rule – Application of these rules in the determination of absolute configuration of cyclohexanones, decalones and cholestanones.

c) **Circular Dichroism:** Principle – positive and negative cotton effects – Absolute configuration.

Unit-II **12 hours**

Infrared Spectroscopy (FT-IR): Fundamental modes of vibrations – Stretching and bending vibrations – overtones, combination bands and Fermi resonance, factors influencing vibrational frequencies, hydrogen bonding – fingerprint region and its importance – Study of typical group frequencies for – CH, -OH, -NH, -CO-NH_2, -CC, -CHO, -CO and aromatic systems. Application in structural determination –Simple problems

Unit-III **12 hours**

^{1}H NMR spectroscopy:

a) Magnetic properties of Nuclei, Nuclear resonance, Fourier Transformation and its importance in NMR. Equivalent and non-equivalent protons, The chemical shift and it's importance, calculation of chemical shift, factors affecting the chemical shifts such as electronegativity and anisotropy, effect of deuteration, Signal integration, Spin-spin coupling: vicinal (Karplus relationships), germinal and long range. Coupling constants (*J*) and factors affecting coupling constants. –Shielding and deshielding mechanisms in acetylene carbonyl and Benzene, anisotropy –Spin-Spin Interactions related to first order and higher order spectra (AB, A_2; AB_2, ABX, ABC, AMX) –temperature dependence spectra, Hydrogen bonding. Nuclear Overhauser effect (NOE).

Unit-IV **12 hours**

Electron Spin Resonance Spectroscopy (**ESR**):

Basic Principles, Comparison of NMR & ESR. Determination of 'g' value, Factors affecting the 'g' value. Isotropic and Anisotropic constants. Splitting, hyperfine splitting coupling constants. Line width, Zero field splitting, and Kramer degeneracy. Crystal field splitting, Crystal field effects.

Applications: Detection of free radicals; ESR spectra of(a) Methyl radical (CH3·), (b) Benzene anion (C6H6-).

UNIT-V
MASS SPECTROMETRY **12 hours**

Introduction, ion production, type of ionization, EI, CI, FD, and FAB-factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular-ion peak, metastable peak, Mac Lafferty rearrangement. Nitrogen rule, isotope labeling. High resolution mass spectrometry, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

IV. Suggested Text Books:

1. Organic spectroscopy, W. Kemp 5th Ed, ELBS

2. Spectroscopy of organic compounds, RM Silversteen and others, 5th Ed, John Wiley

3. Spectroscopy of organic compounds, P.S. Kalsi, Wiley, 1993.

V. References:

1. NMR in chemistry-A multi nuclear introduction, William Kemp, McMillan, 1986.
2. Spectroscopic methods in Organic chemistry, DH Williams & I Flemmi

Course 9A: Spectroscopy of Organic Compounds- Practical Syllabus

***Total* Hours: 30h (2h/week)**

VI. Learning outcomes:

By the end of the course students will be able to

1. Identify the functional groups present in the molecules
2. Apply data to in identification of the molecule
3. Describe principles involved in Spectroscopic methods
4. Predict number of signals, splitting patterns in the proton NMR of a compound
5. Develop ability in the combined use of mass spectrometry and spectroscopic techniques for structure elucidation

VII. Practical Syllabus

a) Problems involving individual spectral methods – UV, IR, PMR and Mass

b) Problems involving combined any two of UV, IR, PMR and Mass

c) Problems involving combined any three of UV, IR, PMR and Mass

c) Problems involving all four UV, IR, PMR and Mass spectral data.

VIII. Co-Curricular Activities:

Mandatory:*(Lab/field training of students by teacher:(lab:10+field:05*):

1. For Teacher: Training of students by the teacher in laboratory and field for not less than15 hours on the field techniques/skills of detection of organic compounds using spectroscopic data.

2. For Students: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the synthetic reaction and obtaining spectral data and analyzing the organic compounds. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

3. Max. Marks for Fieldwork/project work Report: 05.

4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

5. Unit tests (IE).

IX. References:

1. NMR in chemistry-A multi nuclear introduction, William Kemp, McMillan, 1986.

2. Spectroscopic methods in Organic chemistry, DH Williams & I Flemmi

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Course 9B: Organic Chemistry: Stereo Chemistry and Natural Products

I. Course Learning outcomes:

1. Students understand and apply the substitution and elimination reaction mechanisms at aliphatic and aromatic substrates for various reactions leading to research
2. Students can able to write the stereo chemical forms for different organic molecules.
3. Understand the conformations of acyclic, monocyclic and fused ring systems and applying it to organic compounds.
4. Students are able to understand formation of various heterocyclic compounds and their synthesis and importance.
5. Students can understand the importance of natural products in medicinal chemistry

II. Syllabus:(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Total: 60hours(4hr/Week)

Unit – I Reaction Mechanism **12 Hours**

(A) AliphaticNucleophilicSubstitutionandNucleophilicAromaticsubstitution:

(B) Stereo chemistry of SN^2 and SN^1mechanisms, Neighboring Group Participation (Anchimeric assistance), NGP by O,S,N: Aromatic Nucleophilic substitution: SN_2 (Ar) (Addition – Elimination), SN_1(Ar) and benzyne mechanisms(Elimination - Addition); evidence for the structure of benzyne. Von Richter Sommelet-Hauserrearrangements.

(C) Elimination Reactions: Type of elimination reactions, mechanisms, Stereochemistry and Orientation, Hofmann and Saytzeff rules, Syn elimination versus anti-elimination, competition between elimination and substitution,dehydration, dehydrogenation, dehalogenation, decarboxylative eliminations and pyrolytic eliminations.

Unit-II: Stereo Chemistry-I: **12 Hours**

Concept and Recognition of Molecular Symmetry and Chirality. Definition and classification of Stereoisomers, Enantiomer, Diastereomer, Homomer, Epimer, Anomer, Configuration and Conformation, Configurational nomenclature: D,L and R, Snomenclature.Molecularrepresentationoforganicmolecules:Fischer,NewmanandSawhorseprojections and their inter-conversions. Geometrical Isomerism. Cis-trans, E,Z- and Syn and antinomenclature,MethodsofdeterminingconfigurationofGeometricalisomersusingphysical,spect-ral and chemical methods, Stability, Cis-trans inter conversion.

Unit-III: Stereo Chemistry-II: **12 Hours**

Definition of Conformation and factors influencing on stability of Conformations; Conformational analysis and energy profile diagram of a cyclic molecules; Conformational analysis of cyclic molecules – cyclo butane, cyclopentane, cyclohexane – mono and disubstituted cyclohaxanes and carbon hetero atom bond shaving C–O & C–N. Prochirality and Prostereoisomerism:-Homotopic ligands and faces; enantiotopic ligands and

faces; diastereo topic ligands and faces; nomenclature of enantiotopic ligands and faces(Pro-R, Pro-S,Re, Si carbonyl compounds and Alkenes)
Stereo isomerism in molecules without chiral Center- Axial chirality Allenes, Alkylidene cycloalkanes, spiranes, nomenclature. Atropisomerism: Biphenyl derivatives,nomenclature.Planarchirality: Ansa compounds, para cyclophanes, trans-cyclo octene and Helicity.

UNIT–IV

Hetero cyclic compounds 12Hours

Importance of heterocyclic compounds as drugs. Nomenclature of heterocyclic systems based on ring size, number and nature of hetero atoms. Chemistry of heterocyclic compounds, synthesis and reactivity of the following systems: Quinoline, Isoquinoline, Indole, Pyrazole, Imidazole, Oxazole, Isoxazole, Pyridazine, pyrimidine and Pyrazine.

UNIT- V

Chemistry of some typical natural products (Alkaloids and Terpenoids) **12**Hours

A study of the following compounds involving their isolation, classification, structure elucidation, synthesis and biogenesis of:
Alkaloids: Atropine, Nicotine, and Quinine.
Terpenoids: α-Terpeneol, α-Pinene and Camphor.

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

IV. Textbooks:

1. Advanced organic chemistry- Reaction, mechanism and structure, Jerry March, John Wiley.
2. Advanced organic chemistry, F.A. Carey and R.J. Sundberg, Springer, New York.
3. A guide book to Mechanism inorganic chemistry, Peter Sykes, Longman.
4. Organic chemistry, I.L. Finar, Vol.I, Fifthed. ELBS.
5. Organic chemistry, Hendrickson, Cram and Hammond (McGraw–Hill).

V. Reference books:

1. Modern organic Reactions, H.O. House, Benjamin.
2. Structure and mechanism inorganic chemistry, C.K.Ingold, Cornell University Press.
3. Principles of organic synthesis, R.O.C. Norman and J.M.Coxon, Blakie Academic & Professional.
4. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
5. Basic Principles of Organic Chemistry by J.B. Roberts and M. Caserio.
6. Stereochemistry of Organic compounds by ErnestL. Eliel, Samuel H. Wilen
7. Chemistry of natural products by S.V. Bhat, B.A. Nagasampangi.
8. Stereo chemistry of Organic compounds by D. Nasipuri

ORGANIC CHEMISTRY PRACTICALS –I

VI. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. List out, identify and handle various equipment in Chemistry lab.

2. Acquire skills in the separation of organic compounds in the given mixture using solvent extraction.
3. Determine the Melting and Boiling points of Organic compounds.
4. Understand the application of concepts of different organic reactions studied in the theory part of Organic chemistry.

VII. Syllabus.

***Total* Hours: 30h (2h/week)**

Systematic qualitative analysis of an organic mixture containing two compounds;

Identification of method of separation and the functional group(s) present in each of them and preparation of one solid derivative for the conformation of each of the functional group(s). Purification of derivatives- The student has to do Recryastallization to final derivatives(s) and submit the sample. If the sample is impure liquid must carry out distillation process.

VIII. Co-Curricular Activities

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1. **For Teacher**: Training of students by the teacher in laboratory and field for not lessthan15 hours on the field techniques/skills of separation of the given organic mixture, identifying and confirming the functional group followed by the preparation of recrystallized solid derivative.
2. **For Students**: Studentshallvisitarelatedindustry/chemistrylaboratoryinuniversities/research organizations/private sector facility and observes the synthetic reactions. Write their observations and submit a hand written fieldwork/project workreportnotexceeding10 pagesin the given format to the teacher.
3. Max marks for Field work/project work **Report:05**.
4. Suggested Format for Fieldwork/project work**:** Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.
5. Unit tests (IE).

IX. Reference Books:

1. Vogel's Text Book of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J. D. Barnes and M. J. Thomas, 4th& 6th Ed. (Pearson Education Asia).

2. Vogel's Text Book of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, 5 Ed.(Longman Scientific & Technical).

A.P. State Council of Higher Education
Semester-wise Revised Syllabus under CBCS 2020-21
Four Year - B.Sc. (Hons), Semester – VII
Domain Subject: CHEMISTRY

Course 10A: Physical Chemistry – I :Thermodynamics, Electrochemistry and Chemical Kinetics

I. Course Learning outcomes:

1. Students can able to understand the classical thermo dynamics, fugacity.
2. Students are able to understand the Electrochemical cells, Liquid junction potential.
3. Students understand the Butler - Volmer equation and Ilkovic equation
4. Understand the complex reactions, chain reactions.
5. Students understand the Branching Chain Reactions, Enzyme catalysis and Photochemical equilibrium.

II. Syllabus:(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Total: 60hours(4hr/Week)

Unit-I: Thermodynamics: 12 Hours

Classical thermodynamics - Brief review of first and second laws of thermodynamics - Entropy change in reversible and irreversible processes - Entropy of mixing of ideal gases - Entropy and disorder – Free energy functions - Gibbs-Helmholtz equation – Maxwell partial relations. Conditions of equilibrium and spontaneity - Free energy changes in chemical reactions, Van't Hoff reaction isotherm - Van't Hoff equation – Classiuss - Clapeyron equation -partial molar quantities - Chemical potential - Gibbs- Duhem equation - partial molar volume -determination of partial molar quantities - Fugacity - Determination of fugacity – Thermo dynamic derivation of Raoult's law.

Unit-II: Electrochemistry-1: 12 Hours

Electrochemical cells - Measurement of EMF - Nernst equation –Equilibrium constant from EMF Data - pH and EMF data -Determination of solubility product from EMF measurements. Concentration cells with and without transference – Liquid junction potential and its determination -Activity and activity coefficients - Debye Huckel limiting law and its verification. Effect of dilution on equivalent conductance of electrolytes - Anomalous behavior of strong electrolytes. Debye Huckel-Onsagar equation-verification and limitations- Bjerrum treatment of electrolytes.

Unit-III: Electro Chemistry-II: 12 Hours

Referenceelectrode-Standardhydrogenelectrode.Calomelelectrode-Indicator electrodes:
Metal-metal ion electrodes-Inert electrodes-Membrane electrodes
- theory of glass membrane potential, potentiometric titrations, Conductometric titrations. Electrode potentials - Double layer at the interface - rate of charge transfer - Decomposition potential - Overpotential - Tafel plots - Derivation of Butler- Volmer equation for one electron

transfer – electro chemical potential.

Unit-IV: Chemical kinetics and Photochemistry: 12 Hours

Branching Chain Reactions-Hydrogen-oxygen reaction - lower and upper explosion limits - Fast reactions - Study of kinetics by flow methods -Relaxation methods - Flash photolysis. Acid base catalysis –protolytic and prototropic mechanism. Enzyme catalysis-Michelis-Menten kinetics.
Photo chemistry: Quantum yield and its determination, Actinometry, Reactions with low and high quantum yields, Photo sensitization, Exciplexes and Excimers, Kinetics of collisional quenching- Stern-Volmer equation.

Unit-V: Chemical kinetics - II: 12 Hours

Methods of deriving rate laws - complex reactions - Rate expressions for opposing, parallel andconsecutive reactions involving unimolecular steps. Theories of reaction rates-collision theory-Steric factor-Activated complex theory - Thermo dynamic aspects–Uni molecular reactions-Lindemann's theory-Lindemann- Hinshelwood theory. Primary and secondary salt effects. Elementary account of linear free energy relationships-Hammet-Taftequation - Chain reactions - Rate laws of H_2-Br_2, photochemical reactionof H_2 - Cl_2. Decomposition of acetaldehyde and ethane-Rice-Hertzfeld mechanism.

III. Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts

IV. Textbooks:

1. Physical Chemistry P.W. Atkins, ELBS.
2. Chemical Kinetics-K.J. Laidler, Mc Graw Hill Pub.
3. Text Book of Physical Chemistry. Samuel Glass tone, Mc millan Pub.
4. Physical Chemistry, G.W. Castellan. Narosa Publishing House

V. Reference books:

1. Thermo dynamic for Chemists. Samuel Glass tone.
2. Electro chemistry, Samuel Glass tone, Affiliated East West
3. Physical Chemistry, W.J.Moore, Prentice Hall
4. Atomic structure and chemical bond. Manaschanda. Tata Mc Graw Hill Company Limited.

PHYSICAL CHEMSITRY PRACTICALS –I

VI. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. List out, identify and handle various equipment in Chemistry lab.
2. Learn and apply the concepts of electro chemistry in experiments.
3. Be familiar with electro analytical methods and techniques which study an analyte by measuring the potential (volts) and / or current (amperes) in an electro chemical cell containing the analyte..
4. Learn the procedures of preparation of standard solutions.

5. Acquire skills in operation and calibration of instruments.

VII. Syllabus:

***Total* Hours: 30h (2h/week)**

1. Conductometric titration of Strong acid versus Strong base
2. Dissociation constant of weak acid (CH_3COOH) by conductometric method.
3. Conductometric titration of Weak acid vs Strong base.
4. Determination of cell constant
5. Acid-catalyzed hydrolysis of methyl acetate
6. Determination of partial molar volume of solute –H_2O system by apparent molar volume method.

VIII. Co-Curricular Activities

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1. **For Teacher**: Training of students by the teacher in laboratory and field for not lessthan15 hours on the field techniques/skills of handling conductometric titrations.
2. **For Students**: Studentshallvisitarelatedindustry/chemistrylaboratoryinuniversities/research organizations/private sector facility and observes the synthetic reactions. Write their observations and submit a hand written fieldwork/project workreportnotexceeding10 pagesin the given format to the teacher.
3. Max marks for Field work/projectworkReport:05.
4. Suggested Format for Fieldwork/project work**:** Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.
5. Unit tests (IE).

IX. Reference books:

1. Vogel's Text Book of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J. D. Barnes and M. J. Thomas, 4th& 6th Ed. (Pearson Education Asia).

A.P. State Council of Higher Education
Semester-wise Revised Syllabus under CBCS 2020-21
Four Year - B.Sc. (Hons), Semester – VII
Domain Subject: CHEMISTRY
Course 10B: Instrumental Methods of Chemical Analysis

I. Learning Outcomes

By the end of the course, the students will be able to:

1) Handle analytical data

2) Understand basic components of IR, FTIR, UV-Visible and Mass spectrometer.

3) Interpret of IR, FTIR, UV-visible spectra and their applications.

4) Understand the use of single and double beam instruments.

5) Learn elemental analysis, Electro analytical Methods, Radio chemical Methods, X-ray analysis and electron spectroscopy

II. Syllabus:

Total: 60hours(4hr/Week)

Unit- I: Introduction to analytical methods of data analysis and Electroanalytical Methods: **10 hours**

Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiations. Potentiometry & Voltammetry.

Unit –II: Molecular spectroscopy **14 hours**

Infrared spectroscopy: Interaction of radiations with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), and advantages of Fourier-Transform Infrared (FTIR) spectroscopy.

Applications: Issues of quality assurance and quality control, special problems for portable instrumentation and rapid detection.

Unit- III: UV-Visible/ Near IR Spectroscopy **12hours**

Emission, absorption, fluorescence and photoacoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and double beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoacoustic, fluorescent tags).

Unit–IV: Mass spectroscopy **12 hours**

Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadra pole. Resolution, time and multiple separations, detection and interpretation.

Unit – V: Elemental analysis **12 hours**

Atomic spectroscopy**:** Atomic absorption, atomic emission, and atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), wavelength separation and resolution (dependence on technique), detection of radiation (simultaneous/scanning, signal noise), interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

III. Suggested Co-Curricular Activities

1.Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

IV. Suggested Text Books:

1. Willard, H.H.; Merritt, L.L. Jr.; Dean, J.A.; Settle, F.A. Jr.(2004), **Instrumental methods of analysis**, 7th edition, CBS Publishers.

2. Skoog, D.A.; Holler, F. J.; Crouch, S.(2006), **Principles of Instrumental Analysis**, Thomson Brooks/Cole.

3. Ban well, C.N. (2006), **Fundamentals of Molecular Spectroscopy**, Tata McGraw-Hill Education

V. Reference Books:

1.Skoog, D. A.; Holler, F. J.; Crouch, S.(2006),**Principles of Instrumental Analysis**, CengageLearning.
2. Christian, G.D. (2004), **Analytical Chemistry**, 6th Edition, John Wiley & Sons, New York.

Course 10B: Instrumental Methods of Chemical Analysis-Practical Syllabus

***Total* Hours: 30h (2h/week)**

VI. Course learning outcomes

By the end of the course students will be able to

1) Determine the isoelectric pH of a protein

2) Identify the functional groups present in organic compounds

3) Estimate the amount of chloride and iodide present in the solution

4) Recognize the quality of water

VII. Practical-Syllabus

1. Determination of the isoelectric pH of a protein.
2. Titration curve of an amino acid

3. IR absorption spectra (study of aldehydes and ketones)
4. Potentiometric titration of a chloride-iodide mixture
5. Potentiometric Titration of Metal Ions in Ethanol
6. Estimation of Alkalinity, BOD and COD

VIII. Co-Curricular Activities:

a) Mandatory:*(Lab/field training of students by teacher:(lab:10+field:05*):

1. **For Teacher**: Training of students by the teacher in laboratory and field for not less than15 hours on the field techniques/skills of detection of organic compounds using spectroscopic data.
2. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the synthetic reactions and obtain spectral data for interpretation of the synthetic compounds. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.
3. Max. marks for Fieldwork/project work Report:05.
4. Suggested Format for Fieldwork/project work: *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*
5. Unit tests (IE).

IX. References:

1. Skoog, D. A.; Holler, F. J.; Crouch, S.(2006),**Principles of Instrumental Analysis**, Cengage Learning.

2. Christian, G.D.(2004), **Analytical Chemistry**, 6th Edition, John Wiley & Sons, New York.

A.P. State Council of Higher Education
Semester-wise Revised Syllabus under CBCS 2020-21
Four Year - B.Sc. (Hons), Semester – VII
Domain Subject: CHEMISTRY

Course 11A: Green Chemistry

I. Learning Outcomes:

By the end of the course Students will be able to:

1. Understand the twelve principles of green chemistry and will build the basic understanding of toxicity, hazard and risk of chemical substances·
2. Understand stoichiometric calculations and relate them to green chemistry metrics.
3. They will learn about atom economy and how it is different from percentage yield.
4. Learn to design safer chemical, products and processes that are less toxic, than current alternatives. Hence, they will understand the meaning of inherently safer design for accident prevention and the principle "what you don't have can't harm you"
5. Understand benefits of use of catalyst and bio catalyst, use of renewable feed stock which helps in energy efficiency and protection of the environment, renewable energy sources, and importance led reactions in various green solvents.
6. Appreciate the use of green chemistry in problem solving skills, critical thinking and valuable skills to innovate and find out solution to environmental problems. Thus the students are able to realize that chemistry can be used to solve rather than cause environmental problems.
7. Green chemistry is a way to boost profits, increase productivity and ensure sustainability with absolute zero waste. Success stories and real-world cases also motivate them to practice green chemistry.

II. Syllabus:

Total: 60hours(4hr/Week)

Unit I:
Introduction to Green Chemistry **12 hours**

What is Green Chemistry? Some important environmental laws, pollution prevention Act of 1990, emergence of green chemistry, Need for Green Chemistry. Goals of Green Chemistry. Limitations / Obstacles in the pursuit of the goals of Green Chemistry.

Unit II:
Principles of Green Chemistry and Designing a Chemical synthesis **14 hours**

Twelve principles of Green Chemistry and their explanation with examples

Special emphasis on the following:

• Prevention of Waste/ by products; maximum incorporation of the materials used in the process into the final products, Environmental impact factor, waste or pollution prevention hierarchy

• Green metrics to assess greenness of a reaction, e.g. Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.

• Prevention/ minimization of hazardous/ toxic products reducing toxicity

• Risk = (function) hazard x exposure

• Designing safer chemicals with minimum toxicity yet has the ability to perform the desired functions

• Green solvents: super critical fluids with special reference to carbon dioxide, water as a solvent

For organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes,solvents obtained from renewable resources and how to compare greenness of solvents

• Energy requirements for reactions – alternative sources of energy: use of microwaves, ultra sonic energy and photochemical energy

• Selection of starting materials; should be renewable rather than depleting, Illustrate with few examples such as biodiesel and polymers from renewable resources (such as green plastic)

• Avoidance of unnecessary derivatization – careful use of blocking/protecting groups

• Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, bio catalysis, a symmetric catalysis and photocatalysis.

Unit III:

Examples of Green Synthesis/ Reactions **12 hours**

• Green Synthesis of the following compounds: adipic acid, catechol, disodium imino diacetate (alternative to Strecker synthesis).

• Green Reagents: Non-phosgene Isocyanate Synthesis, Selective Methylation using di methyl carbonate.

• Microwave assisted solvent free synthesis of copper phthalocyanine

• Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid And Decarboxylation reaction

• Ultrasound assisted reactions: sono chemical Simmons-Smith Reaction (Ultrasonic alternativeto Iodine)

Unit IV: **12 hours**

Real world case studies based on the Presidential green chemistry awards of EPA

• Surfactants for Carbon Dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.

• A new generation of environmentally advanced wood preservatives: Getting the chromium and Arsenic out of pressure treated wood.

• An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid)

made from corn.

• Healthier Fats and oils by Green Chemistry: Enzymatic Inter esterification for production of No

Trans-Fats and Oils.

• Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting.

• Using a naturally occurring protein to stimulate plant growth, improve crop quality, increase yields, and suppress disease.

Unit V:

Future Trends in Green Chemistry **10 hours**

Oxidation reagents and catalysts; Bio mimicry and green chemistry, Biomimetic, Multifunctional Reagents; mechanochemical and solvent free synthesis of inorganic complexes; co crystal controlled solid state synthesis(C_2S_3); Green chemistry in sustainable development.

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

IV. Suggested Text Books:

1. Anastas, P.T.; Warner, J.C.(1998),**Green Chemistry, Theory and Practice,** Oxford University Press.

2. Lancaster, M.(2016),**Green Chemistry An Introductory Text.**2nd Edition, RSC Publishing.

3. Cann , M. C. ; Connely, M. E.(2000), **Real-World cases in Green Chemistry,** AmericanChemical Society, Washington.

4. Matlack, A.S.(2001),**Introduction to Green Chemistry,** Marcel Dekker.

5. Alhuwalia,V. K.; Kidwai, M.R.(2005),**New Trends in Green chemistry**, Anamalaya Publishers

V. References:

1. Kirchoff, M.; Ryan, M.A. (2002), **Greener approaches to undergraduate chemistry experiment.** American Chemical Society, Washington DC.

2. Sharma, R.K.; Sidhwani, I.T.; Chaudhari, M.K.(2013), **Green Chemistry Experiments: A monograph,** I.K. International Publishing House Pvt Ltd. New Delhi.

3. Pavia, D.L.; Lamponam, G.H.; Kriz, G.S.W. B.(2006),**Introduction to organic Laboratory Technique-A Micro-scale approach**,4th Edition, Brooks-Cole Laboratory Series for Organic chemistry.

Course 11A: Green Chemistry- Practical Syllabus

VI. Learning Outcomes:

By the end of the course students will be able to

1. Synthesize nanoparticles using green methods
2. Prepare biodiesel form waste cooking oil
3. Synthesize inorganic complexes using green methods
4. Synthesize benzo pinacol in the presence of sunlight

VII. Practical Syllabus

***Total* Hours: 30h (2h/week)**

1. Preparation and characterization of nanoparticles of CuO/ ZnO nanoparticles using plant extracts.
2. Preparation of biodiesel from waste cooking oil and characterization (TLC, pH, Solubility, Combustion Test, Density, Viscosity.
3. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.
4. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).
5. Photoreduction of benzophenone to benzo pinacol in the presence of sunlight.
6. Spot tests for qualitative inorganic analysis for cations and anions, and qualitative organic analysis for preliminary test and functional group analysis.

VIII. Co-Curricular Activities:

Mandatory: *(Lab/field training of students by teacher :(lab:10+field:05*):

1. For Teacher: Training of students by the teacher in laboratory and field for not less than 15 hours on the field techniques/skills of green methodologies in place of polluting solvents/chemicals

2. For Students: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the green synthetic methods adopted in the industry. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

3. Max. Marks for Fieldwork/project work Report: 05.

4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

5. Unit tests (IE).

IX. References:

1. Wealth from Waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated. Indu Tucker Sidhwaniet al. University of Delhi, Journal of Undergraduate Research and Innovation, Volume 1, Issue 1, February 2015, ISSN: 2395-2334.

2. Sidhwani, Tucker I.; Chowdhury, S. Greener alternatives to Qualitative Analysis for Cations without H_2S and other sulfur containing compounds, J. Chem. Educ. 2008, 85, 1099.
3. Sidhwani, Tucker I.; Chowdhury, S. et al., DU Journal of Undergraduate Research and Innovation,2016, Volume 2, Issue 2, 70-79.
4. Dhingra, S., ;Angrish, C. Qualitative organic analysis: An efficient, safer, and economical approach to preliminary tests and functional group analysis. *Journal of Chemical Education*,2011, *88*(5), 649-651.

A.P. State Council of Higher Education
Semester-wise Revised Syllabus under CBCS 2020-21
Four Year - B.Sc. (Hons), Semester – VII
Domain Subject: CHEMISTRY

Course 11B: Analysis of Drugs, Foods, Dairy Products &Bio-Chemical Analysis

I. Learning Outcomes:

Students after successful completion of the course will be able to:

1. Explain the principles of formulation and application of Drugs.
2. Acquire a critical knowledge on synthetic techniques of drugs.
3. Demonstrate the skills in analysis of **Foods, Dairy Products.**
4. Comprehended the applications of **Bio-Chemical Analysis**.
5. Acquire a critical knowledge on analysis of **Foods, Dairy Products.**

II. Syllabus:(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Total: 60hours(4hr/Week)

UNIT- I **15 hours**

Analysis of the following drugs and pharmaceuticals preparations: (Knowledge of molecular formula, structure and analysis) Analysis of anlgesics and antipyretics like aspirin and paracetamol Analysis of anti-materials like choloroquine.
Analysis of drugs in the treatment of infections and infestations: Amoxycillin., chloramphenicol, metronidazole, penicillin, tetracycline, cephalexin(cefalexin).
Anti-tuberculous drug- isoniazid.

UNIT- II **10 hours**

Analysis of the following drugs and pharmaceuticals preparations: (Knowledge of molecular formula, structure and analysis)
Analysis of antihistamine drugs and sedatives like: allegra, Zyrtec (citirizine), alprazolam, trazodone, lorazepem, ambien (zolpidem), diazepam,

UNIT- III **10 hours**

Analysis of anti-epileptic and anti-convulsant drugs like phenobarbital and phenacemide. Analysis of drugs used in case of cardiovascular drugs: atenolol, Norvasc (amlodipine), Analysis of Lipitor (atorvastatin) a drug for the prevent in of product in of cholesterol.
Analysis of diuretics like: furosemide (Lasix), triamterene
Analysis of prevacid (lansoprazole) a drug used for the prevention of production of acids in stomach.

UNIT- IV **15 hours**

Analysis of Milk and milk products: Acidity, total solids, fat, total nitrogen,protenines, lactose, phosphate activity, casein, choride. Analysis of food materials- Preservatives: Sodium carbonate, sodium benzoate sorbic acid Coloring matters, - Briliant blue FCF, fast green FCF, tertrazine, erytrhosine, sunset yellow FCF.
Flavoring agents - Vanilla, diacetyl, isoamyl acetate, limonene, ethylpropionate , allyl hexanoate and Adulterants in rice and wheat, wheat floo0r, sago, coconut oil, coffee powder, tea powder, milk..

UNIT-V **10 hours**

Clinical analysis of blood Composition of blood, clinical analysis, trace elements in thebody. Estimation of blood chlolesterol, glucose, enzymes, RBC & WBC, Blood gas analyser.

III. Suggested Co-Curricular Activities

9. Training of students by related industrial experts.
10. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
11. Visits of related Industries/firms, research organizations etc.
12. Invited lectures and presentations on related topics by field/industrial experts.

IV. Text Books:

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.

V. References Books:

a. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
b. Foye's Principles of Medicinal Chemistry.
c. Burger's Medicinal Chemistry, Vol I to IV.
d. Introduction to principles of drug design- Smith and Williams.
e. Remington's Pharmaceutical Sciences.
f. Martindale's extra pharmacopoeia.
g. Organic Chemistry by I.L. Finar, Vol. II.
h. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
i. Text book of practical organic chemistry- A.I. Vogel.

Course 11B. Analysis of Drugs, Foods, Dairy Products &Bio-Chemical Analysis- Practical Syllabus

VI. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. Develop comprehensive product development programs to meet new product criteria and timing.
2. Acquire skills in the Analysis of Drugs, foods and Dairy Products.
3. Demonstrate proficiency in the experimental techniques of biomedical chemical
4. Carry out food testing with the knowledge of foods.
5. Learn the procedure of synthesis of drugs.
6. Critically develop, apply, report, interpret and reflect on strategies for collecting data inthe lab and field.

VII. Practical (Laboratory) Syllabus: *Total* Hours: 30h (2h/week)

1. Preparation of Aspirin
2. Preparation of Paracetamol
3. Preparation of Acetanilide
4. Preparation of Barbutiric Acid
5. Preparation of Phenyl Azo β-naphthol

VIII. References Books:

a. Introduction to principles of drug design- Smith and Williams.
b. Remington's Pharmaceutical Sciences.
c. Martindale's extra pharmacopoeia.
d. Organic Chemistry by I.L. Finar, Vol. II.
e. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
f. Text book of practical organic chemistry- A.I. Vogel.

IX. Co-Curricular Activities

Mandatory:*(Lab/field training of students by teacher:(lab: 10+field:05*):

a. **For Teacher**: Training of students by the teacher in laboratory and field for not less than15 hours on the field techniques/skills of comprehensive product development programs to meet new product criteria and timing. Acquire skills in the preparation of Drugs, foods and Dairy Products, carry out food testing with the knowledge of testing food adultration and learn the procedure of synthesis of drugs.
b. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the preparation of Cosmeceuticals and Pharmaceutical. Write their observations and submit a hand written fieldwork/project work report notexceeding10 pages in the given format to the teacher. a). Max marks for Fieldwork/project work Report: 05.

b). Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

c). Unit tests (IE).

A.P. State Council of Higher Education
Semester-wise Revised Syllabus under CBCS 2020-21
Four Year - B.Sc. (Hons), Semester – VII
Domain Subject: CHEMISTRY

Course 12A: Polymer Chemistry

I. Course Learning Outcomes

By the end of this course, students will be able to:

1. Know about history of polymeric materials and their classification
2. Learn about different mechanisms of polymerization and polymerization techniques
3. Evaluate kinetic chain length of polymers based on their mechanism
4. Differentiate between polymers and copolymers
5. Learn about different methods of finding out average molecular weight of polymers
6. Differentiate between glass transition temperature (Tg) and crystalline melting point (Tm)
7. Determine Tg and Tm
8. Know about solid and solution properties of polymers
9. Learn properties and applications of various useful polymers in our daily life.

II. Syllabus:

Total: 60hours(4hr/Week)

Unit-1

History of polymeric materials and functionality and its importance **10 hours**

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers. Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

Unit-II

Kinetics of Polymerization **12 hours**

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Unit-III

Determination of molecular weight of polymers and crystallinity **12 hours**

(*Mn*,*Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index. Determination of

crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Unit-IV

Glass transition temperature (Tg) and Polymer Solution **14 hours**

Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg). Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

Unit-V

Properties of Polymers **12 hours**

(Physical, thermal, Flow & Mechanical Properties).

Brief introduction to preparation, structure, properties and application of the following polymers: poly olefins, polystyrene and styrene copolymers, poly (vinyl chloride) and related polymers, poly (vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [poly acetylene, poly aniline, poly(p-phenylene sulphide poly pyrrole, poly thiophene)].

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

VI. Suggested Text Books:

1. R.B. Seymour & C.E. Carraher: *Polymer Chemistry: An Introduction,* Marcel Dekker, Inc. New York, 1981.
2. G. Odian: *Principles of Polymerization*, 4th Ed. Wiley, 2004.
3. F.W. Billmeyer: *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971.
4. P. Ghosh: Polymer Science & Technology, Tata McGraw-Hill Education, 1991.
5. R.W. Lenz: *Organic Chemistry of Synthetic High Polymers.* Interscience Publishers, New York, 1967.

V. References:

1. Allcock, H.R.; ; Lampe, F. W.; Mark, J. E.(2003),**Contemporary Polymer Chemistry**, Prentice-Hall.

2. Fried, J.R. (2003), **Polymer Science and Technology**, Prentice-Hall.

Course 12A: Polymer Chemistry-12A- Practical Syllabus

VI. Learning Outcomes:

By the end of the course students will be able to

1. Determine the molecular weight of a polymer by viscometric studies

2. Prepare urea formaldehyde polymer

3. Determine the molecular weight by end group analysis

VII. Practical Syllabus

***Total* Hours: 30h (2h/week)**

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method

2. Determination of molecular weight by viscometry: Poly vinyl proplylidine (PVP) in water

3. Determination of molecular weight by end group analysis

4. Preparation of urea-formaldehyde resin

5. Precipitation polymerization of acrylonitrile

6. Redox polymerization of acrylamide

VIII. Co-Curricular Activities:

Mandatory: *(Lab/field training of students by teacher :(lab:10+field:05*):

1. For Teacher: Training of students by the teacher in laboratory and field for not less than 15 hours on the field techniques/skills of preparation of polymers.

2. For Students: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the preparation steps of polymers and quality polymer formed using various techniques. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

3. Max. Marks for Fieldwork/project work Report: 05.

4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

5. Unit tests (IE).

IX. References:

1. Munk, P.; Aminabhavi, T. M. (2002), **Introduction to Macromolecular Science,** John Wiley &Sons.

2. Sperling, L.H.(2005),**Introduction to Physical Polymer Science**, John Wiley & Sons

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Course 12B. Industrial Chemicals and Environment

I. Learning Outcomes:

Students after successful completion of the course will be able to:

1. Identify the importance of Manufacture of ***Inorganic Chemicals***
2. Acquire knowledge on production, uses, storage and hazards of *Industrial Gases*.
3. Understand the importance of **Environment.**
4. Understanding about water pollution and its effects.
5. Acquire knowledge on **Energy and its effects on Environment**

II. Syllabus: (Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Total theory: 60 hours (4hrs/Week)

Unit-I **10 Hours**

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

Unit-II **10 Hours**

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene

Industrial Metallurgy: Preparation of metals (ferrous and nonferrous) and ultrapure metals for semi-conductor technology.

Unit-III **15 hours**

Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur. Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photo chemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO2, CO2, CO, NOx, H2S and other foul smelling gases. Methods of estimation of CO, NOx, SOx and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

Unit-IV **15 hours**

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and

petrochemicals, agro, fertilizer, etc.
Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for wastewater, industrial water and domestic water.

Unit-V

Energy & Environment **10 hours**

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy,Hydrogen, geothermal, Tidal and Hydel, etc.
Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.
Biocatalysis: Introduction to biocatalysis: Importance in ―Green Chemistry‖ and Chemical Industry.

III. Suggested Co-Curricular Activities

i. Training of students by related industrial experts.
ii. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
iii. Visits of related Industries/firms, research organizations etc.
iv. Invited lectures and presentations on related topics by field/industrial experts.

IV. Text Books:

i. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
ii. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
iii. K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
iv. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.

V. References Books:

i. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
ii. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, WileyPublishers, New Delhi.
iii. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
iv. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
v. K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
vi. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.
vii. S.E. Manahan, Environmental Chemistry, CRC Press (2005).
viii. G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006).
ix. A. Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).

Course 12B: Industrial Chemicals &Environment- Practical Syllabus

VI. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

i. Perform Determination of DO, COD and BOD
ii. Learn the procedure for measurement of chloride, sulphate

and salinity of water

iii. Estimation of total alkalinity of water

iv. Acquire skills in determination of dissolved gases like O2, CO2, SPM etc.

VII. Practical (Laboratory) Syllabus: Total hours:30h (2h/week)

1. Determination of Dissolved Oxygen (DO) in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (Ag NO_3 and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.
7. Measurement of dissolved CO2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

VIII. Lab References:

i. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.

ii. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, WileyPublishers, New Delhi.

iii. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.

iv. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. NewDelhi.

v. K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.

vi. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.

IX. Co-Curricular Activities

Mandatory:*(Lab/field training of students by teacher:(lab: 10+field:05*):

5. **For Teacher**: Training of students by the teacher in laboratory andfield for not less than15 hours on the field techniques/skills in determination of DO, COD, BOD, CO_2, SPM etc. Learn the procedure for measurement of chloride, sulphate and salinity of water, total alkalinity of water
6. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the determination of DO, COD, BOD, CO_2, SPM etc. Write their observations and submit a hand written fieldwork/project work report notexceeding10 pages in the given format to the teacher.

a. Max marks for Fieldwork/project work Report: 05.

b. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

c. Unit tests (IE).

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Course 14A: Inorganic Chemistry-II: Metal clusters, Electronic spectra of Complex compounds and Bio-inorganic chemistry

I. Course Learning outcomes:

1. The Students are able to understand the study of age compounds of oxygen, phosphorous and sulphur compounds and also iso poly and heteropoly anions.
2. The student will understand the various metal clusters and metal π complexes.
3. Understanding the reactions of organo metallic compounds and its applications.
4. The Students are able to understanding the reaction mechanism in transition metal complexes, anation reactions, and complementary reactions.
5. The Students are able to understand the orgel diagrams and electronic spectra of transition metal complexes.
6. The study of magnetic properties and anamolous magnetic moments of transition complexes.
7. The Students are able to understanding structure and functions of hemoglobin, myoglobin and vitamin B_{12}, photochemical laws.

II. Syllabus: (Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Total: 60hours(4hr/Week)

Unit-I: Non-metal cages and metal clusters: **12Hours**

Structure and bonding in phosphorous-oxygen, phosphorous-Sulphur cages; structure and bonding inhigher boranes with (special reference to B12icosahedra). Carboranes, metalloboranes, metallo carboranes. Classification- LNCs and HNCs**,** Isoelectronic and Isolobal relationships, electron counting rules: Wade's and Lauher's rules. M-M multiple bonding; preparation, structure and bonding in di -nuclear $[Re_2Cl_8]^{2-}$ion, tri nuclear $[Re_3Cl_9]$, tetra nuclear $W_4(OR)_{16}$, hexa nuclear $[Mo_6Cl_8]^{4+}$ and $[Nb_6Cl_{12}]^{2-}$.

Unit-II: Organo metallic chemistry of transition metals: 12Hours

Classification and electron counting rules, hapticity, synthesis, structure and bonding of Ferrocene,dibenzene chromium, cycloheptatriene and tropylium complexes of transition metals. Reactions of organo metallic compounds- oxidative addition reductive elimination, insertion and elimination. Applications of organo metallic comp-ounds -Catalytic hydrogenation, Hydroformylation.

Unit-III: Reaction mechanism of transition metal complexes: 12Hours

Kinetics of octahedral substitution, acid hydrolysis, base hydrolysis-conjugate base (CB) mechanism. Direct and indirect evidences in favour of CB mechanism. Anation reactions.

Reactions without metal-ligand bond cleavage. Factors affecting the substitution reactions in octahedral complexes. Trans effect on substitution reactions in square planar complexes. Mechanism of redox reactions, outer sphere mechanism, cross reactions and Marcus – Hush equation, inner sphere mechanism.

Unit-IV: Term symbols and Electronic spectra: 12Hours

Term symbols: Term symbols and their derivation Microstates, Hunds rules to predict ground terms and ground states. List of ground energy and higher energy terms from d^1 to d^9 configurations;

Electronic spectra of transition metal complexes: Spectro scopic terms. Selection rules, Slator–Condon parameters, Racah parameters, Term separation energies for d^n configurations Correlation diagrams and Orgel diagrams. Tanabe-Sugano diagrams for d^1tod^9 configurations. Calculations of Dq, Band β parameters. Charge transfer spectra.

Unit-V: Bio-inorganic chemistry and Magnetic properties of complexes: 12Hours

Storage and transport of dioxygen by Hemoglobin and Myoglobin, Chlorophyll, Vitamin B_{12} and its importance.

Magnetic properties of transition metal complexes: Orbital and spin contribution, spin-orbitcoupling and magnetic moments. Types of magnetism, factors affecting on Para magnetism, Dia, ferro and Anti magnetism.

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts

IV. Textbooks:

1. Inorganic Chemistry by Huheey. Harper and Row.
2. Concisein organic chemistry by J.D. Lee, ELBS.
3. Inorganic chemistry, K.F. Purcelland J.C.Kotz, Holt Saunders international
4. Organometallic chemistry by R.C.Mehrotraand A.Singh. New Age International.
5. Advanced Inorganic Chemistry by Cotton and Wilkinson, Wiley Eastern

V. Reference books:

1. Inorganic reaction mechanism by Basoloand Pearson, Wiley Eastern
2. Bioinorganic Chemistry by K. Hussan Reddy
3. Biological Aspects of inorganic chemistry by A. W. Addiso, W.R.Cullen, D.Dorphinand G.J.James. Weliey Inter science.
4. Photo chemistry of coordination compounds by V. Balzani and V. Carassiti. Academic Press.
5. Text book of Coordination chemistry by K.Soma Sekhara Rao and K.N.K. Vani, Kalyani Publishers.

VI. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. List out, identify and handle various equipment in Chemistry lab.
2. Learn the concepts and procedures of preparation of standard solutions, primary and secondary standards.
3. Demonstrate skills in Volumetric and gravimetric determinations.

4. Acquire skills in standardizing and determination of different metal ions.
5. Understand and explain the volumetric analysis based on fundamental concepts learnt in ionic equillibria.

VII. Practical Syllabus:

***Total* Hours: 30h (2h/week)**

Quantitative analysis:
Volumetric:
1. Determination of Ferric iron by photochemical reduction
2. Determination of Nickel by EDTA
3. Determination of Calcium and Magnesium in a mixture by EDTA
4. Determination of Ferrocyanide by Ceric sulphate
5. Determination of Copper(II) in presence of iron(III)

Gravimetric:
6. Determination of Zinc as Zinc pyrophosphate
7. Determination of Nickel from a mixture of Copper and Nickel.

VIII. Co-Curricular Activities

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1. **For Teacher**: Training of students by the teacher in laboratory and field for not lessthan15 hours on the field techniques/skills of determination of cations by volumetric and gravimetric determinations.
2. **For Students**: Student shall visit are lated industry/ chemistry laboratory in universities/ research organizations/private sector facility and observes the synthetic reactions. Write their observations and submit a hand written fieldwork/project workreportnotexceeding10 pages in the given format to the teacher.
3. Max marks for Fieldwork/projectworkReport:05.
4. Suggested Format for Fieldwork/project work**:** Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.
5. Unit tests(IE).

IX. Reference books:

Vogel's textbook of quantitative chemical analysis, 5th edition by G.H. Jeffery et al.

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Course 14B: Organo Metallic Chemistry

I. Learning Outcomes:

By the end of this course, students will be able to

1. Apply 18-electron rule to rationalize the stability of metal carbonyls and related species
2. Understand the nature of Zeise's salt and compare its synergic effect with that of carbonyls.
3. Identify important structural features of the various hapto metal complexes
4. Get a general idea of catalysis and describe in detail the mechanism of Wilkinson's catalyst,
5. Zeigler- Natta catalyst and synthetic gasoline manufacture by Fischer-Tropsch process
6. Understand the importance of organometallic compounds in the synthesis of organic compounds

II. Syllabus:

Total: 60hours(4hr/Week)

Unit-I

Mono, Di, hapto Complexes **12 hours**

Nomenclature and Classification based on the number of Coordinated Carbons (hapticity) and number of electrons donated by the Ligand. 16 and 18 electron rules. Electron counting covalent and ionic models.□[1] Complexes : General methods of Preparation –Bonding of Ligand to Metal :α and β Interaction and agostic interaction– Stability and decomposition pathways –□1 Complexes –Tertiary Phosphine – Transition Metal Alkyl and Aryl Complexes of Pt – Ortho-effect – Bonding in Metal – Carbene and Carbyne Complexes. □2 –Complexes: General methods of preparation of Metal –Alkene Complexes – Structure and Bonding in □2 Complexes-Zeises salt – Trans Effect – Rotation of Olefin around Metal- Olefin Bond.

Unit-II

Tri, tetra and penta hapto Complexes **12 hours**

□3 - Complexes: Metal-Allyl Complexes – General Preparative Routes – Structure and Bonding in □3 Allyl Complexes – Fluxionality. □4 Complexes: Structure and Bonding in □4 Complexes – Butadiene and Cyclo butadiene Complexes.□5 – Complexes: General methods of Preparation – Bis (□5-cyclopentadienyl) metal complexes (Metallocenes) – Ferrocene: Structure and Bonding –

Reactions of Ferrocene – Mechanism of Electroplilic substitution – Friedel Crafts acylation, alkylation, nitration, halogenations reactions.

Unit-III

Hexa, Hepta and Octahapto Complexes **12 hours**

□6Complexes: Metal –Arene Complexes – Di benzene chromium – Preparation, Structure and Bonding in Bis(arene)-Metal Complexes – Reactions. □^{7} Complexes: Preparation , Structure and Reactions of □^{7} C_7H_7 Complexes.□ ^{8} Complexes: C_8H_8 as a Ligand – Cyclo octatetraene Complexes – Preparation, Structure and Bonding in Uranocene

Unit-IV

Catalysis by Organometallic Compounds **12 hours**

General principles of catalysis, properties of catalysts, homogeneous and heterogeneous catalysis (Catalytic steps, examples and industrial applications), deactivation and regeneration of catalysts, catalytic poison, promoter.

Study of the following industrial processes and their mechanism:

1. Alkene hydrogenation (Wilkinson's Catalyst)
2. Synthetic gasoline (Fischer Tropsch reaction)
3. Polymerisation of ethene using Ziegler-Natta catalyst
4. Wacker Process

Unit-V

Organometallic Reagents in Organic synthesis **12 hours**

Preparation and application of the following in organic synthesis: 1) Organolithium 2) Organo copper reagents 3) Organoboranes in C-C bond formation 4) Organo silicon reagents: reactionsinvolving β-carbo cations and α-carbanions, utility of trimethyl silyl halides, cyanides andtriflates.

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

IV. Suggested Text Books:

1. Shriver, D.D.; Atkins, P.; Langford, C.H. (1994), **Inorganic Chemistry 2nd Ed.,** Oxford

University Press.

2. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Shriver and Atkins Inorganic Chemistry**, 5th Edition, W. H. Freeman and Company.

3. Cotton, F.A.; Wilkinson, G.; Gaus, P.L. **Basic Inorganic Chemistry**, 3rd Edition, Wiley India.

4. Powell, P.(1988), **Principles of Organometallic Chemistry**, Chapman and Hall.

V. References:

1. Organo metallics-A Concise Introduction, Ch. Eischein broich and Salzer-VCH

2. Organo transition Metal Chemistry Fundamental Concepts and Applications, John Akio Yamamato, Wiley & Sons.

3. Basic organometallic Chemistry, B.D. Gupta / A. J. Elias

4. Greenwood, N.N.; Earnshaw, A. (1997), **Chemistry of the Elements**, 2nd Edition, Elsevier

(Ziegler Natta Catalyst and Equilibria in Grignard Solution)

Course 14B: Organo Metallic Chemistry-Practical Syllabus

VI. Learning Outcomes

By the end of the course students will be able to

1. Synthesize inorganic complexes using monodentate ligands
2. Prepare Cis complexes using bi dentate ligands
3. Prepare Trans Complexes using bi dentate ligands
4. Distinguish Cis and Trans compounds

VII. Practical Syllabus:

***Total* Hours: 30h (2h/week)**

1. Tetra ammine Coppe (II) Sulphate monohydrate
2. Potassium tris oxalate Ferrate (III) Tri hydrate
3. Hexa ammine Nickel (II) Chloride
4. Preparation of Cis bis (glycenato) Copper (II) monohydrate
5. Preparation of Transbis (glycenato) Copper (II) monohydrate
6. Synthesis of tris (acetyl acetonato) Manganese (III)

VIII. Co-Curricular Activities:

Mandatory: *(Lab/field training of students by teacher :(lab:10+field:05*):

1. For Students: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the synthesis of inorganic metal complexes and analyzing it using IR spectral data. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

2. Max. Marks for Fieldwork/project work Report: 05.

3. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

4. Unit tests (IE).

IX. References:

1. Advanced Practical Chemistry, J. Singh, R.K.P.,Singh, etc. Pragati Edition
2. R.G. Charles, Inorg. Symth. 7 (1963) 183
3. F. Basolo and R.g. Pearson, Mechanisms of Inorganic reactions, 2 nd Edition. Pearson

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Course 15A: Organic Chemistry: Modern Organic synthesis and Natural products

I. Course Learning outcomes:

1. Understanding of various types of reaction intermediates and the bonding present in variousorganic compounds.
2. Understand how to protect various functional groups in organic synthesis and can apply the sameto novel molecules useful for research also.
3. Students understand the mode of addition reactions involving addition by electrophile andnucleophiles over unsaturated bonds between carbons.
4. Students understand the mechanisms of studied named reactions and their applications in organicsynthesis.
5. Learn about the importance of flavones, flavonoids and harmones.

II. Syllabus: (Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Total: 60hours(4hr/Week)

UNIT - I

Reactive intermediates, Reactive Species and Protecting groups: 12 hours

Reactive intermediates: Generation, Structure, Stability, Detection and Reactivity of Carbocations,Carbanions, Free radicals, Carbenes, Nitrenes and Arynes.

Reactive Species: Generation and reactivity of Electrophiles, Nucleophiles, Dienophiles, Ylids, Enophiles.

Protecting groups: Protection of carbonyl, Hydroxyl, carboxylic and Amine groups

UNIT-II

Addition Reactions 12 Hours

(A) **Addition to Carbon – Carbon Multiple Bonds:** Mechanistic and stereo chemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, region and chemo selectivity, orientation and reactivity, Hydrogenationof double and triple bonds, hydrogenation of aromatic rings, Hydroboration.

(B) **Addition to Carbon-Hetero Multiple Bonds:** Steric course of addition reactions to C=O and C=N, Knoevenagel, Claisen- Schmidt, Claisen, Dieckman, Benzoin and Stobbe condensations, Tollen's reaction, Prins reaction: Wittig, Grignard, Mannich, and Michael reaction.

UNIT-III

Molecular Rearrangements 12 Hours

Types of molecular rearrangements, migratory aptitude;

a) Rearrangements to electron deficient carbon:

Wagner-Meerwein, Tiffeneau–Demjanov, Dienone–Phenol, Arndt-Eistert synthesis;

b) Rearrangements to electron deficient nitrogen: Beckmann, Hofmann, Schmidt and Lossen re-arrangements;

c) Rearrangements to electron deficient oxygen:

Baeyer-villiger and Dakin re-arrangements; Benzil-Benzilic acid and Favorskii rearrangements.

UNIT–IV:

Steroids **12Hours**

Occurrence, nomenclature, basic skeleton, Diel' shydro carbon and it's stereo chemistry. Isolation, structure determination and synthesis of and roster one, testosterone, oestrone and progesterone.

UNIT–V:

Flavonoids and Iso flavonoids: **12 Hours**

Occurrence, nomenclature and general methods of structure determination, Isolation, structure elucidation and synthesis of Kaempferol, Quercetin, Cyanidin, Genestein, Butein and Daidzein. Biosynthesis of flavonoids and Iso flavonoids.

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts

IV. Text books:

1. Advanced Organic Chemistry: Reactions Mechanisms and Structure by Jerry March, Mc. Graw Hill and Kogakush.
2. Organic Chemistry Vol.I(SixthEd.) and Vol.II(FifthEd.) by ILFinar ELBS.
3. Organic Chemistry (fifth Ed.,) by Morrison and Boyd, PHI, India.
4. OrganicChemistry(fifthedition)byFrancisA.CareyTataMcGrawHillpublishingComp an y Limited, New Delhi.
5. Chemistry of natural products by S.V. Bhat, B.A. Nagasampangi

V. Reference Books:

1. Organic Chemistry Vol.I (Sixth Edn.) and Vol. II (Fifth Ed.,) by ILfinar ELBS.
2. Organic Chemistry (fifth Edn.,) by Morrison and Boyd, PHI, India.
3. OrganicChemistry(fifthedition)byFrancisA.CareyTataMcGrawHillpublishingComp an y Limited, New Delhi.
4. Reaction Mechanism in Organic Chemistry by Mukherjee Sirigh, NTerniitarr, Indiar
5. A guide book to mechanism in Organic Chemistry by Peter Sykes, ELBS.
6. Chemistry of Natural products by R.S.Kalsi Kalyani Publishers.1983.

ORGANIC CHEMISTRY PRACTICALS –II

VI. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. List out, identify and handle various equipment in Chemistry lab.
2. Learn the concepts and procedures of handling chemical reagents appropriately.
3. Demonstrate skills to perform reflux, distillation, recrystallisation and vacuum filtration.
4. Calculate theoretical yield and percent yield. .
5. Dispose chemicals in a safe and responsible manner.

VII. Syllabus:

***Total* Hours: 30h (2h/week)**

Preparation, recrystallization, and determination of melting point & yield of the following compounds:

(i) Aspirin,
(ii) Nerolin,
(iii) Chalcone,
(iv) p-Nitro acetanilide,
(v) 2,4,6- Tri bromoaniline,
(vi) m-Dinitrobenzene,
(vii) Phthalimide,
(viii) Diels-Alder adduct.

VIII. Co-Curricular Activities

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1. **For Teacher**: Training of students by the teacher in laboratory and field for not lessthan15 hours

on the field techniques/skills of organic synthesis and recrystallization of the organic compound

2. **For Students**: Studentshallvisitarelatedindustry/chemistrylaboratoryinuniversities/research organizations/private sector facility and observes the synthetic reactions. Write their observationsand submit a hand written fieldwork/project workreportnotexceeding10 pages in the given format to the teacher.
3. Max marks for Fieldwork/projectworkReport:05.
4. Suggested Format for Fieldwork/project work**:** Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.
5. Unit tests (IE).

IX. Reference Books:

1. Vogel's Text Book of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J. D. Barnesand M. J. Thomas, 4th& 6th Ed. (Pearson Education Asia).
2. Vogel's Text Book of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, P.W.G.Smith, A.R. Tatchell, 5 Ed.

(Longman Scientific & Technical)

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Course 15B: Chemistry of Natural Products

I. Course learning Outcomes

By the end of the course students will be able to:

Understand isolation, purification and characterization of simple chemical constituents from the natural source

1. Learn the different types of alkaloids and their chemistry
2. To know the classification of terpenoids, isoprene rule, structures and their natural sources.
3. Learn advanced methods of structural elucidation of compounds of natural origin
4. Understand isolation, purification, chemical constituents from the natural source
5. To know the structure characterization and synthesis of steroids

II. Syllabus:

Total: 60hours(4hr/Week)

Unit I:

Alkaloids **12 hours**

Introduction, general methods for the elucidation of the structure, breaking into small fragments, determination of structure of fragments. Type of linkage, functional nature of oxygen, zwitter ion method to know number of –OH groups, C=O group, -COOH group $–OCH_3$ (Ziesel's method).Detection of N atom, Detection of $–N\text{-}CH_3$ group. Herzig–Meyer method to recognize heterogeneous system. Hofmann exhaustive methylation. Emde's degradation, Von-Braundegradation, reductive degradation, Alkali fusion, oxidation, dehydrogenation**.**

Unit II:

Structure and synthesis **12 hours**

a. Phenyl ethyl amine group alkaloids (adrenaline)

b. Piperedine group alkaloids (piperine)

c. Pyridine group alkaloids (coniine)

Unit- III

Terpenoids **12 hours**

Isoprene rule, special isoprene rule, classification. General methods of the determination of

structure. Nature of Oxygen, number of alkyl groups (Kuhn-roth method). Unsaturation detection, reduction (NOCl), dehydrogenation, oxidative degradation, ozonolysis, H_2O_2, Baeyer's reagent, NaOX, HNO_3, dehydration–$ZnCl_2$, H_2SO_4 . Catalytic hydrogenation, Grignard reaction, reformatsky reaction.

Unit-IV

Structure and synthesis **10 hours**

Mono terpenoids (acyclic)-Citral–structure and synthesis. Monocyclic mono terpenoids:

α -Terpeniol, Menthol, Limonine –Structure and Synthesis

Unit-V

Steroids **12 hours**

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol (Synthesis not required), Bio Synthesis of Steroids**.** Chemistry and synthesis of oestrone, progesterone, androsterone, testosterone, cortisone.

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

IV. Suggested Text Books:

a. Some Modern methods of Organic Synthesis W. Carithers, Cambridge University Press, Cambridge.
b. Organic Chemistry: Stereochemistry and the Chemistry of Natural Products.-I.L. Finar, Pearson Education, Asia
c. Organic Chemistry, Morrison and Boyd, Pearson, 7th Edition
d. Organic Chemistry, Solmons and Fryhle, Willy Student Edition
e. Organic Chemistry a Lab Manual, Piva, Lampman, Engel. Cengage Learning India

V. References:

1.The terpenoids by Simonsen

2) The steroids by Shoppee

3) Chemistry of Carbon compounds by Rodd

Course 15B: Chemistry of Natural Products- Practical Syllabus

VI. Learning outcomes:

By the end of the course students will be able to:

a. Separate the natural products using chromatographic techniques
b. Identify the alkaloids present in extracted natural products
c. Identify the terpenes present in plant extracts
d. Identify the steroids present in plant extracts
e. Identify the phenolic groups present in natural products

VII. Practical Syllabus ***Total* Hours: 30h (2h/week)**

1. Separation of natural products using column chromatography
2. Identification of alkaloids in any three plant extracts
3. Identification of terpenes in any three plant extracts
4. Identification of di terpinoids in any three plant extracts
5. Identification of Steroids in any three plant extracts
6. Identification of phenolic groups in three plant extracts

VIII. Co-Curricular Activities:

Mandatory: *(Lab/field training of students by teacher :(lab:10+field:05*):

1. For Teacher: Training of students by the teacher in laboratory and field for not less than 15 hours on the field techniques/skills of analyzing organic compounds using spectroscopic data.

2. For Students: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the separation of natural products obtaining spectral data and analyzing the functional groups and type of natural product. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

3. Max. Marks for Fieldwork/project work Report: 05.

4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements*.

5. Unit tests (IE).

IX. References:

1.The terpenoids by Simonsen

2) The steroids by Shoppee

3) Chemistry of Carbon compounds by Rodd.

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Course 16A: Physical Chemistry: Quantum and Molecular Spectroscopy

I. Course Learning outcomes:

1) Students learn the basic non-relativistic quantum mechanics.
2) Understand the time-dependent and time-independent Schrödinger equation for simple potentials like for instance the harmonic oscillator and hydrogen like atoms, as well as the interaction of an electron with the electromagnetic field.
3) Understand the principles and theories of rotational, vibrational and vibrational spectroscopy methods.
4) Interpret the molecular spectra and find molecular properties from molecular spectra.

II. Syllabus:

Unit – I

Basic Quantum Chemistry-I: 12 Hours

Wave equation-interpretation of wave function-properties of wave function-normalization and orthogonalisation, Operators- linear and non-linear- commutators of operators. Postulates of quantum mechanics; setting up of operators to observables; Hermitian operator- Eigen values andEigen functions of Hermitian operator; Expansion theorems. Eigen functions of commuting operators-significance. Simultaneous measurement of properties and the uncertainty principle.

UNIT-II

Basic Quantum Chemistry-II: 12 Hours

Wave mechanics of simple systems with constant potential energy, particle in onedimensionalbox-factors influencing color transition- dipole integral, Symmetry arguments in deriving the selection rules, the concept of tunneling- particle in three -dimensional box. Calculations using wave functions of the particle in a box-Orthogonality, measurability of energy, position and momentum, average values and probabilities. Rigid rotor, Wave mechanics of systems with variable potential energy-simple harmonic oscillator- solution of wave equation- selection rules.

UNIT-III

Fundamentals of Molecular Spectroscopy-I: 12 Hours

Microwave and IR- Spectroscopy- Rotational spectra of diatomic molecules-Rigid rotor-Selection rules- Calculations of bond length- Isotopic effect, Second order stark effect and itsapplications. Infrared spectra of diatomic molecules- harmonic and anharmonic oscillators-Selection rules-Overtones- Combination bands- Calculation of force constant, anharmonicityconstant and zero point energy. Fermi resonance, simultaneous vibrational-rotational spectra ofdiatomic molecules.

UNIT- IV

Fundamentals of Molecular Spectroscopy-II: : 12 Hours

Raman and Electronic Spectra- Classical and quantum mechanical explanations- Rotational Ramanand Vibrational Raman spectra. Electronic spectra of diatomic molecules- Vibrational Coarse structure- intensities of spectral lines- Franck-Condon principle- applications, Rotational Fine structure- band head and band shading. Charge transfer spectra

UNIT- V

Introduction to computer programming- FORTRAN 77: : 12 Hours

Basic structures and functioning of computer with P.C. as an illustrative example- Main memory- Secondary storage memory- input/output devices- computer languages- operating systems- principles of algorithms-and flow charts-constants and variables- Arithmetic expressions- Arithmetic statements-Replacement statement- IF statement- logical IF and BLOCK IF statements- GOTO statements-subscripted variable and DIMENSION statement. DO statement- Rules for DO statement- Functions and subroutines- Development of FORTRAN statements for simple formulae in chemistry such as Vander Waals equation- pH of a solution- First order rate equation- Cell constant-Electrode potential.

Flowcharts and computer programs for

a) Program for the calculation of Cell Constant, Specific Conductance and Equivalence.

b) Rate Constant of First order reaction or Beer's law by linear least square method.

c) Hydrogen ion concentration of a strong acid solution/Quadratic equation.

d) Solution for Vander Waals equation or Hydrogen ion concentration of a monoprotic weak acid

e) Standard deviation and Variance of univariant data.

III. Suggested Co-Curricular Activities :

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts

IV. Text books:

1. Fundamentals of Molecular spectroscopy: by C.N. Banwell
2. Molecular spectroscopy: by B.K.Sharma
3. Molecular spectroscopy: by Aruldas
4. Introductory quantum mechanics: by A.K. Chandra

V. Reference books:

1. Quantum chemistry: by R.K. Prasad
2. Principles of computer programming (FORTRAN 77 IBM PC): by V.Rajaraman
3. Basics of computers for chemists: by P.C. Jurs

PHYSICAL CHEMISTRY PRACTICALS –II

VI. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. List out, identify and handle various equipment in Chemistry lab.
2. Learn and apply the concepts of electro chemistry in experiments.
3. Be familiar with electro analytical methods and techniques which study an analyte by measuringthe potential (volts) and / or current (amperes) in an electro chemical cell containing the analyte.
4. Learn the procedures of preparation of standard solutions.
5. Acquire skills in operation and calibration of instruments.

VII. Syllabus:

***Total* Hours: 30h (2h/week)**

1. Titration of mixture Strong acid and weak acid versus Strong base by conductometry.
2. Titration of Strong acid Vs Strong Base – pH – metry.
3. Titration of mixture of ($NaHCO_3$ + Na_2CO_3) VsHCl – pH- metry.
4. Titration of Strong acid Vs Strong Base using Quinhydrone electrode.
5. Titration of Fe^{+2}Vs $K_2Cr_2O_7$ – potentiometry
6. Verification of Beer-Lambert's law by Iron-thiocyanate system –colorimetry.
7. Determination of single electrode potential of Cu^{2+}/Cu and estimate the given unknown concentration.

VIII. Co-Curricular Activities

Mandatory: *(Lab /field training of students by teacher:(lab:10+field:05*):

1. **For Teacher**: Training of students by the teacher in laboratory and field for not lessthan15 hourson the field techniques/skills of handling the P^H metry, potentiometry and colorimetry
2. **For Students**: Students hall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the synthetic reactions. Write their observationsand submit a hand written fieldwork/project workreportnotexceeding10 pages in the given format to the teacher.
3. Max marks for Field work/project work Report:05.
4. Suggested Format for Fieldwork/project work**:** Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.
5. Uni ttests(IE).

IX. Reference books:

1. Vogel's Text Book of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J. D. Barnesand M. J. Thomas, 4^{th}& 6^{th} Ed. (Pearson Education Asia).

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Course 16B: Analytical Methods of Analysis

I. Learning Outcomes:

By the end of this course, students will be able to:

1· Perform experiment with accuracy and precision.

2· Develop methods of analysis for different samples independently.

3· Test contaminated water samples.

4· Understand basic principle of instrument like Flame Photometer, UV-vis spectrophotometer.

5· Learn separation of analytes by chromatography.

6· Apply knowledge of geometrical isomers and keto-enoltautomers to analysis.

7· Determine composition of soil.

8· Estimate macronutrients using Flame photometry.

II. Syllabus:

Total: 60hours(4hr/Week)

Unit I:

Qualitative and quantitative aspects of analysis: 12 hours

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression. Normal law of distribution of indeterminate errors, statistical test of data; F, Q and ttest, rejection of data, and confidence intervals.

Unit II:

Optical methods of analysis 14 hours

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection Rules.

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Transmittance. Absorbance and Beer-Lambert law Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs). Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal, Techniques for the quantitative estimation of trace levelof metal ions from water samples.

Unit III:

Thermal methods of analysis: 10 hours

Theory of thermo gravimetry (TG) and basic principle of instrumentation of thermal analyser. Techniques for quantitative estimation of Ca and Mg from their mixture.

Unit IV:

Electroanalytical methods 10 hours

Classification of electro-analytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

Unit V:

Separation techniques 12 hours

Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by salvation and chelation, Technique of extraction: batch, continuous and counter current extractions, Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non aqueous media.

Chromatography: Classification, principle and efficiency of the technique, Mechanism of separation: adsorption, partition & ion-exchange, Development of chromatograms: frontal, elution and displacement methods.

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

IV. Suggested Text Books:

1. Willard, H.H. (1988), **Instrumental Methods of Analysis**, 7th Edition, Wards worth PublishingCompany.
2. Christian, G.D. (2004), **Analytical Chemistry**, 6th Edition, John Wiley & Sons, New York.
3. Harris, D. C. (2007), **Quantitative Chemical Analysis**,6th Edition, Freeman.

V. References:

i. Khopkar, S.M. (2008), **Basic Concepts of Analytical Chemistry,** New Age InternationalPublisher.
ii. Skoog, D.A.; Holler F.J.; Nieman, T.A. (2005), **Principles of Instrumental Analysis,**
Thomson Asia Pvt. Ltd.

Course 16B: Analytical Methods of Analysis- Practical Syllabus

Total: 30hours(2hr/Week)

VI. Learning Outcomes

By the end of the course students will be able to

1. Separate ions using chromatography
2. Identify the ion by comparing Rf values with the literature
3. Analyze soil parameters
4. Verify Beer Lamberts law
5. Determine the carbonate and bicarbonate using pH

VII. Practical Syllabus

1. Separation of mixtures by paper chromatography and reporting the Rf values of Co^{2+} and Ni^{2+}.
2. Separation of mixtures by paper chromatography and reporting the Rf values of Amino acids present in the given mixture
3. To separate a mixture of Ni^{2+}& Fe^{2+} by complexation with DMG and extracting the Ni^{2+} DMG complex in chloroform, and determine its concentration by spectrophotometry
4. Analysis of soil:

(i) Determination of p^H of soil. (ii) Estimation of calcium and magnesium

(iii) Qualitative detection of nitrate and phosphate

5. Verification of Lambert-Beer's law and determination of concentration of a coloured species ($CuSO_4$, $KMnO_4$)
6. Determination of carbonate- and bicarbonate in a mixture using p^H metry

VIII. Co-Curricular Activities:

Mandatory: *(Lab/field training of students by teacher :(lab:10+field:05*):

1. **For Teacher**: Training of students by the teacher in laboratory and field for not less than 15 hours on the field techniques/skills of estimating the quality of soil.
2. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes various measured parameters of soil analysis. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.
3. Max. Marks for Fieldwork/project work Report: 05.
4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*
5. Unit tests (IE).

IX. References:

i. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C.(1989),**Vogel's Textbook of Quantitative Chemical Analysis**, John Wiley and Sons.

ii. Analytical Chemistry by Gary D. Christian 6th Edition John Wiley &Sons Inc New York 1994.

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Course 17A: Pharmaceutical and Medicinal Chemistry

I. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

a. Know the **Terminology in Pharmaceutical chemistry**.
b. Classification of Pharmaceutical chemistry
c. Learn the procedure for **Synthesis and therapeutic activity of the compounds**.
d. Acquire knowledge on **Pharmacodynamics and Anesthetics Drugs**
e. Acquire knowledge on **HIV-AIDS and Drugs.**

II. Syllabus: (Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Total theory: 60 hours(4h/week)

UNIT-I **12 hours**

Pharmaceutical chemistry Terminology: Pharmacy, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics (ADME, Receptors - brief treatment), Metabolites and Anti metabolites. Nomenclature: Chemical name, Generic name and trade names with examples.

UNIT-II

Classification: Classification based on structures and therapeutic activity with one example each, Administration of drugs. Absorption of drugs - factors affecting absorption of drugs, routes of administration - local, enema, oral and external, parental routes - advantages and disadvantages.

UNIT-III

Synthesis and therapeutic activity of the compounds: **12hours**

a. Chemotheraputic Drugs

l. Sulpha drugs (Sulpha methoxazole) 2.Antibiotics - β-Lactam Antibiotics, MacrolideAntibiotics,
3. Anti malarial Drugs(chloroquine)

b. Psycho therapeutic Drugs:

1.Anti pyrectics (Paracetamol) 2. Hypnotics, 3.Tranquilizers(Diazepam) 4.Levodopa

UNIT-IV

Pharmacodynamics and Anesthetics Drugs: **12hours**

1. Antiasthma Drugs (Salbutamol)
2. Antianginals (Glyceryl Trinitrate)
3. Diuretics (Furosemide)
4. Anesthetics - general - ether, chloroform, ethyl chloride, halothane, nitrous oxide, local - esters - cocaine, benzo cocaine.

UNIT-V

HIV-AIDS: **12 hours**

Immunity - CD-4cells, CD-8cells, Retro virus, Replication in human body, Investigation available, prevention of AIDS, Drugs available - examples with structures: PIS: Indinavir (crixivan), Nelfinavir (Viracept), AZT- Zidovudine.

III. Suggested Co-Curricular Activities:

a. Training of students by related industrial experts.
b. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
c. Visits of related Industries/firms, research organizations etc.
d. Invited lectures and presentations on related topics by field/industrial experts.

IV. Text Books:

a. Synthetic Drugs by O.D.Tyagi & M.Yadav3.Medicinal Chemistry by Ashutoshkar
b. Medicinal Chemistry by P.Parimoo
c. Pharmacology& Pharmacotherapeutics R.S Satoshkar & S.D.Bhandenkar

V. Reference Books:

a. Medicinal Chemistry by Dr. B.V.Ramana
b. Synthetic Drugs by O.D.Tyagi & M.Yadav3.Medicinal Chemistry by Ashutoshkar
c. Medicinal Chemistry by P.Parimoo
d. Pharmacology& Pharmacotherapeutics R.S Satoshkar & S.D.Bhandenkar
e. Medicinal Chemistry by Kadametal P-I & P.II
f. European Pharmacopoeia.

Course 17A. Pharmaceutical and Medicinal Chemistry- Practical Syllabus

VI. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

a. Learn the procedure for the synthesis of drugs.
b. Synthesis of Drugs Assisted by Microwave Oven
c. Acquire skills in Drawing structure and Reaction using Chem draw
d. Know the reactions and mechanisms involved in synthesis of Drugs.

VII. Practical (Laboratory) Syllabus **Total hours: 30h(2h/week)**

e. Synthesis of Sulphanilamide
f. Synthesis of 7- Hydroxy -4- methyl coumarin
g. Synthesis of Chlorobutanol
h. Synthesis of Tolbutamide 07
i. Assay of Chlorpheniramine Maleate
j. Assay of Benzyl Penicillin 20

k. Synthesis of Aspirin Assisted by Microwave Oven

l. Drawing structure and Reaction using Chemdraw

VII. Lab References:

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Text book of practical organic chemistry- A.I.Vogel.

IX, Co-Curricular Activities

a) Mandatory:*(Lab/field training of students by teacher:(lab: 10+field:05*):

1. **For Teacher**: Training of students by the teacher in laboratory and field for not less than15 hours on the field techniques/skills of comprehensive product development programs to meet new product criteria and timing. Acquire skills in the preparationof drugs and pharmaceuticals, learn the procedure of synthesis of drugs with good yield.
2. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the preparation of Cosmeceuticals and Pharmaceutical. Write their observations and submit a hand written fieldwork/project work report notexceeding10 pages in thegiven format to the teacher.
    a. Max marks for Fieldwork/project work Report: 05.
    b. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*
    c. Unit tests (IE).

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Course-17B. Pesticides and Green Chemistry

I. Learning Outcomes:

On completion of this course, the student will be able to

1. Understand the basic knowledge of pesticides and their classification.
2. Explain the synthetic methods of pesticides.
3. Acquire knowledge about the different types of pesticide formulations and their use.
4. Explain concepts in green chemistry.
5. State and explain the principles of green chemistry.
6. Identify the need of green chemistry and green synthesis.
7. Think to design and develop materials and processes that reduce the use andgeneration of hazardous substances in industry.

II. Syllabus :(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Total theory hours: 60h(4h/week)

Unit-I

Pesticides **10 hours**

Introduction to pesticides, advantages and disadvantages of pesticides, types of pesticides – Insecticides, Fungicides, Herbicides, Weedicides, Rodenticides plant growth regulators, Pheromones and Hormones. Brief discussion with examples, Structure and uses.

Unit-II

Pesticides Synthesis **10 hours**

Synthesis and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil); Anilides (Alachlor and Butachlor).

Unit-III

Pesticide Formulations **10 hours**

Dust and Granules, Wettable powders, seed disinfectant, Surfactants, Emulsifiable concentrates, Aerosols, Sprays, and Controlled Release Formulations.

Unit-IV **15 hours**

Green Chemistry

Introduction: Definition of green Chemistry, need of green chemistry, twelve principlesof Green Chemistry with their explanations and examples; Green Synthesis-Maximum utilization of reactants and reagents (atom economy). Selection of solvent: Aqueous phase reactions, Reactions in ionic liquids, Solid supported synthesis, Solvent free reactions (solid phase reactions), and Green catalysts: Phase transfer catalysts (PTC) and Biocatalysts.

Unit-V **15 hours**

Green Synthesis

Green Synthesis of the following compounds: Styrene, Adipic Acid, Catechol, BHT, Methyl Methacrylate, Urethane, 4- amino diphenylamine, benzyl bromide, Acetaldehyde, Furfural, Ibuprofen, Paracetamol, Citral.

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of related Industries/firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

IV. TEXT BOOKS

1. Industrial chemistry by B.K. Sharma. Goel Publishing House, Meerut.
2. E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
3. Chemistry of pesticides by N. K. Roy
4. R. Cremlyn: Pesticides, John Wiley.
5. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers(2005).
6. P.T. Anastes & J.K. Warmer: Oxford Green Chemistry- Theory and Practical,University Press (1998).
7. A.S. Matlack: Introduction to Green Chemistry, Marcel Deckkar (2001).

V. References Books:

1. Fundamentals of industrial chemistry – pharmaceuticals, polymers, and business by John A.Tyrell.

2. Riegel's Handbook of Industrial Chemistry ninth edition Edited by James A. Kent.
3. E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
4. Chemistry of pesticides by N. K. Roy
5. R. Cremlyn: Pesticides, John Wiley.
6. Pesticides Formulations – Van Wade. Velkenburg, 1973.
7. Pesticides Synthesis – Mavy, Kohn, Menn, 1979.
8. Kirchoff, M. & Ryan, M.A. Greener approaches to undergraduate chemistry experiment. American Chemical Society, Washington DC (2002).

Course-17B: Pesticides and Green Chemistry-Practical Syllabus:

VI. Laboratory - Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. List out, identify and handle various equipment in the laboratory.
2. Learn the procedures of green synthesis.
3. Acquire skills in Microwave assisted organic synthesis.
4. Perform some applications of green synthesis.

VII. Practical (Laboratory) Syllabus 30h(2h/week)

The list of suggestive experiments is given below. However, depending upon available resources, any three experiments may be conducted)

1. Benzoin condensation using Thiamine Hydrochloride as a catalyst (instead of cyanide).
2. Formation of Chalcones – A Greener Alternative.
3. Preparation of Salicylic Acid (Aspirin) by Microwave Assisted Method.
4. Green Synthetic Process for Acetanilide.
5. Green Synthetic Process for Dibenzal Propanone.
6. Green Synthetic Process for trans esterification of vegetable oil to crude bio-diesel.

VIII. Recommended Books/References:

1. Anastas, P.T & Warner, J.C. Green Chemistry: Theory and Practice, OxfordUniversity Press(1998).
2. Kirchoff, M. & Ryan, M.A. Greener approaches to undergraduate chemistryexperiment. American Chemical Society, Washington DC (2002).
3. Ryan, M.A. Introduction to Green Chemistry, Tinnesand; (Ed), American ChemicalSociety, Washington DC (2002).
4. Sharma, R.K.; Sidhwani, I.T. and Chaudhari, M.K. I.K. Green Chemistry Experiment: Amonograph, International Publishing ISBN 978-93-81141-55-7

(2013).
5. Cann, M.C. and Connelly, M. E. Real world cases in Green Chemistry, AmericanChemical Society (2008). UGC DOCUMENT ON LOCF CHEMISTRY 83
6. Cann, M. C. and Thomas, P. Real world cases in Green Chemistry, AmericanChemical Society (2008).
7. Lancaster, M. Green Chemistry: An Introductory Text RSC Publishing, Second Edition,2010.
8. Pavia, D. L., Lampman, G.M., Kriz, G.S. & Engel, R.G. Introduction to Organic Laboratory Techniques: A Microscale and Macro Scale Approach, W. B. Saunders,1995.

IX. Co-Curricular Activities

Mandatory:*(Lab/field training of students by teacher:(lab: 10+field:05*):

1. **For Teacher**: Training of students by the teacher in laboratory and field for not less than15 hours on the field techniques/skills of comprehensive product development programs to meet new product criteria and timing. Acquire skills in the preparation of Cosmeceuticals and Pharmaceutical drugs, Carry out perfume testing with the knowledge of perfumes and learn the procedure of synthesis of drugs.
2. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the preparation of Cosmeceuticals and Pharmaceutical. Write their observations and submit a hand written fieldwork/project work report notexceeding10 pages in the given format to the teacher.

a) Max marks for Fieldwork/project work Report: 05.

b) Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

c) Unit tests (IE).

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Course-18A: Corrosion and Its Prevention

I. Learning Outcomes:

1. This course will create awareness of corrosion and its control process

2. It focuses on protective metallic coatings for prevention of corrosion

3. It focuses on protective coatings of materials.

4. It covers about the insulating materials in electric industries and also aware about semiconductors.

II. Syllabus: (Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Total theory hours: 60h(4h/week)

Unit-I: Corrosion **12 hours**

Introduction - Economic aspects of corrosion - Dry or Chemical Corrosion - Wet or electrochemical corrosion - Mechanism of Electrochemical Corrosion. Galvanic Corrosion - Concentration Cell Corrosion - Differential aeration corrosion - Pitting Corrosion - Underground or soil corrosion - Passivity.

Unit-II: Corrosion and Its Control **12 hours**

Factors Influencing Corrosion - Microbiological Corrosion Atmospheric corrosion – Corrosion Control - Proper designing - Using pure metal - Using metal alloys.
Chemical conversion – Coating - Phosphating – Chromising - Treatment of metal surfaceshot dipping - Use of inhibitors.

Unit-III: Protective Coatings **12 hours**

PROTECTIVE COATINGS - Introduction - Metallic Coatings - Various methods of cleaning articles before electrode position – Electroplate and - Electroplating methods.
Pre-treatment of the surface – Metallic Coatings - Hot Dipping -Cementation or Impregnated Coatings - Sprayed Metal Coatings - Cladding – Vapour Deposition.

Unit-IV Paints **12 hours**

Paints - ingredients and their functions Required Properties of a Paint- Paint

Constituents and Their Functions - Manufacture of Paint.

Types of Pigments - Characteristics of pigment - Oils - Uses in Paint Emulsion Paints – Special Paints - Paint Remover Varnishes.

Unit-V: Insulators and Semiconductors **12 hours**

Electrical Insulating Materials - Dielectric properties - Requirements of an Electrical Insulating Material - Classification of insulating material - Electrical Rigid Insulations.

Semiconductors - Introduction - Classification – Degenerate semiconductors – Super conductors.

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of related Industries/firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

IV. Text Books

1. M.G. Fontana: Corrosion Engineering, McGraw Hill International BookCo. London.
2. L.L. Shreir: Corrosion, Vol I and Vol II, Newness Butterworths, EdwardArnold Ltd, London.
3. J.C. Scully: Fundamental of Corrosion, Pergamon Press Inc. New York, USA.

V. References Books:

1. M.G. Fontana: Corrosion Engineering, McGraw Hill International BookCo. London.
2. L.L. Shreir: Corrosion, Vol I and Vol II, Newness Butterworths, EdwardArnold Ltd, London.
3. J.C. Scully: Fundamental of Corrosion, Pergamon Press Inc. New York, USA.
4. V.S. Sastry: Corrosion Inhibitors, Principles & Applications, John Wiley &Sons.
5. C.C. Nathan: Corrosion Inhibitors, NACE, Houston, Texas.
6. Corrosion - Causes and Prevention: Speller. F. N.
7. Material Science mini refresher by H.S. Bawa, Tata publisher India.

Course 18A: Corrosion and its Prevention -Practical Syllabus:

VI. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. Chalk out a plan to decrease the rate of corrosion.
2. Preparation of pigment.
3. To study about the Rate of corrosion with respect to Aluminium and Iron plates
4. To determine the effect of temperature on rate of corrosion

VII. Practical (Laboratory) Syllabus: **Total Hours: 30h(2h/week)**

1. Electroless metallic coatings on ceramic and plastic material.
2. Preparation of pigment (zinc oxide)
3. To determine the rate of corrosion on different metallic plates (Iron, Aluminium) in various Concentrations of HCl.
4. To determine the effect of temperature on rate of corrosion in acidic medium.
5. To determine the rate of corrosion on a metallic plate in acidic medium.
6. To determine the rate of corrosion on an Aluminium plate in basic medium.

VIII. Lab References:

1. Analytical Chemistry by Gary D. Christian 6th edition Wiley publication.
2. Senior Practical Physical Chemistry, B.D. Khosla, V.C. Garg, Adarsh Gulati, R Chand andCo.
3. Applied Chemistry Theory and Practice, O.P. Virani, A.K. Nebula. New Age InternationalPublishers, 2nd Edition.
4. S.W. Rajbhoj and T. K. Chondhekar, Systematic Experimental Physical Chemistry, AnjaliPublication, Second Edition 2000.
5. Sunita Rattan, Experiments in Applied Chemistry, S.K. Kataria & Sons, Second edition,2008
6. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.:New Delhi (2011).
7. UGC practical manual for experimental analysis.

IX. Cocurricular Activities:

a) Mandatory :*(Lab/field training of students by teacher :(lab: 10+ fields: 05*):

1. For Teacher: Training of students by the teacher in laboratory and field for notless than15 hours on the field techniques/skills of corrosion formation observations in nature.

2. For Students: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes corrosion process and its prevention. Write their observations and submit a hand written fieldwork/project work report notexceeding10 pages in the given format to the teacher. And also observe the semiconductors, insulators used in industry.

a. Max marks for Fieldwork/project work Report: 05.

b. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

C. Unit tests (IE).

A.P. State Council of Higher Education
Semester-wise Revised Syllabus under CBCS 2020-21
Four Year - B.Sc. (Hons), Semester – VIII
Domain Subject: CHEMISTRY

Course 18B: Material& Energy Balances and Utilities in ChemicalIndustry

I. Learning Outcomes:

At the end of the course student will be able to

1. Describe the distinction between Atomic weight, Molecular weight and Equivalent Weight.
2. Write down the flow diagrams for chemical engineering operations.CO3
3. Describe hear capacities of gases and gaseous mixtures.
4. Write down water treatment procedures for industrial use.
5. Describe the types of boilers.
6. Demonstrate knowledge acquired in steam generation.
7. Write down compressors and blowers.
8. Classify pumps based on their function.

II. **Syllabus:** *(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)*

Total hours:60h(4h/week)

Unit-I **12 hours**

Dimensions and units: Basic Chemical Calculations -Atomic weight, molecular weight, equivalent weight, Mole, composition of (i) Liquid mixtures and (ii) gaseous mixtures. Ideal gas law, vapor pressure, Humidity and Saturation.

Unit-II **14 hours**

Material Balance without Chemical Reactions: Flow diagram for material balance, simple material balance with or without recycle or by-pass for chemical engineering operations such as distillation, absorption, crystallization, evaporation and extraction.

Material Balance involving chemical reactions: concept of limiting reactant, conversion, yield, selectivity, and liquid phase reaction, gas phase reaction with or without recycle or bypass.

Unit-III **10 hours**

Energy Balance: Heat capacity of pure gases and gaseous mixtures at constant pressures, sensible heat changes in liquids, Enthalpy changes during phase transformation: Enthalpy of fusion, Enthalpy of vaporization,

Enthalpy of condensation, Enthalpy of sublimation, Hess's law of constant, Heat Summation and its applications

Unit-IV **12 hours**

Utilities in Chemical Industry

a) **Boilers**: Types of boilers and their functioning

b) **Water**: Specifications of industrial use, various water treatments.

c) **Steam**: Generation and use.

d) **Air**: Specification of industrial use, processing of air

Unit-V **12 hours**

Fluid flow and Pumps

Fluid flow: Fans, blowers, compressors, vacuum pump, ejectors.

Pumps: Reciprocating pumps, Gear pumps, centrifugal pumps**.**

III. Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of related Industries/firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

IV. Text Books:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, WileyPublishers, New Delhi.
3. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
4. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut

V. Reference Books:

1. B.I. Bhatt and S.M. Vora: *Stoichiometry*, Tata McGraw-Hill publishing Company Ltd, New Delhi.
2. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK
3. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, WileyPublishers, New Delhi.
4. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
7. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut
8. S. C. Bhatia: *Chemical Process Industries*, Vol. I & II, CBS Publishers, New Delhi.
9. W. L. McCabe and J. C. Smith: *Unit Operations in Chemical Engineering*, Mc-Graw Hill Book Company, New York.
10. O. P. Vermani, A. K. Narula: *Industrial Chemistry*, Galgotia Publications Pvt. Ltd.,New Delhi.

Course 18B: Material& Energy Balances and Utilities in Chemical Industry-PracticalSyllabus

VI. Learning Outcomes

At the end of the course student will be able to

1.Carry out the Quantitative analysis of calcium in lime stone.

2.Determine the hardness of given water sample using EDTA.

3.Determine COD and BOD of a given water sample.

4.Find out the Percentage of available chlorine present in the bleaching powder.

VII, Practical Syllabus Total hours:30h(2h/week)

1. Quantitative analysis of calcium in lime stone by complexometric titration.
2. Hardness of water by EDTA titration.
3. Determination of Chemical Oxygen Demand (COD)
4. Determination of Biological Oxygen Demand (BOD)
5. Percentage of available chlorine in bleaching powder

VIII. Reference Books:

a. 4.J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
b. 5.P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
c. 6.R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
d. 7.B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut

e. 8.S. C. Bhatia: *Chemical Process Industries,* Vol. I & II, CBS Publishers, New Delhi.

IX. Co-Curricular Activities:

Mandatory:

a. For Teacher: Training of students by the teacher in laboratory and field for not less than15 hours on the field techniques/skills of detection of N, S and halogens using the green procedure, preparation of TLC plates, detection of organic compounds using R_f values in TLC/ paper chromatography, loading of column, selection of solvent system for column chromatography, separation of amino acids and dye mixture using chromatographic techniques.

b. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the synthetic reactions. Write their observations and submit a hand written fieldwork/project work report notexceeding10 pages in the given format to theteacher.

   i. Max marks for Fieldwork/project work Report: 05.

   ii. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

   iii. Unit tests (IE).