CREDITS IN CHEMISTRY

CHEMISTRY -MbGC,MbBcC,BTGC, MNDC (2020-23)

I YEAR SEMESTER-I				
CODE	**COURSE TITLE**	**COURSE TYPE**	**HPW**	**CREDITS**
CT135	CHEMISTRY- I	DSC-3A	4T+2P=6	4+1=5
			6	**5**

I YEAR SEMESTER-II				
CODE	**COURSE TITLE**	**COURSE TYPE**	**HPW**	**CREDITS**
CT235	CHEMISTRY- II	DSC-3B	4T+2P=6	4+1=5
			6	**5**

II YEAR SEMESTER-III				
CODE	**COURSE TITLE**	**COURSE TYPE**	**HPW**	**CREDITS**
CT335	CHEMISTRY - III	DSC-3C	4T+2P=6	4+1=5
SE 335A	SAFETY RULES IN CHEMISTRY LABORATORY AND PREPARING LAB REAGENTS	SEC-1	2	2
SE 335B	BASIC ANALYTICAL CHEMISTRY	SEC-2	2	2
			10	**9**

II YEAR SEMESTER-IV				
CODE	**COURSE TITLE**	**COURSE TYPE**	**HPW**	**CREDITS**
CT435	CHEMISTRY- IV	DSC-3D	4T+2P=6	4+1=5
SE435A	GREEN METHODS IN CHEMISTRY	SEC-3	2	2
SE435B	CHEMINFORMATICS	SEC-4	2	2
			10	**9**

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BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-07

Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE OF SCIENCE, HUMANITIES AND COMMERCE, SAINIKPURI, SECUNDERABAD. Autonomous College
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Program: B Sc — Mb,G,C; Mb,Bc,C; Bt,G,C; Mb,N&D,C

Subject: Chemistry-I
COURSE CODE: CT135 & CT135P — **HPW:4**
YEAR/SEMESTER: I/I — **No. Of Credits:** Theory – 4
(60 h/ 15 weeks) — Practical –1

SEMESTER-1
COURSE OBJECTIVES

COb1

- This unit enables students to learn various theories of bonding both ionic and covalent. Familiarize with the treatment of bonding in VB theory, understand hybridisation of orbitals, apply the VSEPR theory to determine the structure of small polyatomic molecules. Acquire a knowledge of MOED.
- Identify the basic principles related to structure and bonding in s and p –block elements.

COb2

- This unit introduces the students to three foundation courses (a) the basic ideas of structural theory in organic chemistry and its applications, (b) preparation and reactions of alkanes, alkenes, alkynes – the first family of hydrocarbons, and (c) theory of aromaticity, reactivity of aromatic compounds and substituent effects.

COb3

- Understand the differences between gases and liquids. Derive vander waals laws.
- Identify the properties of various kinds of liquid-liquid solutions and their deviation from ideal behaviour.

COb4

- Acquire qualitative skills for semi micro analysis of double salts.

The stereochemistry part in the unit aims to teach the students three basic concepts - (a) various methods of representing 3-dimensional structures of organic molecules, (b) the concept of isomerism in organic molecules and classification based on superimposability, molecular connectivity, non-superimposable mirror image relationship, and energy barrier, and (c) conformational analysis of simple ethane

CHAIRPERSON
BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry

derivatives and cyclohexane.
- To identify and apply the concepts involved in the structure and physical properties of crystalline inorganic solids.

UNIT I-Inorganic Chemistry-I — **15 h (1 h /w)**
1. Chemical Bonding — 8 h
2. p-Block Elements-I — 7 h

UNIT II-Organic Chemistry-I — **15 h (1 h / w)**
1. Structural Theory in Organic Chemistry — 5 h
2. Acyclic Hydrocarbons — 6 h
3. Aromatic Hydrocarbons — 4 h

UNIT III-Physical Chemistry-I — **15 h (1 h / w)**
1. Atomic structure and elementary quantum mechanics — 2h
2.. Gaseous State — 5h
3. Liquid State — 4h
4. Solutions — 4h

UNIT IV - General Chemistry-I — **15 h (1 h / w)**
1. General principles of Inorganic qualitative analysis — 6 h
2. Stereochemistry -I — 5 h
3. Solid state Chemistry — 4 h

YEAR/SEMESTER: I/I
Unit-I (Inorganic Chemistry) — **15 h (1 hr/week)**

S1- I-1. Chemical Bonding — **8 h**

Ionic solids- lattice and solvation energy, solubility of ionic solids, Fajan's rule, polarity and polarizability of ions VSPER Theory - Common hybridization- sp, sp^2, sp^3 , sp^3d, sp^3d^2 and sp^3d^3
Molecular orbital theory: Shapes and sign convention of atomic orbitals. Modes of bonding. Criteria for orbital overlap. LCAO concept. Sigma and pi overlapping. Concept of types of molecular orbitals-bonding, antibonding and nonbonding. MOED of homo nuclear diatomic - H_2,N_2,O^{2-},O_2^{2-},F_2 and heteronuclear diatomics (unhybridized diagrams only) CO, CN^-, NO, NO^+ and HF. Bond order, stability and magnetic properties.

S1-I-2. p-Block Elements 1 — **7h**

Group–13: Structure of diborane and higher Boranes (B_4H_{10} and B_5H_9), Boron nitrogen compounds ($B_3N_3H_6$ and BN), Lewis acid nature of BX_3.
Group – 14: Carbides-Classification – ionic, covalent, interstitial. Structures and reactivity. Industrial applications. Silicones – Classification – straight chain, cyclic and cross-linked.
Group – 15: Nitrides – Classification – ionic, covalent and interstitial. Reactivity – hydrolysis. Reactions of hydrazine, hydroxyl amine, phosphazenes.

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

S1-O-1: Structural Theory in Organic Chemistry — **5 h**

Bond polarization: Factors influencing the polarization of covalent bonds, electro negativity – inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbocations. Resonance - Mesomeric effect, application to (a) acidity of phenol. (b) acidity of

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BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

carboxylic acids and basicity of anilines. Stability of carbo cations, carbanions and free radicals. Sigma bond lecolization and its application to stability of carbocations, free radicals and alkenes.

S1-O-2: Acyclic Hydrocarbons **6 h**

Alkanes– Methods of preparation: From Grignard reagent, Kolbe synthesis. Chemical reactivity - inert nature, free radical substitution, Halogenation example- reactivity, selectivity and orientation.
Alkenes - Preparation of alkenes (with mechanism) (a) by dehydration of alcohols (b) dehydrohalogenation of alkyl halides (c) by dehalogenation of 1,2 dihalides, Zaitsev's rule. Properties: Anti-addition of halogen and its mechanism. Addition of HX, Markonikov's rule, addition of H_2O, HOX, H_2SO_4 with mechanism and addition of HBr in the presence of peroxide (anti – Markonikov's addition). Oxidation (cis – additions) – hydroxylation by by $KMnO_4$, OsO_4
anti addition- peracids (via epoxidation), hydroboration, ozonolysis – determining the location of double bond. Dienes – Types of dienes, reactions of conjugated dienes – 1,2 and 1,4 addition of HBr to 1,3 – butadiene and Diels – Alder reaction.
Alkynes– Preparation by dehydrohalogenation of *vicinal diho alkenes, dehalogenation of tetrahalides. Physical Properties: Chemical reactivity – electrophilic addition of X_2, HX, H_2O (tautomerism), Oxidation (formation of enediol, 1,2 diones and carboxylic acids) and reduction (Metal-ammonia reduction, catalytic hydrogenation).

Aromatic Hydrocarbons **4h**

Introduction to aromaticity: Huckel's rule – Benzene, Naphthalene and Anthracene. Reactions - General mechanism of electrophilic substitution, mechanism of nitration, sulphonation and halogenation, Friedel Craft's alkylation and acylation. *Orientation of aromatic substitution - Definition of ortho, para, and meta directing groups. Ring activating and deactivating groups with examples. Orientation – (i) activating groups: Amino, methoxy and alkyl groups. (ii) Deactivating groups - nitro, nitrile, carbonyl, carboxylic acid, sulphonic acid and halo groups.

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

S1-P-1: Atomic structure and elementary quantum mechanics **2 h**

Black body radiation, Compton effect, de Broglie's hypothesis.,Heisenberg's uncertainty principle.

S1-P-2: Gaseous State **5 h**

Deviation of real gases from ideal behavior. van der Waals equation of state. Critical phenomenon. PV isotherms of real gases, continuity of state. Andrew's isotherms of CO_2. The van der Waal's equation and critical state. Derivation of relationship between critical constants and van der Waal's constants. The law of corresponding states, reduced equation of states. Joule Thomson effect and inversion temperature of a gas. Liquifaction of gases: i) Linde's method based on Joule Thomson effect ii) Claude's method based on adiabatic expansion of a gas.

S1-P-3: Liquid State **4 h**

Intermolecular forces, structure of liquids (qualitative description). Structural differences between solids, liquids and gases. Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

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BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University

S1-P-4: Solutions **3 h**

Liquid - liquid mixtures, ideal liquid mixtures, Raoult's and Henry's laws. Non ideal systems. Azeotropes: HCl-H_2O and C_2H_5OH - H_2O systems. Fractional distillation. Partially miscible liquids: Phenol – Water, Trimethyl amine – Water and Nicotine – Water systems.

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

S1-G-1. General Principles of Inorganic Qualitative Analysis **6 h**

Anion analysis: Theory of sodium carbonate extract, classification and reactions of anions- CO_3^{2-} CH_3COO^- Cl^- Br^- I^- NO_3^- SO_4^{2-} PO_4^{3-} BO_3^{3-}

Cation Analysis: Principles involved - Solubility product, common ion effect, general discussion for the separation and identification of group I individual cations (Hg_2^{2+}, Ag^+, Pb^{2+}) with flow chart and chemical equations. Principle involved in separation of group II & IV cations. General discussion for the separation and identification of group II (Hg^{2+}, Pb^{2+}, Bi^{3+}, Cd^{2+}, Sb^{3+}), III (Al^{3+}, Fe^{3+}), IV (Mn^{2+}, Zn^{2+}) individual cations with flow chart and chemical equations. General discussion for the separation and identification of group V individual cations Ba^{2+},Ca^{2+},Sr^{2+} with flow chart and chemical equations. Theory of flame test. Identification of Group VI cations (Mg^{2+}, NH_4^+).

S1-G-2. Stereochemistry-I **5 h**

Shapes of organic molecules – Various methods of representing 3-dimensional structures – Wedge, Fischer, Newman and Sawhorse formulae – Meaning, advantages and limitations of each formula.

Isomers - Flow chart for classification - Definition and examples of homomers, isomers, constitutional isomers, stereo-isomers, enantiomers, diastereomers, configurational stereoisomers (enantiomers and diastereomers) and conformational stereoisomers (enantiomers and diastereoisomers)

Conformations of ethane, n-butane, 1,2-dichloroethane, 2-chloroethanol, 1,2-dihydroxyethane - conformational stability - energy diagrams.

Baeyer's strain theory in cycloalkanes - Puckered structures - cyclohexane conformations – chair and boat forms – flipping of chair forms – energy diagram – equatorial and axial bonds.

S1-G-3: Solid state Chemistry **4 h**

Laws of Crystallography: (i) Law of Constancy of interfacial angles (ii) Law of Symmetry- Symmetry elements in crystals (iii) Law of rationality of indices. X-ray diffraction by crystals; Derivation of Bragg's equation. Determination of structure of NaCl, KCl and CsCl (Bragg's method and Powder method).

COURSE OUTCOMES:

CT135.CO1

- Apply the concept of LCAO to construct MOED for simple diatomic molecules and calculate their bond order magnetic property.
  Predict the synthesis and bonding properties of s and p block elements.

CT135.CO2

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Dept. of Chemistry
UCS, Osmania University
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- The students are expected to know the methods of C – C, C=C and C=C bond formation, reagents and respective name reactions; the difference in reactivity of single, double and triple bonds; the meaning and use of reaction mechanisms with examples; the theory of aromaticity, aromatic compounds and their reactivity; difference from acyclic conjugated alkenes.

CT135.CO3

- The student will know non-ideal behaviour of gases, PV isotherms, van der Waal's equation and critical phenomenon. They should be familiar with methods used to liquefy gases.

  Identify different separation techniques and apply them in chemical analysis.

CT135.CO4

- Apply the knowledge of semi micro analysis in identification of ions in many substances.
- Correlate and predict the structure –composition of various inorganic solids.

  The student should be able to write Fischer, Newman and Sawhorse formulae of simple Ethane derivatives and their inter-conversion; determine isomeric relationship between two molecules; types of isomers; strain theory in cycloalkanes; conformations of cyclohexane and types of bonds; flipping of chair forms and energy considerations.

Laboratory Course: Paper code: CT135P:
Qualitative Analysis:

Objective:

- To identify the anions & cations in different salt mixtures using a systematic scheme of semi-micro technique.

Laboratory Course **30h (2 h / week)**

Paper I - Qualitative Analysis - Semi micro analysis of mixtures

Qualitative Analysis - Semi micro analysis of mixtures Analysis of two anions (one simple, one interfering) and two cations in the given mixture.

Anions: CO_3^{2-}, Cl^-, Br^-, I^-, CH_3COO^-, NO_3^-, PO_4^{3-}, $^-$, SO_4^{2-}.

Cations: Pb^{2+},Hg^{2+},Cd^{2+}, Bi^{3+}, Al^{3+}, Fe^{3+} ,Co^{2+} ,Zn^{2+}, Mn^{2+} Ba^{2+}, Sr^{2+}, Ca^{2+} ,Mg^{2+}, NH_4^+

Outcome:

- Learn to identify the presence of anions and cations in salt mixtures using systematic semi-micro analytical method
- Students learn to use some green reagents and green techniques during the analyses

Text books:

Unit - I: Concise Inorganic Chemistry by J.D. Lee 3rd edn
Unit- II: Organic Chemistry by Morrison and Boyd 6th edn
Unit- III: Physical Chemistry by P.L. Soni

CHAIRPERSON
BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-507

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.I Year Chemistry : Semester I

Unit- I

1. Inorganic chemistry by P.L. Soni & others..
2. Basic Inorganic Chemistry by F.A.Cotton, Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001. Chem
3. Inorganic Chemistry Principles of structure and reactivity by James E.Huheey, E.A. Keiter and R.L. Keiter 4th edn.
4. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press 1999.

Unit- II

1. Organic Chemistry by Graham Solomons.
2. Organic Chemistry by John McMurry.
3. Organic Chemistry by Soni.
4. General Organic chemistry by Sachin Kumar Ghosh.

Unit III

1. Text Book of Physical Chemistry by Soni and Dharmahara.
2. Text Book of Physical Chemistry by Puri and Sharma.
3. Text Book of Physical Chemistry by K. L. Kapoor.
4. Principles of physical chemistry by Prutton and Marron.

Unit IV

1. Vogel's Qualitative Inorganic Ănalysis by Svehla
2. Text Book of Organic Chemistry by Graham Solomons.
3. Text Book of Organic Chemistry by Soni.
4. Text Book of Physical Chemistry by Puri And Sharma.
5. Text Book of Physical Chemistry by K. L. Kapoor.

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CHAIRPERSON
BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-07

Bharatiya Vidya Bhavan

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Department of Chemistry

Program: B Sc **Mb,G,C**

Mb,Bc,C

Bt,G,C

COURSE OUTCOMES:

SEMESTER -I:PAPER-I INORGANIC AND GENERAL CHEMISTRY-I(2015-16)

CT135.CO1. Use the knowledge of Ionization energy and Electronegativity to predict types of compounds(Ionic /Covalent) & their reactivity.

CT135.CO2. Compare the properties of s-& p-block elements & organometallic compounds.

CT135.CO3. Familiarisethe concept of VBT & MOT to differentiate physical parameters of various diatomic molecules, .Use the knowledge of quantum mechanics to explain atomic structure

CT135.CO4 Interpret organic reaction mechanisms, reactivity of a few organic compounds & examine the ions in soil, water by the semi micro analysis method

CT135P.CO Learn to identify the presence of anions and cations in salt mixtures using systematic semi-micro analytical method

SEMESTER -II PAPER II PHYSICAL AND GENERAL CHEMISTRY-I(2015-2016)

CT235.CO1 The student will know non-ideal behaviour of gases, PV isotherms, van der Waal's equation and critical phenomenon. They should be familiar with methods used to liquefy gases.

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BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

CT235.CO2 Implement Nernst Distribution law to relate the solubility of solute in immiscible solvents, to interpret the change in physical parameters to liquefy gases & use of Liquid crystals in LCDs

CT235.CO3 At the end of this course, the student will be able to identify whether a molecule is chiral or not by symmetry criteria; the number of stereo isomers possible for a chiral molecule; and the absolute configuration at the chiral centre(s); and the theory of optical activity and internal compensation. The students are expected to know the methods of C – C, C=C formation, reagents and respective name reactions; the difference in reactivity of single, double and triple bonds; the meaning and use of reaction mechanisms with examples;

CT235.CO4 The students interpret the theory of aromaticity, aromatic compounds and their reactivity; difference from acyclic conjugated alkenes.

CT235P.CO By the end of this course, students will be able to

1.Prepare inorganic complexes & test the presence of ions in the salt mixtures.

2. Students will be able to utilize green solvents for analyses

SEMESTER -III PAPERIII ORGANIC AND GENERAL CHEMISTRY-II(2016-17)

CT335.CO1 Differentiate between SN^1 and SN^2 reactions and identify different alcohols. Apply these reactions in organic synthesis.

CT335.CO2 Write mechanisms of organic reactions involving reactive intermediates.

CT335.CO3Solve problems based on various analytical tools. Design experiments with improved sample preparation and new measurement procedures.

CT335.CO4 Appreciate the application of nuclear reactions in the field of Agriculture, medicine etc. Determine the symmetry operations of simple molecules. Apply Woodward Hoffman's rules for different molecular systems.

CT335PCO Acquire quantitative skills in volumetric analysis and gain knowledge about the neutralisation, redox and complexometric titrations.

1. Able to prepare standard solutions.
2. Find the concentrations of unknown solutions.

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BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

SEMESTER-IV PAPERIV INORGANIC AND PHYSICAL CHEMISTRY-II(2016-17)

CT435.CO1 Identify the basic principles related to structure and properties of lanthanides and Actinides. Apply the concept of lanthanide contraction for separation techniques.

CT435.CO2 Identify the structure and bonding in simple metals .Apply the 18- electron rule to simple and bridged metal carbonyls.

CT435.CO3 Use the phase rule to determine the number of components, phases and degrees of freedom of different systems. Calculate the molecular weights of solutes using colligative properties.

CT435.CO4 Write equations representing electrochemical cell and calculate electrochemical parameters

CT435P CO Acquire quantitative skills in volumetric analysis and gain knowledge about the neutralisation, redox and complexometric titrations.

1. Able to prepare standard solutions.
2. Find the concentrations of unknown solutions.

SEMESTER-V PAPER V ORGANIC,GENERAL AND PHYSICAL CHEMISTRY-III(2017-2018)

CT535.CO1 Analyse different nitrogen compounds by conducting simple experiments.

CT535.CO2 Identify the principles, structure and reactivity of selected coordination complexes. Utilise the principles of coordination complexes in understanding the functions of biological systems.

CT535.CO3

- Identify the heterocyclic structure in metalloproteins or enzymes. synthesise them through green chemistry approach.
- Interpret electronic spectra and magnetic properties

CT535.CO4 Calculate change in thermodynamic properties .Calculate the absolute value of thermodynamic quantities (U, H, S, A, G).

CT535PCO Develops a skill in organic synthesis and re-crystallisation

SEMESTER-V PAPER VI PHYSICO-CHEMICAL METHODS OF ANALYSIS,SPECTROSCOPY AND ANALYSIS (2017-2018)

CT535A.CO1 Acquires a basic knowledge in solvent extraction and all chromatographic techniques

CT535A.CO2 Acquaint withspectroscopic techniques and colorimetic estimations .Students identify organic compounds using mass spectroscopy

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BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

CT535A.CO3 Identify organic molecules using spectroscopic tools such as UV, IR, Raman and H^1NMR spectroscopy.

CT535A.CO4 Apply the knowledge of catalysis to carry out atom economy organic synthesis. Acquires the knowledge of how alcohol dehydrogenase catalysis is different in Asians and Europeans

CT535APCO Develops a skill to use conductometers, potentiometers, PH meters and colorimeters that are required for the industry

SEMESTER-VI PAPER VII ORGANIC,GENERAL AND PHYSICAL CHEMISTRY-IV (2017-2018)

CT635.CO1 Identify the carbohydrates and explain its role in living organisms.

CT635.CO2 Apply HSAB principle for stability and occurrence of simple salts in nature.

CT635.CO3 Apply various synthetic strategies in the field of synthesis. Use retro synthesis and disconnection approach for synthesis of drugs.

CT635.CO4 Solve problems on rate and rate constants. Calculate the age of rocks, carbon dating etc

CT635PCO Organic Analysis-Apply principles of identification techniques in organic analysis

- Identify organic compounds
- Identify the presence of organic compounds in vegetables and fruits

SEMESTER-VI PAPER VIII DRUGS,PESTICIDES,MACROMOLECULES (2017-2018)

CT635A.CO1 Apply the knowledge of drugs & formulation chemistry to the pharmaceutical industry.

CT635A.CO2 Acquaint with green pesticides and harmful effect of other organic pesticides.

CT635A.CO3 Acquire knowledge in Material science, super conductance and nanotechnology- the allied subjects in chemistry, which find a great place in modern research.

CT635A.CO4 Students can synthesize different polymers based on their tacticity and different mechanisms of polymerization.

CT635APCO

- Familiarized with calculation of rate constant for first and second order kinetic reactions

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BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-507

- Utilise the technique of solvent extraction to separate different solutes in a compound or extract medicinal components from herbs.

SEC-SEMESTER III(SE335)SAFETY RULES IN CHEMISTRY LABORATORY & PREPARING LAB REAGENT (2017-18)

OUTCOMES :

- To improve the skills of students in the application of theory and practical knowledge.
- To fill the gap between theory and experimental procedures.
- 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

SEC-SEMESTER IV(SE435) GREEN METHODS IN CHEMISTRY(2017-18)

OUTCOMES:

- 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.
- Acquaint with different green reactions.

SEC-SEMESTER V(SE535)BASIC ANALYTICAL CHEMISTRY(2018-19)

OUTCOMES:

- 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.
- Improve the use of statistical tools.
- 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.

SEC-SEMESTER VI(SE635)CHEMINFORMATICS (MoU with IICT)(2018-19)

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Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

OUTCOMES:

- 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 modelling
- Hands on experiment on drug development using cheminformatics.
- Hands on MOLINSPIRATION

GE-SEMESTER V (GE 535) ORGANIC FARMING(2018-19)

OUTCOMES:

Upon successful completion of this course, students will:

- Have a better understanding of the basic principles of organic farming.
- Recognize that organic farming systems, if practiced in a an environmentally sound manner, can constitute a larger philosophy of sustainable agriculture.
- Be able to devise an organic farm management plan.
- Have improved their ability to think critically about the opportunities and challenges faced by organic growers.

GE-SEMESTER VI (GE 635)CHEMISTRY OF COSMETICS & PERFUMES(2018-19)

OUTCOMES:

- Describe fundamentals of chemistry and the scientific basis for cosmetic formulation and the function of the active ingredients.
- Comprehend the efforts of scientists in cosmetic product design and developments.

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2.6.2 Attainment of program outcomes and course outcomes are evaluated by the institution

CHAIRPERSON
BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

The students of Life Sciences of the Undergraduate program are satisfied with the program and 75 % undertake higher studies in Life Science courses.

CHAIRPERSON
BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad 007

Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE OF SCIENCE, HUMANITIES AND COMMERCE, SAINIKPURI, SECUNDERABAD. Autonomous College
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Program: B Sc — Mb,G,C / Mb,Bc,C / Bt,G,C / Mb,N&D,C

Subject: Chemistry-II
COURSE CODE: CT235 & CT235P
YEAR/SEMESTER: I/II
(60 h/ 15 weeks)

HPW:4
No. Of Credits: Theory – 4
Practical –1

SEMESTER-11
COURSE OBJECTIVES

COb1

- To use the knowledge of p, d block and zero group elements to interpret structure and reactivity of compounds. Students learn in detail about oxyacids, Pseudohalogens and interhalogen compounds. They are able to distinguish the properties of transition and inner transition elements.

COb2

- This unit introduces the study of three most important functional groups – halo, hydroxyl, and carbonyl; and the students are expected to learn the preparation, properties and reactions of halogen compounds, alcohols, ethers, aldehydes and ketones; their inter-conversion by chemical methods and all the related name reactions – Mechanisms of reactions and stereochemical implications.

COb3

- This unit is designed to learn the fundamentals of electrochemistry and the applications of electrochemical methods. They use this knowledge to distinguish between electrolytic and galvanic cells.
- To relate the concept of electrochemistry, working and reactions of different electrochemical cells.

COb4

- To discuss concepts of principles involved in qualitative analysis of ions, basics in Stereochemistry of organic compounds.
- The first part of this unit expects to teach students the principles involved in the quantitative analysis.
- The second course of the unit is about chiral organic molecules, criteria for chirality, optical activity, molecules with one or more chiral carbons (centres), configuration at the chiral carbon, definitions of asymmetric and dissymmetric molecules.

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Bhavan's Vivekananda College
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UCS, Osmania University
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- To describe the relationship between solute concentration and physical properties of a solution.

UNIT I-Inorganic Chemistry-II	15 h (1 h / w)
1. p-block Elements -II	7 h
2.Chemistry of Zero group elements	2 h
3. Chemistry of d-block elements	6 h
UNIT II-Organic Chemistry-II	15 h (1 h / w)
1.Halogen compounds	4 h
2. Hydroxy compounds and ethers	6 h
Carbonyl compounds	5 h
UNIT III-Physical Chemistry-II	15 h (1 h / w)
1. Electrochemistry	15 h
UNIT IV- General Chemistry-II	15 h (1 h / w)
1. Theory of Quantitative Analysis	6 h
2. Stereochemistry – II	5 h
3.Dilute Solutions & Colligative Properties	4 h

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

S2-I-1 P-block Elements –II **7 h**

Oxides: Types of oxides (a) Normal- acidic, basic amphoteric and neutral (b) Mixed (c) sub oxide (d) peroxide e) superoxide. Structure of oxides of C, N, P, S and Cl-reactivity. Oxy acids: Structure and acidic nature of oxyacids of B, C, N, P, S, Cl and I. Redox properties of oxyacids of Nitrogen: HNO_2 (reaction with $FeSO_4$, $KMnO_4$, $K_2Cr_2O_7$), HNO_3 (reaction with H_2S, Cu), HNO_4 (reaction with KBr, Aniline), $H_2N_2O_2$ (reaction with KMnO4). Redox properties of oxyacids of Phosphorus: H_3PO_2 (reaction with $HgCl_2$), H_3PO_3 (reaction with $AgNO_3$, $CuSO_4$). Redox properties of oxyacids of Sulphur: H_2SO_3 (reaction with $KMnO_4$, $K_2Cr_2O_7$), H_2SO_4 (reaction with Zn, Fe, Cu), $H_2S_2O_3$ (reaction with Cu, Au), H_2SO_5 (reaction with KI, $FeSO_4$), $H_2S_2O_8$ (reaction with $FeSO_4$, KI).Redox properties of oxy acids of Chlorine. Interhalogens-Classification- general preparation- structures of AB, AB_3, AB_5 and AB_7 type and reactivity. Pseudohalogens: Comparision with halogens.

S2-I-2: Chemistry of Zero group elements **2 h**

Isolation of noble gases, Structure, bonding and reactivity of Xenon compounds-Oxides, Halides and Oxy-halides. Clatherate compounds and Anomalous behavior of He (II) .

S2-I-3: Chemistry of d-block elements **6 h**

Characteristics of d-block elements with special reference to electronic configuration, variable valence, ability to form complexes, magnetic properties & catalytic properties. Stability of various oxidation states and standard reduction potentials. Comparative treatment of second and third transition series with their 3d analogues. Study of Ti, Cr and Cu traids. Titanium triad –

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BOS in Chemistry
Physics Vivekananda College
Kaithikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-507

electronic configuration and reactivity of +3 and +4 states – oxides and halides. Chromium triad – reactivity of +3 and +6 states. Copper triad – reactivity of +1, +2 and +3 states.

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

S2-O-1: Halogen compounds **4 h**

Classification: alkyl (primary, secondary, tertiary), aryl, aralkyl, allyl, vinyl, benzyl. Chemical reactivity - reduction, formation of RMgX, Nucleophilic substitution reactions – classification into S_N^1 and S_N^2 Mechanism and energy profile diagrams of S_N^1 and S_N^2 reactions. Stereochemistry of S_N^2 (Walden Inversion) 2-bromobutane, S_N^1 (Racemisation) 1-bromo-1-phenylpropane Structure and reactivity – Ease of hydrolysis - comparison of alkyl, vinyl, allyl, aryl, and benzyl halides.

S2-O-2: Hydroxy compounds and ethers **6 h**

Alcohols: Preparation: 1°, 2° and 3° alcohols using Griganard reagent, Reduction of Carbonyl compounds, carboxylic acids and esters. Physical properties: H-bonding, Boiling point and Solubility. Reactions with Sodium, $HX/ZnCl_2$ (Lucas reagent), esterification, oxidation with PCC, alk. $KMnO_4$, acidic dichromates,conc.HNO_3 and Oppenauer oxidation (Mechanism).
Phenols: Preparation: (i) from diazonium salts of anilines, (ii) from benzene sulphonic acids and (iii) Cumene hydroperoxide .
Properties: Acidic nature, formation of phenoxide and reaction with R-X, electrophilic substitution; halogenations, Riemer Tiemann reaction (Mechanism), Kolbe reaction (Mechanism), Gattermann-Koch reaction, Azo-coupling reaction, Schotten-Boumann reaction, Houben-Hoesch condensation, .
Ethers: Nomenclature, preparation by (a) Williamson's synthesis (b) from alkenes by the action of conc. H_2SO_4. Chemical properties – inert nature, action of conc. H_2SO_4 and HI.

S2-O-3 Carbonyl compounds **5 h**

Preparation of aldehydes & ketones from acid chloride,1,3-dithianes, nitriles and from carboxylic acids. Special methods of preparing aromatic aldehydes and ketones by (a) Oxidation of arenes (b) Hydrolysis of benzyl halides Physical properties – absence of Hydrogen bonding. Reactivity of the carbonyl groups in aldehydes and ketones. Chemical reactivity: Addition of (a) $NaHSO_3$ (b) HCN (c) RMgX (d) NH_3 (e) RNH_2 (f) NH_2OH (g) $PhNHNH_2$ (h) 2,4-DNP (Schiff bases). Addition of H_2O to form hydrate , chloral hydrate (stable), addition of alcohols - hemi acetal and acetal formation. Cannizaro reaction. Oxidation reactions-$KMnO_4$ oxidation and auto oxidation, reduction – catalytic hydrogenation, mechanism of Clemmenson's reduction, Wolf- kishner reduction, Meerwein Pondoff Verly reduction. Reduction with LAH, $NaBH_4$.

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

S2-P-1: Electrochemistry **15 h**

Electrical transport – conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of specific and equivalent conductance with dilution. Migration of ions and Kholrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law - its uses and limitations. Debye-Huckel- Onsagar's equation for

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BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf's method for attackable electrodes. Applications of conductivity measurements: Determination of degree of dissociation, determination of Ka of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.
Electrolytic and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells. Electro motive force (EMF) of a cell and its measurement. Computation of EMF. Types of reversible electrodes- the gas electrode, metal-metal ion, metal-insoluble salt and redox electrodes. Electrode reactions, Nernst equation,cell EMFand Single electrode potential, Standard Hydrogen electrode -reference electrodes (calomel electrode)-standard electrode potential, sign conventions, electrochemical series and its significance. Applications of EMF measurements. Calculation of thermodynamic quantities of cell reactions (Gibbs free energy G, Helmholtz free energy and Equilibrium constant K). Determination of pH using hydrogen electrode, glass electrode and quinhydrone electrode. Solubility product of AgCl. Potentiometric titrations.

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

S2-G-1: Theory of Quantitative Analysis **6 h**

Volumetric Analysis: Introduction, standard solutions, indicators, end point, titration curves, Types of titrations: i) neutralization titration- principle, theory of acid base indicators, titration curves and selection of indicators- strong acid - strong base, strong acid –weak base, weak acid-strong base and weak acid –weak base. Theory of redox titrations - internal($KMnO_4$) and external indicators – use of diphenylamine and ferroin indicators. Theory of complexometric titrations – use of EBT, Murexide and Fast sulphone black indicators. Role of pH in complexometric titrations. Precipitation titrations – theory of adsorption indicators. Gravimetric analysis- Introduction, nucleation, precipitation, growth of precipitate, filtration and washing, drying and incineration of precipitate, coprecipitation and post precipitation. Determination of Ni^{2+}

S2-G-2: Stereochemistry- II **5 h**

Chiral molecules: definition and criteria - absence of plane, center and Sn axis of symmetry - Optical activity: Definition, wave nature of light, plane polarised light, optical rotation and specific rotation –- Asymmetric and dissymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and dissymmetric molecules (trans1,2-dichlorocyclopropane). Molecules with more than one chiral carbons - constitutionally similar and dissimilar chiral carbons – examples - Tartaric acid, 2,3-dibromopentane; meso-compounds, D, L nomenclature and R, S – configuration: Cahn-Ingold-Prelog rules – examples.

S2-G-3: Dilute Solutions & Colligative Properties **4 h**

Dilute Solutions, Colligative Properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis - laws of osmotic pressure, its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point.

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COUSRE OUTCOMES:

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

CT235.CO1

- Implement the basics of p-block elements to interpret acidity of oxyacids and appraise the trends in d block elements.

CT235.CO2

- The student will be familiar with identification of halogen, hydroxyl and carbonyl functional groups in the molecules, synthesis and reactions of halohydrocarbons, alcohols, aldehydes and ketones; and conversions of one class of compound to the other by means of chemical reactions and interpret the mechanism involved.

CT235.CO3

- Write equations representing electrochemical cell and calculate electrochemical parameters

CT235.CO4

- At the end of this course, the student will be able to identify whether a molecule is chiral or not by symmetry criteria; the number of stereo isomers possible for a chiral molecule; and the absolute configuration at the chiral centre(s); and the theory of optical activity and internal compensation.

Laboratory Course Paper code: CT235P
Paper II - Quantitative Analysis

Objective:

- Acquire quantitative skills in volumetric analysis and gain knowledge about the neutralisation, redox and complexometric titrations

Laboratory Course **30hrs (2 h / week)**
Paper II- Quantitative Analysis

Acid - Base titrations:

1. Estimation of Carbonate in Washing Soda.
2. Estimation of Bicarbonate in Baking Soda.
3. Estimation of Carbonate and Bicarbonate in the Mixture.
4. Estimation of Alkali content in Antacid using HCl.
5. Estimation of NH_4^+ by back titration

Redox Titrations:

1. Determination of Fe(II) using $K_2Cr_2O_7$
2. Determination of Fe(II) using $KMnO_4$ with sodium oxalate as primary standard.
3. Determination of Cu(II) using $Na_2S_2O_3$ with $K_2Cr_2O_7$ as primary standard

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Complexometric Titrations:
1. Estimation of Mg^{2+}
2. Estimation of Cu^{2+}

Outcome:

- Able to prepare standard solutions.
- Find the concentrations of unknown solutions

Text books:
Unit - I: Concise Inorganic Chemistry by J.D. Lee 3rd edn
Unit- II: Organic Chemistry by Morrison and Boyd.
Unit- III: Physical chemistry by P.L Soni
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.I Year Chemistry : Semester II
Unit- I
1. Inorganic chemistry by P.L. Soni& others..
2. Basic Inorganic Chemistry by F.A.Cotton, Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001. Chem
3. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn.
4. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press 1999.

Unit- II
1. Organic Chemistry by Graham Solomons.
2. Organic Chemistry by John McMurry.
3. Organic Chemistry by Soni.
4. General Organic chemistry by Sachin Kumar Ghosh.

Unit III
1. Text Book of Physical Chemistry by Soni and Dharmahara.
2. Text Book of Physical Chemistry by Puri and Sharma.
3. Text Book of Physical Chemistry by K. L. Kapoor.
4. Elements of Physical Chemistry by Lewis Glasstone.
5. Principles of physical chemistry by Prutton and Marron

Unit IV
1. Vogel's Qualitative Inorganic Analysis by Svehla
2. Text Book of Organic Chemistry by Morrison And Boyd.
3. Text Book of Organic Chemistry by Graham Solomons.
4. Text Book of Organic Chemistry by Soni.
5. Text Book of Physical Chemistry by Puri And Sharma.
6. Text Book of Physical Chemistry by K. L. Kapoor.

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Department of Chemistry
UCS, Osmania University
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Bharatiya Vidya Bhavan

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Autonomous College
Affiliated to OSMANIA UNIVERSITY, Hyderabad.
(Accredited with 'A' grade by NAAC)
Department of Chemistry

PROGRAM NAME: B.Sc MbGC, MbBcC, BtGC, MNDC
Course Name: Chemistry-I

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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BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

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.

CHAIRPERSON
BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-500 007

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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Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-07

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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BOS in Chemistry
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Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-500 007

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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Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-07

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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Sainikpuri

Head
Department of Chemistry
UCS, Osmania University

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

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)
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BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

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.

CHAIRPERSON
BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

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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BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

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.

CHAIRPERSON
BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

Bharatiya Vidya Bhavan

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

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Department of Chemistry

Semester V								
Course Code	Course title	Course Type	Hours/week			Credits		
			Theory	Practical	Total	Theory	Practical	Total
BS 501	Chemisty of Cosmetics, Food Processing, Drugs & Pharmaceuticals	GE	4		4	4		4
BS 502	English	CC-1E	3		3	3		3
BS 503	Second Language	CC-2E	3		3	3		3
BS 504	Optional 1	DSE-1E						5
BS 505	Optional 2	DSE-2E						5
BS 506	Optional 3- Chemistry Spectroscopy & Chromatography (OR) Mettalurgy Dyes & Catalysis	DSE-3E	4	3	7	4	1	5
	Laboratory Course -V Experiments in Physical Chemistry - I							

Semester VI								
Course Code	Course title	Course Type	Hours/week			Credits		
			Theory	Practical	Total	Theory	Practical	Total
BS 601	Project in Chemistry/ Advanced Chemistry							4
BS 602	English	CC-1F	3		3	3		3
BS 603	Second Language	CC-2F	3		3	3		3
BS 604	Optional 1	DSE-1F						5
BS 605	Optional 2	DSE-2F						5
BS 606	Optional 3- Chemistry Medicinal Chemistry (OR) Agricultural and Fuel Chemistry	DSE-3F	4	3	7	4	1	5
	Laboratory Course -VI Experiments in Physical Chemistry - II							

Head of the Department
Department of Chemistry
Bharatiya Vidya Bhavan's Vivekananda College
Sainikpuri, Secunderabad - 500 094.

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-007

Bharatiya Vidya Bhavan

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Department of Chemistry

Program: B Sc Mb,G,C , Bt,G,C , Mb,N&D,C , Mb,Bc,C

Subject: Chemistry-III

COURSE CODE: CT535 & CT535P **HPW:4**

YEAR/SEMESTER: III/ V **No. Of Credits:** Theory – 4
Practical –1

(60 h/ 15 weeks)

COURSE OBJECTIVES-CHEMISTRY

Name of the Course	**Semester-V Paper V -Spectroscopy and Chromatography**
Course Code	**CT535**
COb1	The main aim is to provide students a concept about how the commonly used molecular spectroscopy techniques work a theoretical knowledge of each of these methods and their usage in molecular and electronic structure determination.
COb2	To understand the important role of nuclear magnetic resonance spectroscopy in the study of the structures of organic compounds. To develop an understanding of the significance of the number, positions, intensities and splitting of signals in nuclear magnetic resonance spectra and to assign structures to simple molecules on the basis of NMR. Analyze how to find molecular weight, and base peak from a mass spectrum. Identify simple fragmentation patterns and rearrangements in simple molecules.
COb3	Recognize the requirement and Importance of separation of components of a mixture. To understand that the choice of the method of separation depends upon the nature of the component of the mixture. Explain the basic principles, operation and application of chromatographic methods .Differentiate between the different chromatographic methods.
COb4	Appraise the different principles involved in the chromatographic techniques.

Head of the Department
Department of Chemistry
Bharatiya Vidya Bhavan's Vivekananda College
Sainikpuri, Secunderabad - 500 094.

Head
Department of Chemistry
UCS, Osmania University
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	Identify the working of the instruments used in GC,Ion exchange chromatography and HPLC techniques.

UNIT 1- Molecular Spectroscopy **15 h (1 h /w)**

1. Rotational spectroscopy (Microwave spectroscopy)

2. Infra red spectroscopy

3. Electronic spectroscopy

UNIT II- NMR and Mass spectrometry **15 h (1 h / w)**

1. Proton Magnetic Resonance Spectroscopy

2. Mass spectrometry

UNIT III- Separation Techniques I **15 h (1 h /w)**

1. Solvent Extraction

2. Chromatography

3. Thin layer Chromatography (TLC)

4. Paper Chromatography

UNIT IV - Separation Techniques II **15 h (1 h /w)**

1. Column Chromatography

2. Ion exchange chromatography

3. Gas Chromatography

4. High performance liquid chromatography

Unit 1: Molecular spectroscopy **15 h**

Introduction to electromagnetic radiation, interaction of electromagnetic rations with molecules, various types of molecular spectra.

Rotational spectroscopy (Microwave spectroscopy)

Rotational axis, moment of inertia, classification of molecules (based on moment of inertia), rotational energies, selection rules, determination of bond length of rigid diatomic molecules eg. HCl.

Infra red spectroscopy

Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant. Qualitative relation of force constant to bond energies.

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Anharmonic motion of real molecules and energy levels. Modes of vibrations in polyatomic molecules. Characteristic absorption bands of various functional groups. Finger print nature of infrared spectrum.

Electronic spectroscopy:

Bonding and antibonding molecular orbitals, electronic energy levels of molecules (σ, π, n), types of electronic transitions:σ-σ*, n-σ*, n-л*, л-л* with suitable examples.Selection rules,Terminology of chromophore, auxochrome, bathochromic and hypsochromic shifts. Absorption of characteristics of chromophones: diene, enone and aromatic chromophores. Representation of UV-visible spectra. General features of absorption – spectroscopy, transmittance, absorbance and molar absorptivity. Beer Lambert's law and its limitations.

Unit 2: NMR and Mass spectrometry **15h**

Proton Magnetic Resonance Spectroscopy

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals – spin-spin coupling, representation of proton NMR spectrum – Integrations.1H NMR spectrum of – ethyl bromide, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate and acetophenone.

Mass Spectrometry

Electron Impact Mass: Basic principles, Nitrogen rule, types of ions: Molecular ion, fragment ion and isotopic ions, representation of mass spectrum, types of peaks (molecular ion, fragment and isotopic ion peaks). Determination of molecular weight Mass spectrum of ethyl chloride, ethyl bromide and acetophenone.

Unit 3 Separation Techniques I **15h**

Solvent Extraction- Principle, Methods of extraction: Batch extraction, continuous extraction and counter current extraction. Application – Determination of Iron (III).

Chromatography: Classification of chromatographic methods, principles of differential migration, adsorption phenomenon, nature of adsorbents, solvent systems.

Thin layer Chromatography (TLC): Advantages, preparation of plates, solid phase and mobile phase used in TLC, eluotopic series, development of the chromatogram, Detection of the spots, visualizing agents, factors effecting Rf values and applications of TLC.

Paper Chromatography: Principle, choice of paper and solvent systems, development of chromatogram – ascending, descending, radial and two dimensional chromatography and applications of paper chromatography.

Unit 4 Separation Techniques II **15h**

Column Chromatography- Principle, Types of stationary phases, Column packing – Wet packing technique, Dry packing technique. Selection criteria of mobile phase solvents for eluting polar, non-polar compounds and its applications.

Ion exchange chromatography: Principle, cation and anion exchange resins, its application in separation of ions, de-ionized water.

Gas Chromatography: Theory and instrumentation (Block Diagram), Types of stationary phases and carrier gases (mobile phase). Applications of GC.

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High performance liquid chromatography: Theory and instrumentation, stationary phases and mobile phases. Applications of HPLC, Analysis of paracetamol.

COURSE OUTCOMES-CHEMISTRY

Name of the Course	**Semester-V Paper V- Spectroscopy and Chromatography**
Course Code	**CT535**
CO1	Analyze and interpret spectroscopic data collected by the methods discussed in the course.
CO2	Identify organic compounds by analysis and interpretation of spectral data. Explain common terms in NMR spectroscopy such as chemical shift, coupling constant and anisotropy and describe how they are affected by molecular structure. Solve problems related to the structure, purity and concentration of chemicals and to study molecular interactions by choosing suitable spectroscopic methods and interpreting corresponding data.
CO3	Understand the importance and notice the difference between different modes of chromatographic separation. Apply knowledge of qualitative and quantitative analysis in various fields of chemical¬ industry, pharmaceutical industry, the environment and other analytics.
CO4	Apply the knowledge in solving specific problems by using the appropriate chromatographic techniques (gas, liquid, ion-pair chromatography, HPLC) and accurately analyze and interpret the results of chromatographic analysis.

Text books and Reference books

Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publication(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). Chem.
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).

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)

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5. Text book of organic chemistry by Bruice Yuranis Powla. (2012)

Unit III &Unit IV

1.Analytical Chemistry by David Krupadanam, Universities Press (India) Limited.
2. D.A. Skoog, F.J. Holler, T.A. Nieman, Principles of Instrumental Analysis, Engage earning India Ed.
3. D. A. Skoog, D.M. West, F.J. Holler, Fundamentals of Analytical Chemistry 6thEd ., Saunders College Publishing, Fort worth (1992).
4. 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.
5. Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.2007.
6. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
7. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
8. Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA, 1982.
9. Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA. 16, 1977.
10. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.
11. Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.
12. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc, New York (1995)

COURSE OBJECTIVES-CHEMISTRY

Name of the Course	**Semester-V Paper V –Metallurgy, Dyes and Catalysis**
Course Code	**CT535A**
COb1	Evaluate the Extractive metallurgy processes and their relative merits and demerits. Identify the different Pyrometallurgy, Hydrometallurgy and Electrometallurgy operations. Know flow sheets of extraction of different metals.
COb2	Identify and classify the dyes .Summarize the structures of both natural and synthetic dyes. Illustrate the synthesis of dyes with various examples.
COb3	Recognize the principles, mechanisms and applications of the different types of catalysts that operate both in homogeneous phase, such as organometallic catalysts and organocatalysts, and in heterogeneous phase. Describe the basic concepts of catalysis, the different types of catalysts. To gain the knowledge of catalyst characteristics, mechanism of catalytic reactions.
COb4	Understand the theories of enzyme kinetics, the mechanisms of enzyme catalysis, and the mechanisms of enzyme regulation in the cell. Describe and identify the significance of enzyme kinetics.

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Unit I- General principles of Metallurgy and production of non-ferrous metals **15 h (1 h /w)**

1. Pyrometallurgy
2. Hydrometallurgy
3. Separation of liquid and solid phases and processing of aqueous solutions
4. Electrometallurgy
5. Refining processes
6. Production of selected non-ferrous metals

Unit II: Natural and Synthetic Dyes **15 h (1 h / w)**

1. Dyes
2. Structures of Synthetic Dyes
3. Synthesis of Dyes

Unit III: Catalysis **15 h (1 h /w)**

1. Homogeneous and heterogeneous catalysis
2. Acid-base catalysis-
3. Phase transfer catalysis

Unit IV: Catalysis II **15 h(1 h /w)**

1. Enzyme catalysis

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B.Sc. Chemistry
Semester V, Paper V
Discipline Specific Elective-B
Metallurgy, Dyes and Catalysis

Unit I: General Principles of Metallurgy and Production o f Non Ferrous Metals 15h

Pyrometallurgy: Drying and calcination, roasting, smelting, products of smelting,

Hydrometallurgy: Leaching methods, leaching agents, leaching of metals, oxides and sulphides.

Separation of liquid and solid phases and processing of aqueous solutions

Electrometallurgy: Electrolysis, Refining electrolysis, electrolysis from aqueous solutions, fused-salt electrolysis

Refining processes: Chemical and physical refining processes

Production of selected non-ferrous metals (Copper, Nickel, Zinc): Properties, raw materials, production (flow charts presentations and chemical reactions involved) and uses.

Unit II: Natural and Synthetic Dyes 15h

Dyes: Definition, Classification of dyes- Naturaldyes, synthetic dyes; based on chemicalconstitution of dyes; Chemical nature of dyes; application of dyes.
Structures of natural Dyes: Indigo, Tyrian purple, Alizarin, Indigotin.

Structures of Synthetic Dyes: Nitrodyes, Nitrosodyes, Azodyes(Monoazodyes, Bisazodyes),diaryl methane dyes, triaryl methane dyes, Xanthene dyes, Phenolphthalein, Fluorocein, Acridine dyes.

Synthesis of dyes: Monoazodyes, Bisazodyes (Congored), Auromine O, Malachite Green, Crystal Violet, Rhodamine B, Acridine Yellow, Indigotin.
Binding of drugs to fabric. Application of dyes.

Unit III: Catalysis –I 15h

Homogeneous and heterogeneous catalysis -
Definition of a catalyst and catalysis. Comparison of homogeneous and heterogeneous catalysis with specific examples. General characteristics of catalytic reactions.

Acid-base catalysis- Examples of acid and base catalysed reactions, hydrolysis of esters. Kinetics of acid catalysed reactions. Specific acid and general acid catalysis, Kinetics of base catalysed reactions. Specific base and general base catalysis. Examples-Aldol condensation and decomposition of nitramide, base catalysed conversion of acetone to di acetone alcohol. Mutarotation of Glucose. Effect of pH on reaction rate of acid and base catalysed reactions.

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Phase transfer catalysis: Principle of phase transfer catalysis, classification of phase transfer catalysts. Factors influencing the rate of PTC reactions.

Unit IV: Catalysis II **15h**

Enzyme catalysis- Characteristics of enzyme catalysis, Examples: (i) Invertase in inversion of cane sugar (ii) Maltase in conversion of maltoseto glucose (iii) Urease in decomposition of urea (iv) Zymase in conversion of glucose to ethanol (v) working of carbonic anhydrase and (vi) mechanism of oxidation of ethanol by alcohol dehydrogenase. Factors affecting enzyme catalysis. Effect of temperature, pH, concentration and
inhibitor on enzyme catalysed reactions.Kinetics of enzyme catalysed reactions: Michaelis-Menton Equation. Mechanism of enzyme catalysed reactions. Significance of Michaelis constant (Km) and maximum velocity (Vmax), Line weaver-Burk plot. Types of enzyme inhibitors.

COURSE OUTCOMES-CHEMISTRY

Name of the Course	**Semester-V Paper V- Metallurgy, Dyes and Catalysis**
Course Code	**CT535A**
CO1	Define the relationship between metal properties and alloy composition, microstructure, and processing. Understand microscopic structures present in metals and how they influence metal mechanical properties.
CO2	They will get detailed knowledge of synthesis of azo dyes, diphenylmethane dyes, nitro dyes nitroso dyes etc.Identify the toxicity in different food dyes and substitute with natural dyes for the betterment of society and environment.
CO3	To be able to apply the fundamentals of catalysis to the synthesis of chemicals following sustainable and environmentally friendly procedures. To identify and use the most useful sources in the scientific research field of catalysis.
CO4	Predict possible catalytic mechanisms of given reaction types. Evaluate the strategies for the analysis of kinetic mechanisms of catalyzed reactions. Apply the knowledge for industrial applications of biocatalysis.

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Textbooks and Reference books:

1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
3. J. A. Kent: Riegel**'s Handbook of Industrial Chemistry, CBS Publishers, New Delhi.**
4. **Kateřina Skotnicová, Monika Losertová, Miroslav Kursa, Theory of production of non ferrous**
metals and alloys Study.
5. K Venkataraman, the Chemistry of Synthetic Dyes, Volume 4, Elsevier, Technology & Engineering.
6. Sujata Saxena and A. S. M. Raja by Natural Dyes: Sources, Chemistry, Application and Sustainability Issues.
7. **Physical Chemistry by Atkins and De Paula, 8th** Edn.
8. Physical Chemistry by Puri, Sharma and Pattania, 2017.
9. Kinetics and mechanism of chemical transformations by Rajarajm and Kuraiacose, Published by Macmillan India Ltd.
10. Text book of Physical Chemistry by K.L. Kapoor Macmillan, 1999.
11. Catalysis by J.C. Kuriacose, Macmillan Macmillan Publishers India Limited, 1980

SEM V

LABORATORY COURSE – IV **(45h/15weeks) 3h/w**

Practical Paper – (Physical Chemistry)

1. Distribution law

a) Determination of distribution coefficient of acetic acid between water and butanol.

b) Determination of molecular status and partition coefficient of benzoic acid in Toluene and water

2. Electrochemistry

a) Determination of Cell Constent of a Conductivity cell.

b) Determination of dissociation constant (K_a) of acetic acid by conductivity measurements.

3. Colorimetry

a) Verification of Beer-Lambert law for $KMnO_4$

b) Determination of Concentration of the given $KMnO_4$ solution.

4. Adsorption

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a) Adsorption of Acetic acid on animal charcoal –Verification of Freundlich adsorption isotherm

5. Physical Constants:

a) Surface tension of liquids b) Viscosity of liquids (Demonstration experiments)

Laboratory Course: Paper code: CT535P

Physical Chemistry I

LEARNING OBJECTIVES:

- Apply Nernst Distribution law and determine the partition coefficient.
- Understand the basic principles of electrochemistry.

LEARNING OUTCOMES:

- The implementation of solution for practical problems in the field of physical chemistry in the production and monitoring of the safe and proper use of medicinal products.

Textbooks and Reference books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).

3 Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

4 Athawale V. D. and Mathur P. Experimental Physical Chemistry,, New Age Intenational

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COURSE OBJECTIVES-CHEMISTRY

Name of the Course		Semester-V GE-Chemistry of Cosmetics, Food Processing, Drugs and Pharmaceuticals
Course Code		GE 535
COb1	Describe fundamentals of chemistry and the scientific basis of cosmetic formulation and the function of the active ingredients. Identify different cosmetic and perfumes. Analyze the importance and uses of them.	
COb2	To acquire knowledge of emerging / alternative technologies applied to food processing. To enable a student to know the relative advantages / disadvantages over existing technologies. To illustrate the recent developments in the cereals science and technology. To explain modern processing techniques of cereals in food industries. To impart knowledge regarding various processed product lines in food industries. To describe various food additives and contaminants. To illustrate the functionality of food additives. To exemplify the limits of permissible additives in processed foods.	
COb3	Explain the Drugs used for various infectious diseases caused by pathogens. Classify various drugs based on their nature, dosage forms etc.Identify the different routes to administer the drugs.	
COb4	Define the different classes of drug and identify different types of drugs. Outline the function and impact of each class of drugs. Describe the structure activity relation of some important class of drugs. Explain mechanism of action of the drugs.	

UNIT Chemistry of Cosmetics and Perfumes **15 h (1 h /w)**

UNIT II-Food Processing and Food Adulterants **15 h (1 h / w)**

UNIT III- General Characteristics of Drugs **15 h (1 h / w)**

UNIT IV – Classification of Drugs **15 h (1 h / w)**

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GENERIC ELECTIVE (GE) COURSE

CHEMISTRY OF COSMETICS, FOOD PROCESSING, DRUGS AND PHARMACEUTICALS

UNIT I: Chemistry of Cosmetics and Perfumes (15h)

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, lipsticks, talcum powder, nail enamel, creams (cold cream, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenylethyl alcohol.

Demonstration experiments or illustration of experimental procedures through charts for the preparation of talcum powder, shampoo and vanishing cream .Chemistry and applications of deodorants and antiperspirant-Aluminium,Zinc,Boric acid ,Chloride and Sulphide

Unit II: Food Processing and food adulteration (15h)

Food processing: Introduction, methods for food processing, additives and preservatives. Food processing-impact on nutrition.

Food adulteration: Adulterants in some common food items and their identification: pulses, chilli powder, turmeric powder, milk, honey, spices, food grains and wheat flour, coffee powder, tea leaves, vegetable oil, ice creams and tomato sauce.

Food Packaging: Definition and function of packaging- Classification of packaging materials-different types of packaging materials such as glass,wood,metal, paper, plastic etc., advantages and disadvantages of each packaging material. Packaging materials and systems corrugated fiber board boxes, shrink bundles and reusable packages. Effect of packaging materials on nutritive values of food.

Food labeling: Introduction, need and importance

Unit III: General Characteristics of Drugs (15h)

Introduction: Diseases- causes of diseases, Drugs –definition and sources. ADME of drugs (brief)-Absorption, distribution, drug mechanism (in liver), elimination (brief), Toxicity

Examples (i) Zintac (Ranitidine, antacid) (ii) Paracetamol (antipyretic) (iii) Benadryl (cough syrup). Characteristics of an ideal drug

Nomenclature of Drugs: Chemical name- generic name- trade name. Trade names for the given generic names trade name-(i) Aspirin (ii) Amoxicillin (ii) ciprofloxacin (iv) Paracetamol (v) Mebendazole

Drug formulations: Definition -need for conversion of drug into Pharmaceutical (drug formulations)- Additives –diluents, binders, lubricants, antioxidants ,flavourants, colorants

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sweetness ,coating agents. Classification of Drug formulations: Oral, parenterals and topical dosage forms. Advantages and disadvantages

(i)Oral Dosage forms: Tablets (Aspirin- analgesic: Ciprofloxacin –antibacterial). Capsules (Amoxycillin- antibiotic; Omeprazole- antacid).Syrups (B complex syrup; Benadryl- cough syrup)

(ii)Parenteral (injection forms): Propranolol (antihypertensive), Heparin (anticoagulant)

(iii) Topical dosage forms: Creams and Ointments

(iv) Antiallergic: Aclometasone (Aclovate), Betamethasone valerate (2%) Multiple purposes.

(v) Anti-itching: Doxepin (Zonalon), Antifungal: Miconozole (Dactarin, Neomicol), Ketoconazole (Nizoral Cream), Fluconazole, Anesthetic-Lidocaine (Lidocaine ointment) and Antiseptic: Boro plus Cream,for burns -Iodine ointment.

Unit IV-Classification of Drugs:

Classification of drugs based on therapeutic action - Chemotherapeutic agents, Pharmacodynamic agents and drugs acting on metabolic processes.

Brief explanation for the following:

(i) **Chemotherapeutic agents:** Antimalarials ,Chloroquine; Antibiotic- Amoxicillin; Antitubercular drugs –isoniazole;Antiprotozoals- metronidazole.

(ii) **Pharmacodynamic agents:**

(a) Drugs acting on CNS: Diazepam(CNS depressant), General anesthetics (thiopental sodium), antipyretic and analgesic(ibuprofen)

(b) Drugs acting on PNS: local anesthetics (Benzocaine)

(c) Drugs acting on cardiovascular system: Metoprolol(antihypertensive agents) nefidipine (antianginal and antihypertensive agent)

(d) drugs acting on renal system: Diuretics (Acetazolamide)

(iii) **Drugs acting on metabolic process:**

(a) Vitamins: Common name, source, deficiency, Vitamin A ,B2, B6 ,C,D,E,K – remedy

(b) Hormones: Function(brief)- deficiency of hormones (Insulin, testosterone and Osterone)

COURSE OUTCOMES-CHEMISTRY

Name of the Course	**Semester-IV GE-Chemistry of Cosmetics, Food Processing, Drugs and Pharmaceuticals**
Course Code	**GE 535**
CO1	Evaluate the side effects of using synthetic cosmetics and substitute with natural ingredients.
CO2	Develop an appreciation about need of different emerging techniques used in food processing and preservation. Apply their knowledge on high pressure processing, pulsed electric processing, irradiation and hurdle technology in various food industries. To illustrate the functionality of food additives. To exemplify the limits of permissible additives in processed foods.
CO3	Correlate between pharmacology of a disease and its mitigation or cure. To

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	write the chemical synthesis of some drugs. Interpret the structural activity relationship of different class of drugs. Knowledge about the mechanism pathways of different class of medicinal compounds.
CO4	Apply the knowledge about the mechanism pathways of different class of medicinal compounds. Identify the different types of drugs used for different therapeutic action.

Recommended Textbooks and Reference Books:

1. Industrial chemistry, Volume -1, E.Stocchi, Ellis Horwood Ltd. UK.
2. Engineering Chemistry ,P.C Jain, M.Jain, Dhanpat Rai & Sons, Delhi
3. Industrial Chemistry ,Sharma, B.K &Gaur, H., Goel Publishing House, Meerut(1996)
4. Food Processing and Impact on Nutrition. Rameen Devi ,Sc J Agric Vet Sci., Aug-Sepr 2015
5. Perfumes, Cosmetics and Soaps, W A .Poucher,(1993)
6. A first course in food analysis by A Y Sathe
7. Food Science by N Potter, CBS Publishers
8. Food chemistry, Lillian Hoogland Meyer, (2008)
9. A Handbook of food packaging by F.A. Paine and H.Y. Paine
10. Fundamental concepts of applied chemistry J.C.Ghosh,S Chand and Co, Ltd, New Delhi
11. Applied Chemistry K.Bhagavathi Sundar ,MJP Publishers

Drugs by G L David Krupanandam, D. Vijay Prasad, K. Varaprasad Rao, K.L.N Redd

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Department of Chemistry
Bharatiya Vidya Bhavan's Vivekananda College
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Affiliated to OSMANIA UNIVERSITY, Hyderabad.
(Reaccredited with 'A' grade by NAAC)

Department of Chemistry

Program: B Sc Mb,G,C , Bt,G,C , Mb,N&D,C , Mb,Bc,C

Subject: Chemistry-III

COURSE CODE: CT635 & CT535P **HPW:4**

YEAR/SEMESTER: III/ VI **No. Of Credits:** Theory – 4
Practical –1

(60 h/ 15 weeks)

COURSE OBJECTIVES-CHEMISTRY

Name of the Course	**Semester-VI Advanced Chemistry**
Course Code	**CT635-O**
COb1	Differentiate types of substitution reaction like SN1, SN2 etc, and difference between acid hydrolysis & base hydrolysis .Discuss how ligand substitution reaction takes place in octahedral and square- planar, trans effect and trans influence and how trans effect is applicable in synthesis of different metal complexes. Discuss the concept of symmetry element, symmetry operation and point groups. Classify & recognize the symmetry elements and their operations as required to specify molecular symmetry. To introduce the students to the existence of solvents other than water for analytical, preparatory, industrial purposes and special purposes. To explain the various behaviour of non-aqueous solvents and compare them with aqueous medium.
COb2	Explain pericyclic reactions like Electrocyclic reactions, Cycloaddition reactions and Sigmatropic reactions. Illustrate the principles of retrosynthesis and, how to apply them to the synthesis of an organic molecule from readily accessible starting products. Learn the mechanism of the organic reactions

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	and its relationship with issues such as: chemoselectivity, regioselectivity and stereoselectivity.
COb3	Describe the role of rubber-toughening in improving the mechanical properties of polymers. Identify the repeat units of particular polymers and specify the isomeric structures which can exist for the repeat units. Estimate the number- and weight-average molecular masses of polymer samples given the degree of polymerization and mass fraction of chains present.
COb4	Valuate fundamentals of electrochemistry. Recognize the electrochemical processes. Evaluate electrodes and cells. Express the electrodes materials. Discuss electrode potentials and cell thermodynamics. Explain the type of electrodes.

Unit I (Inorganic Chemistry) **15h**

1. Inorganic reaction mechanisms **4h**

2. Boranes and Carboranes **2h**

3. Symmetry of molecules **5h**

4. Non- aqueous solvents **4h**

Unit II (Organic Chemistry) **15h**

1. Pericyclic Reactions **5h**

2. Synthetic strategies **5h**

3. Asymmetric synthesis **5h**

Unit III (Physical Chemistry) **15h**

1. Polymers

Unit IV (General Chemistry) **15h**

1. Electro analytical methods

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Advanced Chemistry

Unit I (Inorganic Chemistry) **15h**

1. Inorganic reaction mechanisms **4h**

Labile and inert complexes, Thermodynamic and Kinetic stability based on VBT and CFT: ligand substitution reactions – S_N1 and $S_N2$in Octahedral complexes; substitution reactions of square planar complexes – Trans effect and applications of trans effect. Reactions of Tetrahedral complexes-Hydrolysis of silicon halides and phosphorous oxides.

2. Boranes and Carboranes **2h**

Definition of clusters. Structures of boranes and carboranes-Wade's rules, closo, nido, arachno boranes and carboranes.

3. Symmetry of molecules **5h**

Symmetry operations, symmetry elements. Rotational axis of symmetry and types of rotational axes. Planes of symmetry and types of planes. Improper rotational axis of symmetry. Inversion centre. Identity element.

4. Non- aqueous solvents **4h**

Classification and characteristics of a solvent .Reactions in liquid ammonia -physical properties, auto- ionization, examples of ammono acids and ammono bases. Reactions in liquid ammonia-precipitation, neutralization, solvolysis,solvation- solutions of metals and ammonia, complex formation, redox reactions ,reactions in HF- auto-ionization ,reactions in HF- precipitation, acid-base reactions protonation.

Unit II (Organic Chemistry) **15h**

1. Pericyclic Reactions

Concerted reactions, Molecular orbital of ethane, 1, 3-butadiene and allyl radical. Symmetry properties, HOMO, LUMO, thermal and photochemical pericyclic reactions. Types of pericyclic reactions-electrocyclic, cycloaddition and sigmatropic reactions-one example each and their explanation by FMO theory.

2. Synthetic strategies **5h**

Terminology-Disconnection (dix), Symbol (),Synthon, Synthetic equivalent(SE), Functional group interconversion (FGI). Linear, Convergent and Combinatorial syntheses, Target molecule (TM). Retrosynthesis of the following molecules-Acetophenone, Cyclohexene, 2-Phenylethanol

3. Asymmetric synthesis

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Head
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Selectivity in chemistry – Definition and examples of Chemoselectivity, Regioselectivity and Stereoselectivity – Stereospecific reactions – Definition of enantiomeric and diastereomeric excess (e e and d e) –. Mechanism of Iodide catalysed dehalogenation of meso and active 2,3-dibromobutane

Brief introduction to Asymmetric synthesis

Unit III (Physical Chemistry) **15h**

1. Polymers **15h**

Classification of Polymers –natural polymers and synthetic polymers examples. Classification of plastics, fibers, elastomers.

Thermosetting, thermoplastic polymers .Branched, cross-linked and co-polymers.

Definition of polymerization-addition and condensation polymerization with examples.

Explanation: chain polymerization, step polymerization, copolymerization and coordination polymerization Kinetics of free radical polymerization. – Tacticity, atacticity, stereospecifc synthesis-Zeigler –Natta catalyst.

Molecular weight of polymers-number average and weight average molecular weight, degree of polymerization, determination of molecular weight of polymers by viscometry, Osmometry.Problems.

Preparation and industrial application of polyethylene, PVC, Teflon, polyacrylonitrile, terelene and Nylon6, 6.

Introduction to biodegradability and examples of important applications of biodegradable polymers in agriculture, medicine, food & packaging industry. Introduction to bio polymers

Unit IV (General Chemistry) **15h**

Electro analytical methods

Types of electro analytical methods

(I)interfacial methods- a) potentiometry: Principle ,Electrochemical cell ,Electrodes- (i) indicator and(ii) Reference electrodes- Normal Hydrogen Electrode, Quinhydrone electrode, Saturated Calomel Electrode. Numerical problems.Applications of Potentiometry- Assay of Sulfanilamide

(b)Voltammetry- three electrode assembly, Introduction to types of voltametric techniques, microelectrodes, Overpotential and Polarization.

(II) Bulk methods- Conductometry, Conductivity Cell, Specific Conductivity, and Equivalent Conductivity. Numerical problems. Applications of conductometry. Estimation of Cl using $AgNO_3$ .Determination of Aspirin with KOH

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Head
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COURSE OUTCOMES-CHEMISTRY

Name of the Course		Semester- VI Advanced Chemistry
Course Code		CT635-O
CO1	Apply trans effect to inorganic complexes and identify its stereoisomerism. Identify different types of clusters .Identify the symmetry and symmetry elements of simple molecules. Apply the concept of non aqueous solvents in industry.	
CO2	Solve practical problems and general issues of synthetic organic chemistry. Able to propose reasonable synthetic procedures for a relative complex organic compound.	
CO3	Demonstrate an ability to distinguish different polymerization reactions and their mechanisms/kinetics. Analyze polymerization data and predict the conversion and molecular weight, which will lead to critical thinking about how to improve the setup for better polymerization.	
CO4	Perform quantitative calculations for each of the methods if provided appropriate information or data. Compare the advantages and disadvantages of the different electrochemical methods of analysis.	

Recommended text books and Reference books

1. Text book of organic chemistry by R.L.Madan

2. Book of Physical Chemistry by Puri and Sharma and Pathania.

3. 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

4. Text book of organic chemistry by R.L.Madan

5. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vishal Publications1996.

6. Inorganic Chemistry by J.D. Lee 3rd edn.

7. Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus ,3rd edn ,Wiley Publishers 2001. Chem.

8. Text book of organic chemistry by Morrison and Boyd.

9. Text book of organic chemistry by Graham Solomons.

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Department of Chemistry
Bharatiya Vidya Bhavan's Vivekananda College
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10. Text book of organic chemistry by Bruice Yuranis Powla

COURSE OBJECTIVES-CHEMISTRY

Name of the Course	**Semester-VI DSE Medicinal Chemistry**
Course Code	**CT635**
COb1	Define and Classify the drugs with examples and structures. Explain the Drugs used for various infectious diseases caused by pathogens. Describe the structure activity relation of some important class of drugs. Explain mechanism of action of the drugs.
COb2	Describe the nomenclature, classification and characteristics of enzymes. Explain the mechanism of enzyme action, enzyme kinetics, factors affecting enzyme reaction rate and the regulation of enzyme activity .Explain the drug-receptor theory and the mechanism involved in enzymes as drug.
COb3	Classify the drugs based on their mode of action .Learn the synthesis of the drugs, their advantages and disadvantages. Knowledge of the connection between the structural features of the drugs and their physico-chemical characteristics, mechanism of action and use.
COb4	Introduction to different types of hormones and neurotransmitters. Discuss the various types of drugs (Antithyroid, Antiparkinson).Discuss the uses of vitamins and Micronutrients in our daily diet.

UNIT I- Introduction and terminology **15 h (1h/w)**

1. Diseases

2. Terminology in medicinal chemistry

3. Drugs

4. ADMET

UNIT II- Enzymes and receptors **15 h (1h/w)**

1. Enzymes

2. Receptors

UNIT III- Synthesis and therapeutic activity of drugs **15 h (1h/w)**

1. Chemotherapeutics

2. Drugs to treat metabolic disorders

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3. Drugs acting on nervous system

UNIT IV – Molecular messengers ,vitamins and micronutrients 15 h (1h/w)

1. Molecular messengers

2. Vitamins

3. Micronutrients

Semester – VI, Paper -VI

Discipline Specific Elective - A (4 Credits)

Medicinal Chemistry

60h

Unit-I Introduction and terminology 15 h

S6--I: Diseases:

Common diseases, infective diseases - insect borne, air - borne, water - borne and hereditary diseases.

Terminology in medicinal chemistry:

Drug, Active pharmaceutical ingredient (API), Pharmaceuticals, pharmacology, pharmacophore, pharmacodyanamics, pharmacokinetics, metabolites, antimetabolites, therapeutic index.

Drugs:

Nomenclature: Chemical name generic names and trade names with examples;
Classification: Classification based on structures and therapeutic activity with examples.

ADMET:

a) Absorption: Definition, absorption of drugs across the membranes – active and passive absorption, routes of administration of drugs.
b) Distribution: definition and effect of plasma protein binding
c) Metabolism: definition, phase I and phase II reaction
d) Elimination: definition and renal elimination, toxicity

Unit-II Enzymes and receptors 15 h

S6--II: Enzymes: Introduction.

Mechanism and factors affecting enzyme action, Specificity of enzyme action (including stereo specificity), Enzyme inhibitors and their importance. Types of inhibition – reversible, irreversible and their subtypes with examples.

Receptors:

Introduction, Drug action – receptor theory, mechanism of drug action, concept of agonist s and antagonists with examples. Drug receptor interactions involved in drug receptor complex.

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Binding role of -OH group, -NH_2 group, quaternary ammonium salts and double bond. Structure –activity relationships of drug molecules, explanation with sulfonamides.

Unit-III Synthesis and therapeutic activity of drugs **15 h**

S6--III:

Introduction, synthesis and therapeutic activity of

Chemotherapeutics:

Sulphanilamide, Dapson, Penicillin-G (semi synthesis), Chloroquin, Isoniazid, Cisplatin and AZT.

Drugs to treat metabolic disorders: Anti-diabetic -

Tolbutamide; anti-inflammatory- Ibuprufen, cardiovascular- Glyceryl trinitrate; antipyretic (paracetamol, aspirin) and antacid – Omeprazole.

Drugs acting on nervous system:

Anaesthetic- definition, Classification – Local and General.

Volatile – Nitrous acid, chloroform uses and disadvantages.

Local anaesthetics – benzocaine

Unit-IV: Molecular messengers, Vitamins and micronutrients **15 h**

S6 -IV:

Molecular messengers:

Introduction to hormones and neurotransmitters, Thyroid hormones, Antithyroid drug-Carbimazol.

Adrenaline: Adrenergic drugs- salbutamol, atenolol.

Serotonin: SSRIs- fluoxetine.

Dopamine: Antiparkinson drug- Levodopa

Vitamins and micro nutrients:

Introduction, vitamin sources, Deficiency disorders and remedy of A, B, C, D, E, K and micronutrients- Na, K, Ca, Cu, Zn and I.

COURSE OUTCOMES-CHEMISTRY

Name of the Course	**Semester- V|Medicinal Chemistry**
Course Code	**CT635**
CO1	Correlate between pharmacology of a disease and its mitigation or cure. To write the chemical synthesis of some drugs. Interpret the structural activity relationship of different class of drugs. Knowledge about the mechanism pathways of different class of medicinal compounds.
CO2	Predict possible catalytic mechanisms of given reaction types. Evaluate the strategies for the analysis of kinetic mechanisms of catalyzed reactions. Apply the concept of drug receptors in molecules with simple functional groups like OH,NH_2 etc.

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CO3	Define the different classes of drug and identify different types of drugs. Outline the function and impact of each class of drugs. Describe the structure activity relation of some important class of drugs. Explain mechanism of action of the drugs. Application of the gained knowledge about the therapeutic classes of drugs. Recognize the drug structure and predict its pharmacologic action. Recognize the drug physico-chemical and stereochemical features. Describe and perform synthesis of the drugs and determine the reaction yield.
CO4	Apply the knowledge of vitamins and Micronutrients in our daily diet for a healthy living.

Recommended Text Books and reference books

1. Introduction to Medicinal Chemistry, G.L Patrick, Oxford University Press,New York. 2013.
2. Medicinal Chemistry, Thomas Nogrady, Oxford Univ.Press,New York.2005
3. Foye's Principles of Medicinal Chemistry David William and Thomas Lemke, Lippincott Williams & Wilkins, 2008.
4. Medicinal Chemistry, Ashutosh Kar, New Age International, 2005.
5. Synthetic Drugs,O.D.Tyagi& M. Yadav, Anmol Publications,1998.
6. Medicinal Chemistry, Alka L. Gupta, Pragati Prakashan.
7. Drugs,G.L. David Krupadanam, D. Vijaya Prasad, K.Varaprasad Rao, K.L.N.Reddy, C.Sudhakar, Universities Press (India) Ltd. 2012.

COURSE OBJECTIVES-CHEMISTRY

Name of the Course	**Semester-VI DSE Agricultural and Fuel Chemistry**
Course Code	**CT635A**
CObl	Learn about the different types of pesticides. Use of Neem for natural pest control. Acquire information about the risks associated with the use of pesticides. Define integrated pest management and other pesticide alternatives. Pesticide uses and their potential side effects demands that these chemicals be used safely and effectively in today's agriculture. To study the persistence/dissipation of pesticides in crops and provide alternatives such as biopesticide.
COb2	Discuss types of organic manures, Green/leaf manuring.Fertilizer recommendation approaches. Identify the factors affecting nutrient availability to plants.
COb3	Identify the key learning points in the concept of energy, clean energy, and

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	renewable energy. Coal as a source of energy and characterization of coal. To understand the basic concepts of Renewable and non renewable energy. Discuss the present uses and composition of coal in various industries. The principles of Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and solvent Refining techniques.
COb4	The objectives of the course are to develop an understanding of properties and application of petroleum products. Principle and process of fractional distillation. To understand different lubricants, the principles of their lubrication and their properties. To understand the different kinds of fuels and importance of bio fuels.

UNIT-I -Pesticides **15 h (1h/w)**

1. Introduction, Definition

2. Pesticide formulations

3. Biopesticides

II- Fertilizers **15 h (1h/w)**

1. Introduction

2. Nitrogenous fertilizers

3. Phosphate fertilizers

4. Potassium fertilizers

5. Biofertilizers

6. Organic farming

UNIT III-Energy Sources and Coal **15 h (1h/w)**

1. Coal

UNIT IV -Petroleum and its products, petrochemicals and non-petroleum fuels 15 h (1h/w)

1. Petroleum

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2. Petroleum products

3. Petrochemicals

4. Lubricants

5. Non petroleum fuels

Discipline Specific Elective –B (4 Credits)

Agriculture and Fuel Chemistry

(60h)

UNIT I: Pesticides **15h**

S6-E-B-I:Introduction, Definition, classification of pesticides based on use(target). Toxicity and chemical structure with examples. Adverse effects of pesticides and its impact on environmental pollution.

Synthesis, manufacture and uses of representative pesticides: Organochlorines (Cypermethrin); Organophosphates (parathion); Carbamates (Carbaryl); Quinones (Chloranil), Anilides(Alachlor).

Pesticide formulations: Dusts, Granules, Wettable powders, Emulsions and Aerosols.

Biopesticides: Introduction: potential pesticidal plants of India, Role of Neem in plant protection -constituents,Azardirachtin andits role in pest control, Structure and mode of action of Pyrethrins(pyrethrin-1) and Pyrethroids(permethrin) and Nicotinoids (Imidacloprid).

UNIT II: Fertilizers **15h**

S6-E-B-II: Introduction: (need of fertilizers), functions of essential plant nutrients (N, P, K), Classification formula and uses of fertilizers:

Nitrogenous fertilizers: Ammonium nitrate, Urea, Calcium Cyanamide, Calcium Ammonium Nitrate, Sodium Nitrate, Ammonium Chloride and their uses.

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Phosphate fertilizers: Normal super phosphate,Triple Super Phosphate, Ammonium Phosphate and their uses.

Potassium fertilizers: Potassium Chloride, Potassium nitrate, Potassium sulphate and uses.

Complex fertilizers:Diammonium phosphate and mixed fertilizers their uses.Manufacture of urea and Super phosphate of lime and their reactions in the soil.

Biofertilizers–Introduction,definition, classification, Rhizobium, Azatobactor, Azospirillium, Azolla, Blue Green Algae, Vermicomposting and uses.

Organic farming: The principal methods, crop rotation, green manures and compost, biological pest control, and mechanical cultivation and uses.

UNIT III: Energy Sources and Coal **15h**

S6-E-B-III: Review of energy sources (renewable and non renewable). Classification of fuels and their calorific values.

Coal: Uses of coal (fuel and non-fuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas – composition and uses. Fractionation of coal tar, uses of coal tar-based chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and solvent Refining.

UNIT IV: Petroleum and its products, petrochemicals and non-petroleum fuels

S6-E-B-IV: **15h**

Petroleum and its products

Petroleum: Origin, Composition of crude petroleum and classification, Properties – flash point and its determination, Knocking and anti-knocking compounds; Octane number and cetane number. Distillation of crude petroleum, Fractional distillation – Principle and process, refining, Fractions and uses, Cracking -Thermal and catalytic cracking, Reforming

Petroleum products – Petrol, Diesel, LPG, Kerosene, Tar and their applications

Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene and their uses.

Lubricants: Classification of lubricants – Solid, semisolid and liquids; Properties (viscosity, flash point, firepoint, cloud point, pourpoint) and their determination. Functions of lubricants. Mechanism of lubrication.

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Non petroleum fuels: Natural gas-CNG, LNG, Clean fuels – H_2 gas,ethanol, Fuel from waste – bio-gas, Fuel from biomass – bio ethanol, biodiesel, Synthetic fuel- syngas based.

COURSE OUTCOMES-CHEMISTRY

Name of the Course	**Semester- V/DSE Agricultural and Fuel Chemistry**
Course Code	**CT635A**
CO1	Apply the concept of organic pest control methods for better soil nourishment and good yields of crops.
CO2	Appraise the organic methods of farming .Apply the knowledge of bio fertilizers and vermicomposting and leaf compositing to crops and gardens. Recognize the Environmental issues caused by fertilizers. Identify Newer types of fertilizers that can reduce environmental impacts.
CO3	Analyse the different types og energy sources and their uses.
CO4	Understand the concepts of energy usage and global energy scenario. Understand types of Fuels and have profoundness in understanding their application. Understand and work out analytical problems related to combustion theory.

Recommended text books and Reference books

1. Chemistry of pesticides,N.N. Melnikov, Springer-Verlag-Technology & engineering(2012)
2. Pesticide synthesis Handbook, Thomas A. Unger, Elsevier, (200).
3. Pesticides, R.Cremlyn, John Wiley, 1980.
4. Manures and fertilisers, K. Kolay, Published by Atlantic (2007).
5. Sharma,B.K.&Gaur,H.IndustrialChemistry,Goel Publishing House,Meerut(1996)
6. A textbook of Engineering Chemistry Paperback – 2017 by Shashi Chawla
7. Industrial Chemistry, Vol-I, Stocchi,E,Ellis Horwood Ltd.UK(1990)
8. Jain, P.C and Jain, M. Engineering Chemistry Dhanpat Rai &Sons, Delhi.
9. Engineering Chemistry by Shashi Chawla, Dhanpat Rai &sons, Delhi.

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LABORATORY COURSE – IV **(45h/15weeks) 3h/w**

Practical Paper – (Physical Chemistry)

1. Chemical kinetics:

a) Determination of specific reaction rate of the hydrolysis of methyl acetate catalyzed by hydrogen ion at room temperature.

b) Determination of rate of decomposition of hydrogen peroxide catalysed by $FeCl_3$

Electrochemistry:

A.Potentiometry:

a) Determination of Redox potential of Fe^{2+}/Fe^{3+} by potentiometric titration of Ferrous ammonium sulphate vs. Potassium dichromate

b) Precipitation titration of KCl Vs.$AgNO_3$ –Determination of given Concentration of $AgNO_3$

B. pH metry:

a) pH metric titration of strong acid, HCl with strong base NaOH and determination of Concentration of the given acid

b) pH metric titration of weak acid, acetic acid with strong base NaOH and calculation of dissociation constant.

C.Conductometry:

a) Determination of overall order: Saponification of Methyl acetate with NaOH by conductometric measurements

Laboratory Course: Paper code: CT635P

Physical Chemistry II

LEARNING OBJECTIVES:

- Perform experiments in Chemical kinetics and using different instruments like pH meter, potentiometer.

LEARNING OUTCOMES:

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Able to perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation,interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions

Textbooks and Reference books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).

3 Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

4 Athawale V. D. and Mathur P. Experimental Physical Chemistry,, New Age Intenational

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Department of Chemistry
Bharatiya Vidya Bhavan's Vivekananda College
Sainikpuri, Secunderabad - 500 094.

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