SECOND YEAR- SEMSTER III				
BS 301	**A. Safety Rules in Chemistry Laboratory and Lab Reagents** **B. Remedial methods for pollution, drinking water and Soil fertility**	**SEC-1** **SEC-2**	**2** **2**	**2** **2**
BS 302	English	CC-1C	3	3
BS 303	Second language	CC-2C	3	3
BS 304	Optional I	DSC-1C	4T+2P=6	4+1=5
BS 305	Optional II	DSC-2C	4T+2P=6	4+1=5
BS 306	**Optional III- Chemistry - III**			
	Laboratory Course - III **(Synthesis of Organic compounds)**	**DSC-3C**	**4T** **2P** } **= 6**	**4** **1** } **=5**
	Total Credits		**28**	**25**
SECOND YEAR- SEMSTER IV				
BS 401	**A. Materials and their Applications** **B. Chemistry of Cosmetics and Food Processing**	**SEC-3** **SEC-4**	**2** **2**	**2** **2**
BS 402	English	CC-1D	3	3
BS 403	Second language	CC-2D	3	3
BS 404	Optional I	DSC-1D	4T+2P=6	4+1=5
BS 405	Optional II	DSC-2D	4T+2P=6	4+1=5
BS 406	**Optional III- Chemistry - IV**			
	Laboratory Course - IV **(Qualitative Analysis of Organic Compounds)**	**DSC-3D**	**4T** **2P** } **= 6**	**4** **1** } **= 5**
	Total Credits		**28**	**25**

* AECC: Ability Enhancement Compulsory Course, SEC: Skill Enhancement Course, DSC: Discipline Specific Course,

Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE OF SCIENCE, HUMANITIES AND COMMERCE, SAINIKPURI, SECUNDERABAD.

Autonomous College

Affiliated to OSMANIA UNIVERSITY, Hyderabad.

(Accredited with 'A' grade by NAAC)

Department of Chemistry

PROGRAM NAME: B.Sc MbGC, BtMbC, BtGC, MNDC

B.Sc II Yr CHEMISTRY
SEMESTER WISE SYLLABUS
SEMESTER III
Paper-III
Chemistry - III

COURSE CODE: CT335 & CT335P **HPW: 4**

YEAR/SEMESTER: II/III **No. Of Credits:** Theory – 4

Practical – 1

COURSE OBJECTIVES-CHEMISTRY

Name of the Course	**Semester-III Paper III Chemistry-III**
Course Code	**CT335**
COb1	Classify and identify the different properties of transition elements. Apply the theories of chemical bonding, reaction mechanism in complexes. Analyze the structure and reactivity of metals and metal carbonyls.
COb2	Learn detailed mechanisms for various fundamental reactions of carboxylic acids. Identify different nitrogen compounds and their properties. To learn various organic reactions of nitrogen compounds in synthesis of organic compounds.
COb3	Apply the principles of thermodynamics to different systems. Identify the thermodynamic quantities (U, H, S, A, G).
COb4	Estimates kinds of errors in chemical analysis. Learn detailed mechanisms for various fundamental reactions involving carbanions. Recognize single and two component systems.

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UNIT I-Inorganic Chemistry-III	**15 h (1 h /w)**
1. Chemistry of f-block elements	5 h
2. Coordination Compounds-I	6 h
3. Metal carbonyls and Organometallic Chemistry	4 h
UNIT II-Organic Chemistry-III	**15 h (1 h / w)**
1. Carboxylic acids and derivatives	5 h
2. Nitrohydrocarbons	3 h
3. Amines, Cyanides and Isocyanides	7 h
UNIT III-Physical Chemistry-III	**15 h (1 h / w)**
1. Thermodynamics –I	10h
2. Thermodynamics –II	5h
UNIT IV - General Chemistry-III	**15 h (1 h / w)**
1. Evaluation of analytical data	4 h
2. Carbanions-I	5 h
3. Phase Rule	6 h

Unit-I (Inorganic Chemistry) 15 h (1 hr/week)

S3-I-1: Chemistry of f-block elements: **5 h**

Chemistry of Lanthanides: Position in periodic table,Electronic structure, oxidation state, ionic and atomic radii- lanthanide contraction- cause and consequences, anomalous behavior of post lanthanides-complexation- type of donor ligands preferred. Magnetic properties-paramagnetism. Colour and spectra, f-f transitions –occurrence and separation– ion exchange method, solvent extraction.

Chemistry of actinides- general features – electronic configuration, oxidation state, actinide contraction, colour and complex formation. Comparison with lanthanides.

S3-I-2: Coordination Compounds-I **6 h**

Simple inorganic molecules and coordination complexes. Nomenclature – IUPAC rules, 1. Coordination number, coordination geometries of metal ions, types of ligands. 2. Brief reviewof Werner's theory,Sidgwick's electronic interpretation and EAN rule and their limitations.(Valence bond theory (VBT) – postulates and application to (a) tetrahedral complexes$[Ni(NH_3)_4]^{2+}$, $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ (b) Square planar complexes $[Ni(CN)_4]^{2-}$, $[Cu(NH_3)_4]^{2+}$,$[PtCl_4]^{2-}$ (c) Octahedral complexes $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$, $[FeF_6]^{4-}$, $[Co(NH_3)_6]^{3+}$, $[CoF_6]^{3-}$Limitations of VBT. 3. Isomerism in coordination compounds, stereo isomerism –(a)geometrical isomerism in (i) square planar meta l complexes of the type$[MA_2B_2]$, $[MA_2BC]$, $[M(AB)_2]$, [MABCD]. (ii) Octahedral metal complexes of the type $[MA_4B_2]$, $[M(AA)_2B_2]$,$[MA_3B_3]$ using suitable examples, (b) Optical isomerism in (i). tetrahedral complexes[MABCD], (ii). Octahedral complexes $[M(AA)_2B_2]$, $[M(AA)_3]$ using suitable examples.Structural isomerism: ionization, linkage, coordination ligand isomerism using suitableexamples.

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S3-I-3: Metal carbonyls and Organometallic Chemistry **4 h**

Metal carbonyls: Preparation and properties of $Ni(CO)_4$. Structural features of $Ni(CO)_4$, $Fe(CO)_5$, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$ and $Cr(CO)_6$ -18 valence electron rule.

Definition, nomenclature and classification of organometallic compounds. Methods of preparation, properties and applications of alkyl and aryl compounds of Li, Mg & Al.

Unit - II (Organic Chemistry) 15h (1 hr/week)

S3-O-1: Carboxylic acids and derivatives **5 h**

Preparation: a) Hydrolysis of Nitriles, amides and esters. b) Carbonation of Grignard reagents. Special methods of preparation of Aromatic Acids - Oxidation of Arenes. Physical properties- hydrogen bonding, dimeric association,. Chemical properties – Reactions involving H, OH and COOH groups -salt formation, anhydride formation, Acid halide formation, Esterification (mechanism) & Amide formation. Reduction of acid to the corresponding primary alcohol - via ester or acid chloride. Degradation of carboxylic acids by Huns Diecker reaction, Schmidt reaction (Decarboxylation). Arndt – Eistert synthesis, Halogenation by Hell – Volhard - Zelensky reaction. Carboxylic acid Derivatives – Hydrolysis nand Amonolysis of acid halides, Acid anhydrides and esters (mechanism of ester hydrolysis by base and acid). Hydrolysis and dehydration of amides.

S3-O-2: Nitrohydrocarbons **3 h**

Preparation of Nitroalkanes. Reactivity - halogenation, reaction with HNO_2 (Nitrous acid), Nef reaction, reduction. Aromatic Nitrohydrocarbons: Preparation of Nitrobenzene by Nitration. Physical properties, chemical reactivity –Reduction of Nitrobenzenes in different media.

S3-O-3: Amines, Cyanides and Isocyanides **7 h**

Amines: classification into 1°, 2°, 3° Amines and Quarternary ammonium compounds. Preparative methods – Ammonolysis of alkyl halides, Gabriel synthesis, Hoffman's bromamide reaction (mechanism). Reduction of Amides and Schmidt reaction. Physical properties. Use of amine salts as phase transfer catalysts. Chemical Properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation. Reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines). Electophilic substitutions of Aromatic amines – Bromination and Nitration, oxidation of aryl and 3° Amines, diazotisation. Diazonium salts: Preparation with mechanism. Synthetic importance – a) Replacement of diazonium group by – OH, X (Cl)- Sandmeyer and Gatterman reaction, by fluorine (Schiemann's reaction), by iodine, CN, NO_2, H and aryl groups. Coupling Reaction of diazonium salts. i) with phenols ii) with anilines. Reduction to phenyl hydrazines.

Cyanides and isocyanides: Structure. Preparation of cyanides from a) Alkyl halides b) from amides c) from aldoximes. Preparation of isocyanides from Alkyl halides and Amines. Properties of cyanides and isocyanides, a) hydrolysis b) addition of Grignard reagent iii) reduction iv) oxidation.

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Unit III (Physical Chemistry) 15 h (1 hr/week)

S3-P-1:Thermodynamics –I **10 h**

A brief review of - Energy, work and heat units, mechanical equivalent of heat, definition of system, surroundings. First law of thermodynamics statement- various forms mathematical expression. Thermodynamic quantities- extensive properties and intensive properties, state function and path functions. Energy as a state function and exact differential. Work of expansion and heat absorbed as path function.

Expression for work of expansion, sign convention problems on first law. Heat changes at constant pressure and heat changes at constant volume. Enthalpy. Heat capacities at constant pressure and constant volume. Derivation of Cp-Cv = R. Isothermal adiabatic processes. Reversible and irreversible processes. Reversible change and maximum work. Derivation of expression for maximum work for isothermal reversible process. Problems. Internal energy of an ideal gas. Joules experiment. Joule-Thompson coefficient. Adiabatic changes in ideal gas, derivation of equation, PV^{γ}= constant. P-V curves for isothermal and adiabatic processes. Heat of a reaction at constant volume and at constant pressure, relation between ΔH and ΔV. Variation of heat of reaction with temperature. Kirchhoff's equation and problems. Limitations of first law and need for second law. Statement of second law of thermodynamics. Cyclic process. Heat engine, Carnot's theorem, Carnot's cycle. Derivation of efficiency of heat engine. Problems. Thermodynamic scale of temperature.

S3-P-2: Thermodynamics-II **5 h**

Entropy: Definition from Carnot's cycle. Entropy as a state function. Entropy as a measure of disorder. Sign of entropy change for spontaneous and non- spontaneous processes &equilibrium processes. Entropy changes in i). Reversible isothermal process, ii). Reversible adiabatic process, iii). Phase change, iv). Reversible change of state of an ideal gas. Problems. Entropy of mixing of ideal gases. Free energy Gibb's function (G) and Helmholtz'sfunction (A) as thermodynamic quantities. Concept of maximum work and network ΔG as Criteria for spontaneity. Derivation of equation $\Delta G = \Delta H - T\Delta S$. Significance of the equation. Gibbs equations and Maxwell relations. Variation of G with P, V and T.

Unit – IV (General Chemistry) 15 h (1 hr/week)

S3-G-1 Evaluation of analytical data **4 h**

Significant figures, accuracy and precision. Errors-classification of errors- determinate and indeterminate errors, absolute and relative errors. Problems based on mean, median, range, standard deviation

S3-G-2: Carbanions-I **5 h**

Introduction, acidic nature of α-hydrogens and tautomerism in carbonyl compounds, nitro hydrocarbons, ethyl acetoacetate, diethyl malonate. Terminal alkynes. Stabilty of carbanions Reactions : Aldol reaction, Perkin reaction, Benzoin condensation, haloform reaction, conversion of smaller alkynes to higher alkynes.

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S3-G-3: Phase Rule **6 h**

Statement and meaning of the terms – Phase, Component and Degrees of freedom, Gibb's Phase rule, phase equilibria of one component system – water system. Phase equilibria of two-component system – Solid-Liquid equilibria, simple eutectic –Pb-Ag system, desilverisation of lead. Solid solutions – compound with congruent melting point – Mg-Zn system and incongruent melting point – NaCl-H_2O system.

COURSE OUTCOMES-CHEMISTRY

Name of the Course	Semester-III Paper III Chemistry-III
Course Code	CT335
CO1	Identify the basic principles related to structure and properties of lanthanides and Actinides. Apply the concept of lanthanide contraction for separation techniques. Identify the principles, structure and reactivity of selected coordination complexes. Utilise the principles of coordination complexes in understanding the functions of biological systems. Identify the structure and bonding in simple metals .Apply the 18- electron rule to simple and bridged metal carbonyls.
CO2	Write mechanisms of organic reactions involving reactive intermediates. Analyse different nitrogen compounds by conducting simple experiments.
CO3	Calculate change in thermodynamic properties .Calculate the absolute value of thermodynamic quantities (U, H, S, A, G).
CO4	Solve problems based on various analytical tools.Evaluates the effects of systematic errors on analytical results.Write mechanisms of organic reactions carbanions.Use the phase rule to determine the number of components, phases and degrees of freedom of different systems.

Text books:

Unit - I: Concise Inorganic Chemistry by J.D. Lee 3rd edn

Unit- II: Organic Chemistry by Morrison and Boyd.

Unit- III: Principles of physical chemistry by Prutton and Marron.

Unit- IV: Vogel's Text Book of Qualitative Analysis by G.H.Jeffery, J.Bassett, J.Mendham and R.C. Denney 5th edn Addison Wesley Longman Inc. 1999

Reference books: B.Sc.II Year Chemistry: Semester III

Unit- I

1. Analytical chemistry by G. L. David Krupadanam, D. Vijaya Prasad, K. Varaprasada Rao, K.L.N. Reddy and C. Sudhakar
2. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications(1996).
3. Concise Inorganic Chemistry by J.D. Lee 3rd edn Van Nostrand Reinhold Company(1977)
4. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers (2001).
5. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn. (2006)

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6. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press(1989).
7. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press (1999).
8. Textbook of Inorganic Chemistry by R Gopalan(Universities Press(2012)
9. College Practical chemistry by V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati Universities Press (India) Limited(2012)

Unit- II

1. Text book of organic chemistry by Soni. Sultan Chand & Sons; Twenty Ninth edition (2012)
2. General Organic chemistry by Sachin Kumar Ghosh. New Age Publishers Pvt Ltd (2008).
3. Text book of organic chemistry by Morrison and Boyd. Person(2009)
4. Text book of organic chemistry by Graham Solomons. Wiley(2015)
5. Text book of organic chemistry by Bruice Yuranis Powla. (2012)
6. Text book of organic chemistry by C N pillai CRC Press (2012)
7. Organic Chemistry by L. G. Wade Jr.
8. Organic Chemistry by M. Jones, Jr
9. Organic Chemistry by John McMurry.

Unit III

1. Principles of physical chemistry by Prutton and Marron. The MacmillanCompany; 4th Edn.(1970)
2. Text Book of Physical Chemistry by Soni and Dharmahara. Sulthan Chand and Sons.(2011)
3. Text Book of Physical Chemistry by Puri and Sharma. S. Nagin chand and Co.(2017)
4. Text Book of Physical Chemistry by K. L. Kapoor. (2012)
5. Colloidal and surface chemistry , M. Satake, Y. Hayashi, Y.Mido, S.A.Iqbal
6. M.S.Sethi, Discovery Publishing Pvt.Ltd (2014)
7. Material science by Kakani & Kakani, New Age International(2016)
8. Physical Chemistry by Ira Levine (Author) McGraw-Hill Education; 6 edition (May 9, 2008)

Unit IV

1. Text book of organic chemistry by Morrison and Boyd, Person(2009)13
2. Text book of organic chemistry by Graham solomons, Wiley(2015)
3. Text book of organic chemistry by Sony, Sultan Chand & Sons; 29th edition (2012)
4. Text book of organic chemistry by Bruice yuranis Powla, (2012)
5. General Organic chemistry by Sachin kumar Ghosh, New Age Publishers Pvt Ltd (2008)

Laboratory Course

Paper III (Organic Synthesis) **45 h (3h/week)**

Laboratory Course: Paper code: CT335P

Organic Preparations

- Objective:
  To learn various organic reactions and reagents for organic synthesis.
- Outcome:
  To use various organic reactions and reagents in a logical manner for organic synthesis.

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1. **Synthesis of Organic compounds:**
   - Acetylation: Acetylation of salicylic acid, Benzoylation of Aniline.
   - Aromatic electrophilic substitution: Nitration: Preparation of Para nitro salicylic acid
   - Halogenation: Preparation of p-bromo acetanilide
   - Oxidation: Preparation of benzoic acid from benzyl chloride.
   - Esterification: Preparation of n-butyl acetate from acetic acid.
   - Methylation: Preparation of - naphthyl methyl ether. (Demo experiment)
   - Condensation: Preparation of benzilidine aniline from Benzaldehyde and aniline.
   - Diazotisation: Azocoupling of β-Naphthol.

2. **Microwave assisted synthesis of Asprin – DEMO (demonstration only)**

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B.Sc. Chemistry II Year Semester-III
Skill Enhancement Course- I (SEC-I) (2 Credits)

SKILL ENHANCEMENT COURSE (SEC)
SEMESTER III
SAFETY RULES IN CHEMISTRY LABORATORY AND PREPARING LAB REAGENTS(credits:02)
(30hrs 15 weeks)
(2h/w)

UNIT I:

Laboratory Safety Rules and Regulations

General rules and regulations for lab safety: Minimizing Risks of Hazards, Personal Protective Equipment (PPE) - Hair, Dressing for the Laboratory, Eye Protection, Eye-wash fountain, Gloves.

Laboratory Protocols- Labeling Chemicals, Careful reading of labels Prevention of Inhaling Harmful Chemicals- Guide to Chemical Hazards, Chemical Spills.

Accidents- use of fire extinguisher and first aid kit in the laboratory, safety symbols

Normality/Molarity and specific gravity of concentrated acids – Preparation of dilute solutions (Numerical problems). Precautions to be taken in the preparation of dilute acids and bases and bases.

Preparation of stock solutions of salts with specific examples. Properties of primary standard salt and preparation of standard solution. Good laboratory practices-maintenance of observation book record.

UNIT II:

Preparation of Lab Reagents:

Preparation of indicators and use of indicators in volumetric analysis- acid base titrations, redox titrations, precipitation titrations and complexometric titrations. Role of an indicator in detecting end point (Phenolphthalein, Methyl orange, Methyl-red, Potassium Chromate, Diphenylamine, EBT, Murexide, etc).

Preparation of buffers – pH 10 ammonical buffer and acetate buffer solutions.Preparation of commonly used reagents : Ammonium hydroxide solution, Ammonium molybdate reagent, Ammonium hydrogen phosphate solution, Bromine water, Dimethyl glyoxime reagent, 2,4-Dinitrophenyl hydrazine reagent, Eriochrome black-T reagent Fehling solution, Ferric chloride solution, Ferrous sulphate solution, Iodine solution, Molisch's reagent, Neutral FeCl3, Schiff's reagent, Silver nitrate solution, Sodium carbonate solution , Sodium hydroxide (Caustic soda) solution, Starch solution, Tollen's reagent.(reference work and submission of assignments).

RECOMMENDED BOOKS

1. Vogel's Text Book of Quantitative Chemical Analysis, 5thedition.
2. Vogel's Text Book of macro and semimicro qualitative inorganic analysis. G. Svehla, 5th edition.
3. American Chemical Society Safety in Academic Chemistry Laboratories 8thedition.

OUTCOMES FOR SAFETY RULES IN CHEMISTRY LABORATORY AND PREPARING LAB REAGENTS:

- To improve the skills of students in the application of theory and practical knowledge.
- To fill the gap between theory and practicals
- To train the students in understanding laboratory safety rules and to improve the skills in preparation of laboratory regents
- To make students aware about best lab practices.

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B.Sc. Chemistry II Year Semester-III
Skill Enhancement Course- I (SEC-2) (2 Credits)

BASIC ANALYTICAL CHEMISTRY: (CREDITS :02) **(30hrs 15 weeks) (2h/w)**

INTRODUCTION: **5h**

Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the statistical point of view, using a few examples.

ANALYSIS OF SOIL: **5h**

Composition of soil, Concept of pH and pH measurement.

a. Determination of pH of soil samples.

b. Estimation of Calcium and Magnesium ions as carbonates by complexmetric titration.

ANALYSIS OF WATER: **5h**

Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

a. Determination of pH, acidity and alkalinity of a water sample.

b. Determination of dissolved oxygen (DO) of a water sample.

ANALYSIS OF COSMETICS: **5h**

Major and minor constituents and their functions

a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.

b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

LAB COURSE: **10h**

a. Determination of of macro nutrients in soil samples.

b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.

c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in aerated drinks.

REFERENCE BOOKS:

1.Willard, H.H., Merritt, L.L., Dean, J. &Settoe, F.A. Instrumental Methods of Analysis. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.

2.Skoog, D.A. Holler F.J. &Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.

3.Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992).

OUTCOMES OF ANALYTICAL CHEMISTRY:

1. It enhances the knowledge and skills required for attaining analytical and critical abilities, logical thinking, and ability to apply knowledge learnt to solve issues and problems related to chemical analysis.
2. Improve the use of statistical tools.
3. Used in determining the water quality refers to the chemical, physical, biological, and radiological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose.
4. pH, hardness, presence of a selected group of chemical parameters, biocides, highly toxic chemicals, and B.O.D are estimated. pH is a measure of hydrogen ion concentration. It is an indicator of relative acidity or alkalinity of water. ... Drinking water should have a pH between 6.5 and 8.5.
5. ph. Soil pH is one of the most important parameter son your soil test report. The pH level of the soil can tell you a lot about the potential availability of plant nutrients and on possible toxicities of other elements (such as aluminum). Soils with pH greater than 7.0 are considered to be alkaline soils.

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B.Sc. II yr CHEMISTRY
SEMESTER WISE SYLLABUS
SEMESTER IV
Paper-IV
Chemistry - IV

COURSE OBJECTIVES-CHEMISTRY

Name of the Course	Semester-IV Paper IV Chemistry-IV
Course Code	CT435
COb1	To predict the properties of coordination compounds .Describe the stability of complexes and explain their reactivity based on trans effect. Apply HSAB principle for simple salts and complexes.
COb2	Classify carbohydrates and identify the structure of different class of carbohydrates. Learn to convert them by simple reactions. Classify amino acids and identify their importance. Classify the heterocyclic compounds and differentiate the chemical properties of these compounds.
COb3	Apply elementary laws of chemical kinetics and analyze reaction mechanisms. Solve problems on rate and rate constants. Explore and apply the basic principles of photochemistry.
COb4	Analyze the conducting properties of metals from bonding theories. Learn detailed mechanisms for various fundamental reactions involving carbanions. Evaluate basic knowledge of surface and colloid chemistry from a physical-chemical perspective.

UNIT I-Inorganic Chemistry-III	**15 h (1 h /w)**
1. Coordination Compounds-II	11 h
2. Bioinorganic Chemistry	4 h
UNIT II-Organic Chemistry-III	**15 h (1 h / w)**
1. Carbohydrates	6 h
2. Amino acids and proteins	5 h
3. Heterocyclic Compounds	4 h
UNIT III-Physical Chemistry-III	**15 h (1 h / w)**
1. Chemical Kinetics	11h
2. Photochemistry	4h
UNIT IV - General Chemistry-III	**15 h (1 h / w)**
1. Theories of bonding in metals	4 h
2. Carbanions-II	5 h
3. Colloids & Surface Chemistry	6 h

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Unit-I (Inorganic Chemistry) **15h (1 h/week)**

S4-I-1: Coordination Compounds –II **11 h**

Crystal field theory (CFT) - Postulates of CFT, splitting patterns of d-orbitals in ctahedral, tetrahedral, square planer with suitable examples. Crystalfield stabilization energies and its calculations for various dn configurations in octahedral complexes. High Spin Low Spin complexes. Colour and Magnetic properties of transition metal complexes. Calculations of magnetic moments spin only formula. Detection of complex formation - basic principles of various methods- change in chemical properties, solubility, colour, pH, conductivity, magnetic susceptibility.

Hard and soft acids bases (HSAB) - Classification, Pearson's concept of hardness and softness, application of HSAB principles – Stability of compounds / complexes, predicting the feasibility of reaction. Thermodynamic and kinetic stability of transition of metal complexes. Stability of metal complexes –stepwise and overall stability constant and their relationship and chelate effect determination of composition of complex by Job's method and mole ratio method.

Applications of coordination compounds: Applications of coordination compounds a) in quantitative and qualitative analysis with suitable examples b) in medicine for removal of toxic metal ions and cancer therapy c) in industry as catalysts polymerization – Ziegler Natta catalyst d) Water softening.

S4-I-2: Bioinorganic Chemistry **4 h**

Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and chloride (Cl-). Toxic metal ions As, Hg & Pb Oxygen transport and storage – structure of hemoglobin, binding and transport of oxygen. Fixation of CO_2 in photosynthesis- overview of light and dark reactions in photosynthesis. Structure of chlorophyll and coordination of magnesium. Electron transport in light reactions from water to NADP+ (Z – scheme).

Semester-IV

Unit - II (Organic Chemistry) **15h(1 hr/week)**

S4-O-1: Carbohydrates **6 h**

Introduction: Classification and nomenclature. Monosaccharides: All discussion to be confined to (+) glucose as an example of aldo hexoses and (-) fructose as example of ketohexoses. Chemical properties and structural elucidation: Evidences for straight chain pentahydroxy aldehyde structure. Number of optically active, isomers possible for the structure, configuration of glucose based on D-glyceraldehyde as primary standard (No proof for configuration is required). Evidence for cyclic structure of glucose (Pyranose structure, anomeric Carbon and anomers). Proof for the ring size (methylation, hydrolysis and oxidation reactions). (Haworth formula and chair conformational formula). Structure of fructose: Evidence of 2 – ketohexose structure. Same osazone formation from glucose and fructose, Hydrogen bonding in osazones,

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cyclic structure for fructose (Furanose structure,Haworth formula).

Inter Conversion of Monosaccharides: Arabinose to D-glucose, D- mannose (kiliani – Fischer method). Epimers, Epimerisation- Lobry de bruyn van Ekenstein rearrangement. D-glucose to D-arabinose by Ruff's degradation. Aldohexose(+) (glucose) to ketohexose (–) (fructose) and Ketohexose(Fructose) to aldohexose (Glucose).

S4-O-2: Amino acids and proteins **5 h**

Classification. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples – Glycine, Alanine, Valine and Leucine) by following methods: a) From halogenated Carboxylic acid b)Malonic ester synthesis c) strecker's synthesis. Physical properties: Optical activity of naturally occurring amino acids. Zwitter ion structure – salt like character, definition of isoelectric point. Chemical properties: General reactions due to amino and carboxyl groups – Lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides. Primary structure of proteins, di peptide synthesis

S4-O-3: Heterocyclic Compounds **4 h**

Introduction and definition: 5 membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole. Importance of ring systems –Numbering. Aromatic character

Resonance structures: Explanation of feebly acidic character of pyrrole, electrophillic substitution, Halogenation, Nitration and Sulphonation. Reactivity of furan as 1,3-diene, Diels Alder reactions (one example). Sulphonation of thiophene purification of Benzene obtained from coal tar). Preparation of furan, Pyrrole and thiophene Paul-Knorr synthesis. Structure of pyridine, Basicity – Aromaticity – Comparison with pyrrole – preparation by Hantsch method and properties – Reactivity towards Nucleophilic substitution reaction – chichibabin reaction.

Unit III (Physical Chemistry) **15h (1 hr/week)**

S4-P-1: Chemical Kinetics **11 h**

Introduction to chemical kinetics, rate of reaction, variation of concentration with time, rate laws and rate constant. Specific reaction rate. Factors influencing reaction rates: effect of concentration of reactants, effect of temperature, effect of pressure, effect of reaction medium, effect of radiation, effect of catalyst with simple examples. Order of a reaction.

First order reaction, derivation of equation for rate constant. Characteristics of first order reaction. Units for rate constant. Half- life period, graph of first order reaction, Examples- Decomposition of H_2O_2 and decomposition of oxalic acid, Problems.

Pseudo first order reaction, Hydrolysis of methyl acetate, inversion of cane sugar, problems.

Second order reaction, derivation of expression for second order rate constant, examples- Saponification of ester, $2O_3 \rightarrow 3O_2$, $C_2H_4+H_2 \rightarrow C_2H_6$. Characteristics of second order reaction, units for rate constants, half- life period and second order plots. Problems

S4-P-2: Photochemistry **4 h**

Introduction to photochemical reactions, Difference between thermal and photochemical reactions, Laws of photo chemistry- Grotthus Draper law, Stark–Einstein's Law of photochemical equivalence. Quantum yield. Examples of photo chemical reactions with

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different quantum yields. Photo chemical combinations of H_2–$Cl_2$and H_2–Br_2 reactions, reasons for the high and low quantum yield. Problems based on quantum efficiency. Consequences of light absorption. Singlet and triplet states. Jablonski diagram. Explanation of internal conversion, inter- system crossing, phosphorescence, fluorescence.

Unit III (General Chemistry) 15h (1 hr/week)

S4-G-1: Theories of bonding in metals **4 h**

Valence bond theory, Explanation of metallic properties and its limitations, Free electron theory, thermal and electrical conductivity of metals, limitations, Band theory, formation of bands, explanation of conductors, semiconductors n-type and p-type, extrinsic & intrinsic semiconductors, and insulators.

S4-G-2: Carbanions-II **5 h**

Mannich reaction , Michael addition and Knoevengeal condensation Synthetic applications of Aceto acetic ester. Acid hydrolysis and ketonic hydrolysis: Preparation of ketones, monocarboxylic acids and dicarboxylic acids Malonic ester– synthetic applications. Preparation of (i) substituted mono carboxylic acids and (ii) substituted dicarboxylic acids.

S4-G-3: Colloids & Surface Chemistry **6 h**

Definition of colloids. Classification of colloids. Solids in liquids (sols): preparations and properties – Kinetic, Optical and Electrical stability of colloids. Protective action. Hardy–Schultz law, Gold number. Liquids in liquids (emulsions): Types of emulsions, preparation and emulsifier. Liquids in solids(gels): Classification, preparations and properties, General applications of colloids.

Adsorption: Types of adsorption. Factors influencing adsorption. Freundlich adsorption isotherm. Langmuir theory of unilayer adsorption isotherm. Applications.

COURSE OUTCOMES-CHEMISTRY

Name of the Course	**Semester-IV Paper IV Chemistry-IV**
Course Code	**CT435**
CO1	Apply HSAB principle for stability and occurrence of simple salts in nature. Apply the principles of coordination chemistry in qualitative & quantitative analysis
CO2	Identify the carbohydrates and explain its role in living organisms. Identify the heterocyclic structure in metalloproteins or enzymes. Synthesise them through green chemistry approach.
CO3	Solve problems on rate and rate constants. Calculate the age of rocks, carbon dating etc. Explain examples of the effects of photochemistry in nature and in various applications.
CO4	Provide examples of materials that are good insulators and good conductors. Write mechanisms of organic reactions carbanions. Define and explain surface and interfacial phenomena. Demonstrate how colloid and surface chemistry is applied in industry and the environment.

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Text books:

Unit - I: Concise Inorganic Chemistry by J.D. Lee 3rd edn

Unit- II: Organic Chemistry by Morrison and Boyd.

Unit- III: Principles of physical chemistry by Prutton and Marron.

Unit- IV: Vogel's Text Book of Qualitative Analysis by G.H.Jeffery, J.Bassett, J.Mendham and R.C. Denney 5th edn Addison Wesley Longman Inc. 1999

References

Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications (1996).
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn. Van Nostrand ReinholdCompany(1977)
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers (2001).
4. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn. (2006)
5. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press(1989)
6. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press (1999).
7. Textbook of Inorganic Chemistry by R Gopalan, Universities Press,(2012)

Unit- II

1. Text book of organic chemistry by Soni. Sultan Chand & Sons; Twenty Ninthedition (2012)
2. General Organic chemistry by Sachin Kumar Ghosh. New Age Publishers Pvt Ltd (2008)
3. Text book of organic chemistry by Morrison and Boyd. Person(2009)
4. Text book of organic chemistry by Graham Solomons. Wiley(2015)
5. Text book of organic chemistry by Bruice Yuranis Powla. (2012)
6. Text book of organic chemistry by C N pillai CRC Press (2012)
7. Organic Chemistry by L. G. Wade Jr.
8. Organic Chemistry by M. Jones, Jr
9. Organic Chemistry by John McMurry.

General reference: B.Sc II Year Chemistry : Semester IV, Telugu Academy publication, Hyd

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1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications (1996).
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn. Van Nostrand ReinholdCompany(1977)
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers (2001).
4. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn. (2006)
5. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press(1989).
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7. Textbook of Inorganic Chemistry by R Gopalan, Universities Press,(2012)

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4. Text book of organic chemistry by Graham Solomons. Wiley(2015)
5. Text book of organic chemistry by Bruice Yuranis Powla. **(2012)**
6. Text book of organic chemistry by C N pillai CRC Press (2012)
8. Organic Chemistry by L. G. Wade Jr.
9. Organic Chemistry by M. Jones, Jr
10. Organic Chemistry by John McMurry.

Unit III

1. Principles of physical chemistry by Prutton and Marron. The MacmillanCompany; 4th edn. (1970)
2. Text Book of Physical Chemistry by Soni and Dharmahara. Sulthan Chand &sons.(2011)
3. Text Book of Physical Chemistry by Puri and Sharma. S. Nagin chand and Co.(2017)
4. Text Book of Physical Chemistry by K. L. Kapoor. (2012)
5. Physical Chemistry through problems by S.K. Dogra. (2015)
6. Text Book of Physical Chemistry by R.P. Verma.
7. Elements of Physical Chemistry byLewis Glasstone. Macmillan (1966)
8. Industrial Electrochemistry, D. Pletcher, Chapman & Hall, London, 1990)

Unit IV

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications(1996).
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn. Van Nostrand Reinhold Company (1977)
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers (2001).
4. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn. (2006)
5. Text book of organic chemistry by Morrison and Boyd, Person (2009)
6. Text book of organic chemistry by Graham solomons, Wiley (2015)
7. Fundamentals of organic synthesis and retrosynthetic analysis by Ratna Kumar Kar, CBA,(2014)
8. Organic synthesis by Dr. Jagadamba Singh and Dr. L.D.S. Yadav, Pragati Prakashan, 2010
9. Stereochemistry of organic compounds by D. Nasipuri, New Academic Science Limited, 2012
10. Organic chemistry by Clayden, Greeves, Warren and Wothers, Oxford University Press, 2001
11. Fundamentals of Asymmetric Synthesis by G. L. David Krupadanam, Universities, Press 2014).

Paper IV-

Qualitative Analysis of Organic Compounds: **45hrs (3 h/week)**

Qualitative analysis: Identification of organic compounds through the functional group analysis - ignition test, determination of melting points/boiling points, solubility test, functional group tests and preparation of suitable derivatives of the following: Carboxylic acids, phenols, urea, carbohydrates, aldehydes, ketones, amides, ester and naphthalene.

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B.Sc. Chemistry II Year Semester-IV
Skill Enhancement Course- I (SEC-3) (2 Credits)

SKILL ENHANCEMENT COURSE (SEC)
SEMESTER IV
GREEN METHODS IN CHEMISTRY(credits:02) (30hrs 15 weeks)

(2h/w)

THEORY AND HANDS-ON EXPERIMENTS

INTRODUCTION: **8h**

Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity,green solvents, green reactants, green reagents,one pot syntheses.Green Chemistry and catalysis and alternative sources of energy.

GREEN ENERGY AND SUSTAINABILITY. BETTER LIVING THROUGH GREEN CHEMISTRY: **10h**

1. Surfactants for Carbon Dioxide –replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.
2 Designing of Environmentally safe marine antifoulant,green computing.
3. Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments, green pigments.
4 An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn, green plastics.
5. Improvement of lab atmosphere-green guidelines.

LAB COURSE: **12h**

1.Alternate procedure for Lassaignes test
2.Acetylation of primary amine
3. Bromination of acetanilide
4.Transesterification reaction –synthesis of biodiesel.
5.Green photochemical reaction-photoreduction of benzophenone to benzopinacol

REFERENCE BOOKS:

1.Anastas,P.T.andWarner,J.K. Oxford -Green Chemistry-Theory and Practical, University Press,1998
2.Matlack,A.S., Marcel Dekker,2001- Introduction to Green Chemistry,
3. Sharma, R.K.,Sidhwani, I.T. andChaudhari, M.K.- Green Chemistry
4. Ahluwalia VkKidwai - New Trends In Green Chemistry

OUTCOMES FOR GREEN METHODS IN CHEMISTRY:

- Know about green lab practices.
- Improving reaction efficiency by changing certain parameters and making it more environment friendly.
- Learning about green reagents and their mode of action in making chemistry less hazardous.
- Atom economy and its usefulness i.e. utilizing 100% of the reactants.
- Different green reactions.

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B.Sc. Chemistry II Year Semester-IV
Skill Enhancement Course- I (SEC-4) (2 Credits)

CHEMINFORMATICS (credits:02) **(30hrs 15 weeks)**
(2h/w)

INTRODUCTION TO CHEMINFORMATICS: **2h**
History and evolution of cheminformatics, use of cheminformatics, prospects of cheminformatics, molecular modelling, structure elucidation.

RERESENTATION OF MOLECULES AND CHEMICAL REACTIONS: **7h**
Chemical Nomenclature – (development, representation of elements and, Molecular formulas), types of notations, SMILES coding, matrix representation, structure of Molfiles and Sdfiles, libraries and tool kits, reaction classification.

SEARCHING CHEMICAL STRUCTURES: **9h**
Full structure search, sub-structure search, basic ideas, similarity search, 3D search methods, Basics of computation of physical and chemical data and structure descriptors.

APPLICATIONS: **12h**
Prediction of properties of compounds: Linear free energy relations, Quantitative Structure –Property Relations, Descriptor analysis, model building, modelling toxicity.
COMPUTER ASSISTED SYNTHESIS DESIGN.
DRUG DESIGN – introduction, Drug discovery process (Target identification and validation, Lead finding and optimization), Application of cheminformatics in drug design (Analysis of HTS data, virtual screening, design of combinatorial libraries, ligand based and structure based drug design).

REFERENCE BOOKS:
1. Andrew R. Leach & Valerie, J. Gillet (2207) An introduction to Cheminformatics.
2. Gasteiger, J. & Engel, T. (2003) Cheminformatics: A text book. Wliey-VCH

OUTCOMES FOR CHEMINFORMATICS:
- Learn about drawing chemical structures on pc
- Using the tools to search the chemicals in the database to help in research.
- Identification of protein targets.
- Spectral predictions of various drugs.
- Molecular modeling
- Hands on experiment on drug development using cheminformatics.
- Hands on molisnpiration.

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