பகுதி – I, தமிழ்பருவம் I

16LSU101 : தமிழ்முதல்தாள் 4-H,4-C

(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)

பாடத்திட்டப் பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், மேம்படுத்துதல்.
- ஆய்வுநோக்கை மேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

பாடத்திட்டப் பயன் விளைவு

1. இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
2. கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
3. தமிழின் வளர்ச்சித் துறையாகிய, 'அறிவியல் தமிழ்' ; 'இணைய தமிழ்' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனை மேம்பாடு.
4. வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
5. சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்குக் கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை வளர்ச்சி.
6. மொழிபெயப்புத் துறைசார்ந்த வேலைவாய்புத் திறன் பெற்றிருத்தல்

அலகு – I :இக்காலஇலக்கியம்: **(10 மணிநேரம்)**

கல்வி : மகாகவிபாரதியார் – சுயசரிதை - ஆங்கிலக் கல்வி.
இன்றைய நிலை : கவிமணி தேசிக விநாயகம் பிள்ளை–
ஒற்றுமையே உயிர்நிலை.
மனிதநேயம் :கவிஞர்சிற்பிபாலசுப்பிரமணியன் –மலையாளக் காற்று.
சூழலியல் :கவிஞர்வைதீஸ்வரன் - விரல் மீட்டிய மழை.
பெண்ணியம் :கவிஞர்சுகந்தி சுப்பிரமணியம் – புதையுண்ட வாழ்க்கை.

அலகு – II :அறஇலக்கியம்: **(10 மணிநேரம்)**

கொன்றை வேந்தன்: 1-50 பாடல்கள்

திருக்குறள்: பண்புடைமை, வினைத்திட்பம் – 20 குறள்கள்

பழமொழி நானூறு: 5 பாடல்கள்

அலகு - III :சிற்றிலக்கியம்: **(10 மணிநேரம்)**

மூவருலா: 1-26 கண்ணிகள்

திருச்செந்தூர் முருகன் பிள்ளைத்தமிழ்: 2 பாடல்கள்

கலிங்கத்துப் பரணி: போர்பாடியது - 9 பாடல்கள்

அலகு – IV :கட்டுரை: **(10 மணிநேரம்)**

1. உயர்தனிச் செம்மொழி - பரிதிமாற்கலைஞர்
2. கட்டிடக்கலை - அ. இராசமாணிக்கனார்
3. வாழ்க்கை - இளவழகனார்
4. ஆளுமைத்திறன் அறிவோம் - ஸ்ரீகண்ணன்
5. மணற்கேணி - நெ.து.சுந்தரவடிவேலு

அலகு- V :மொழிப்பயிற்சி: **(8 மணிநேரம்)**

1. படைப்பிலக்கியப் பயிற்சிகள் (கதை,கவிதை, கட்டுரை, உரைநடை)
2. மொழிபெயர்ப்பு
3. இலக்கணப் பயிற்சிகள்

பாடநூல்:கற்பகச்சோலை – தமிழ்ஏடு.கற்பகம்பல்கலைக்கழகத்தமிழ்த்துறைவெளியீடு.

Semester-I

16ENU101 ENGLISH – 1 4H 4C

Instruction Hours/week:L:40 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

- To enable the learners to acquire English language skills at a faster pace.
- To train the learners to reflect on the literary works and communicate flexibly.
- Know about the Prose and Poetry
- To develop the Short Story:
- Learn about Vocabulary, Grammar and Composition:
- Know about Proverb Expansion

Course Outcomes

1. Enable the learners to acquire English language skills at a faster pace.
2. Trained the learners to reflect on the literary works and communicate flexibly.
3. Knowledge about the Prose and Poetry
4. Development of the Short Story:
5. Learnt about Vocabulary, Grammar and Composition:
6. Knowledge about Proverb Expansion

UNIT I

Prose: Google Guys (Extract) – Richard L Brandt
Poetry: The Blind Pedlar – Osbert Sitwell
Short Story: A Garden So Rich – Christie Craig
Vocabulary: Prefix, Antonyms, Sentence Completion
Grammar: Article, Adverb, Pronoun

UNIT II

Prose: Happiness 101 – Geeta Padmanabhan
Poetry: An Old Woman – Arun Kolatkar
Vocabulary: Suffix, Analogies
Grammar: Noun, Adjective

UNIT III

Prose: Structured Procrastination – John Perry
Short Story: The Umbrella Man – Roald Dahl
One-Act Play: The Boy Who Stopped Smiling – Ramu Ramanathan
Vocabulary: Synonyms, Euphemisms, Word Definitions
Grammar: Verb, Conjunction and Interjection, Indirect/Reported Speech

UNIT IV

Poetry: No Sentence – Anjum Hassan
One-Act Play: While the Auto Waits- O' Henry
Vocabulary: Words Often Confused, Anagrams

Grammar: Preposition, Voice- Active and Passive

UNIT V

Short Story: The Bird **–** Amar Jalil

One-Act Play: The Cellphone Epidemic – Claudia I. Haas

Vocabulary: Portmanteau Words, One Word Substitution

Grammar: Question, Pronunciation

Prescribed Text:

Rao, G. Chandralekha et al. *Spring* 2013**.** Emerald Publishers: Chennai.

Suggested Book:

Shyamala, V. (2006). *English for Communication*. Chennai, Emerald Publishers.

Semester-I

16CHU101 ATOMIC STRUCTURE AND CHEMICAL BONDING5H 5C

Instruction Hours/week:L: 5 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

Students should be able

- To discuss the limitations of classical mechanics and its drawbacks.
- To discuss the radial and angular part of orbitals
- To explain the fundamentals of quantum mechanics and Schrödinger equation for simple atoms.
- To predict and write the electronic configuration of elements.
- To explain a different types of bonding like ionic and covalent bonding.
- To interpret a knowledge about the various theories of bonding like VSEPR, Valence Bond Theory and Molecular Orbital Theory of covalent bonding.

Course Outcomes

The students

1. Explain the atomic theory of matter, composition of the atom, which defines the identity of a given element.
2. Understood the radial and angular part of orbitals
3. Explain the relative sizes, masses, and charges of the proton, neutron, and electron, and their assembly to form different atoms.
4. Define the term isotope, and their atomic and mass numbers.
5. Use the Periodic Table to rationalize similarities and differences of elements, including physical and chemical properties and reactivity.
6. Predict common ionic charges of group 1A, 2A, 3A, 6A, and 7A elements based on position in the periodic table.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

Atomic Structure:

UNIT I

Review of: Bohr's theory and its limitations, dual behaviour of matterand radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atomspectra. Need of a new approach to atomic structure.What is Quantum mechanics? Time independent Schrodinger equation and meaning ofvarious terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and

angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1*s* and 2*s* atomic orbitals.

UNIT II

Significance of quantum numbers, orbital angular momentum and quantum numbers *ml* and *ms*. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (*ms*).Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stabilityof half-filled and completely filled orbitals, concept of exchange energy. Relative energies ofatomic orbitals, Anomalous electronic configurations.

Chemical Bonding and Molecular Structure
UNIT III

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Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character

UNIT IV

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basisof VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar,tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.

UNIT V

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and theircharacteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combinationof orbitals, MO treatment of homonuclear diatomic molecules of 1^{st} and 2^{nd} periods(including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO andNO^{+}. Comparison of VB and MO approaches.

Suggested Readings:
Text Books:

1. Lee, J.D. (2010). *Concise Inorganic Chemistry*.ELBS.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. (2008). *Basic Inorganic Chemistry*. 3rd ed.Hohn Wiley& sons.

Reference Books:

1. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. (2010).*Concepts and Models in InorganicChemistry*. John Wiley & Sons.
2. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. (2006).*Inorganic Chemistry: Principles of Structure and Reactivity*. Pearson Education India.

Semester-I

5H 5C

16CHU102 PHYSICAL CHEMISTRY I(States of matter and ionic equilibrium)

Instruction Hours/week:L: 5 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course objectives

Enable the students

- To understand the Kinetic molecular model of a gas and about the molecular velocities
- To provide a knowledge about the behaviour of real gases
- To provide knowledge about the structure of the liquid state and its properties like surface tension and viscosity.
- To provide knowledge about the solid state, symmetries present and different types of crystals.
- To provide a knowledge about the theory of ionic equilibria, ionisation of electrolytes and salt hydrolysis.
- To provide a knowledge about the buffer solutions and acid-base titrations.

Course outcomes (CO's)

Students are able to

1. Understand the postulates of Kinetic theory of gases, kinetic molecular model of gases and about the molecular velocities
2. Has the knowledge, why real gases deviate from ideal gases, Vander Waals equation of state
3. and about critical constants.
4. Has the knowledge about the structure of the liquid state and its properties like surface tension and viscosity.
5. Understood about the solid state, symmetries present and different types of crystals.
6. Has knowledge about the theory of ionic equilibria, ionisation of electrolytes and salt hydrolysis.
7. Know to formulate the buffer solutions and the choice of indicators to acid-base titrations

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Gaseous state: Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of ζ from η; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean

square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

UNIT II

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure and temperature for different gases. Causes of deviation from ideal behaviour. Van der Waals equation of state, its derivation and application in explaining real gas behaviour, calculation of Boyle temperature. Isotherms of real gases and their comparison with Van der Waals isotherms, continuity of states, critical state, relation between critical constants and Van der Waals constants, law of corresponding states.

Liquid state: Qualitative treatment of the structure of the liquid state; physical properties of liquids, vapour pressure, surface tension coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.

UNIT III

Solid state: Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl.

UNIT IV

Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono and diprotic acids. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.

UNIT V

Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.

Suggested Readings:

Text Books:

1. Atkins, P. W. & Paula, J. de Atkin's. (2006).*Physical Chemistry Ed*. Oxford University Press.
2. Ball D. W. (2007).*Physical Chemistry*.India : Thomson Press.

Reference Books:

1. Castellan, G. W. (2004). *Physical Chemistry*. 4th Ed. Narosa.
2. Mortimer, R. G. (2009).*Physical Chemistry*. 3rd Ed. NOIDA, UP : Elsevier.

Semester-I

16CHU103 ORGANIC CHEMISTRY I(Basics and Hydrocarbon) 4H 4C

Instruction Hours/week:L:4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course objectives

- To describe knowledge on the basics of organic chemistry
- To gain knowledge in particularly the shapes of molecules, electron displacement effects, reagents, intermediates and fundamental types of reactions.
- To explain the students about the stereochemistry, projection formulae of molecules, geometrical isomerism and optical isomerism
- To explain the preparation and conformation analysis of alkanes.
- To paraphase a knowledge about the preparation and properties of alkenes and alkynes, mechanisms of reactions and rules behind the reactions.
- To summarise a knowledge about the aromaticity of molecules and about electrophilic aromatic substitutions.

Course outcomes

1. Describe molecular structure and bonding in organic molecules.
2. Classify organic compounds by structure, use the IUPAC nomenclature, and identify conformational effects in organic compounds.
3. Predict the products of reactions of alkenes and describe the mechanisms showing how the products are formed.
4. Draw and interpret reaction coordinate diagrams, and relate the energetic changes associated with chemical reactions to equilibrium constants and rate; and differentiate kinetic versus thermodynamic control of reactions.
5. Identify the types of isomerism in organic compounds, to identify and classify chiral centers, and explain the physical and chemical consequences of chirality.
6. Correctly represent the structures and bonding of alkynes, and describe the mechanisms for reactions of alkynes and predict the products of such reactions.
7. Identify compounds in which resonance is important, predict the effect of resonance on the stability of compounds and reactive intermediates, and draw resonance structures.
8. Identify conjugated pi systems and explain the effect of conjugation on molecular structure and reactivity; and predict the products of reactions of dienes.
9. Describe mechanisms for substitution and elimination reactions, and predict the effect of nucleophile, leaving group, and solvent on the relative rates of S 1 versus S 2 reactions, and E1 versus E2 reactions, as well as on the relative rates of substitution versus elimination.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Basics of Organic Chemistry

Hybridization, Shapes of molecules
Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation anddipole moment; Hydrogen bonding (Applications to be discussed with relevant topics) Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Types, shape and relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions: Addition, Elimination and Substitution reactions.

UNIT II
Stereochemistry:
Fischer,Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans , syn-anti and E/Z notations with C.I.P rules.
Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Diastereoisomers, meso structures, Racemic mixture and their resolution. Relative and absolute configuration: D/L and R/S designations.

UNIT III
Chemistry of Aliphatic Hydrocarbons
Carbon-Carbon sigma bonds
General methods of preparation, physical and chemical properties of alkanes: Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation-relative reactivity and selectivity.

Cycloalkanes and Conformational Analysis
Conformational analysis of alkanes: Relative stability and Energy diagrams. Types of cycloalkanes and their relative stability, Baeyer strain theory: Chair, Boat and Twist boat forms of cyclohexane with energy diagrams; Relative stability of mono substituted cycloalkanes.

Unit IV
Chemistry of Aliphatic Hydrocarbons
Carbon-Carbon pi bonds:
General methods of preparation, physical and chemical properties of alkenes and alkynes, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Electrophilic additions and their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation(oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.
Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

UNIT V
Aromatic Hydrocarbons
Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

Suggested Readings:
Text Books

1. Morrison, R. N. & Boyd, R. N. (1992). *Organic Chemistry*. India: Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. (2002). *Organic Chemistry.*Volume 1. India: Dorling Kindersley (India) Pvt. Ltd. (PearsonEducation).

Reference Books:

1. Finar, I. L. (2002).*Organic Chemistry:Stereochemistry and the Chemistry of Natural Products.*Volume 2. India: Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Eliel, E. L. &Wilen, S. H. (1994). Stereochemistry of Organic Compounds.London :Wiley.
3. Kalsi, P. S. (2005). *Stereochemistry Conformation and Mechanism*. New Age International.

Semester-I

16CHU111 ATOMIC STRUCTURE AND CHEMICAL BONDING PRACTICAL **2H 1C**

Instruction Hours/week:L: 0 T:0 P:2 Marks: Internal:40 External: 60 Total:100

Course objectives

- To illustrate the principles of volumetric analysis.
- To categorize a versatile knowledge of solution preparations
- To prepare solutions with appropriate concentrations, titrations
- How to handle the apparatus while doing a titration.
- To analyse the knowledge about the calculations involved in the estimation of compounds using volumetric analysis.
- To estimate the amount of solution present quantitatively.

Course outcomes (CO's)

The Students are able

1. Summarize the principles of volumetric analysis.
2. Gained knowledge about the preparations of solutions
3. Understood the preparation of appropriate concentrations, titrations
4. Handled the respective apparatus while doing a titration.
5. Analyse the calculations involved in volumetric analysis and in the estimation of compounds using volumetric analysis.
6. The lab will also provide hands-on opportunities to develop and apply this knowledge

Methodology

Titrations, Volumetric analysis.

Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Suggested Readings:

Text Book:

1. Svehla, G. (2012).*Vogel's Qualitative Inorganic Analysis*. Pearson Education.

Reference Book:

1. Mendham, J. (2009) *Vogel's Quantitative Chemical Analysis*, Pearson.

Semester-I

16CHU112 STATES OF MATTER AND IONIC EQUILIBRIUM PRACTICAL **2H 1C**

Instruction Hours/week:L: 0 T:0 P:2 Marks: Internal:40 External: 60 Total:100

Course Objectives

The students develop the skills to categorize

- Surface tension of a liquid
- Study the variation of surface tension with different concentration of detergent solutions.
- Viscosity of a liquid
- Prepare a buffer solution and to measure its pH.
- Monitor the pH of a solution during the course of a titration.
- Indexing of a given powder diffraction pattern of a cubic crystalline system.

Course Outcomes

The students develops the practical skill have categorized the

1. Determination of surface tension of a liquid
2. Determination the viscosity of a liquid
3. Prepare a buffer solution and to measure the pH of a solution
4. Monitor the pH of a solution during the course of a titration.
5. The lab will also provide hands-on opportunities to develop and apply this knowledge
6. Indexing of a given powder diffraction pattern of a cubic crystalline system**.**

Methodology

Surface tension & viscosity measurements, XRD data, PH meter and buffer solutions.

1. **Surface tension measurements**

a. Determination of the surface tension of a liquid.

b. Study the variation of surface tension with different concentration of detergent solutions.

2. **Viscosity measurement.**

a. Determination of co-efficient of viscosity of an unknown aqueous solution.

b. Study the variation of co-efficient of viscosity with different concentration of Poly Vinyl Alcohol (PVA) and determine molar of PVA.

b. Study the variation of viscosity with different concentration of sugar solutions.

3. **Solid State:**

a. Indexing of a given powder diffraction pattern of a cubic crystalline system.

4**. pH metry**:

a. Study the effect of addition of HCl/NaOH on pH to the solutions of acetic acid, sodium acetate and their mixtures.

b. Preparation of buffer solutions of different pH values (i). Sodium acetate-acetic acid (ii). Ammonium chloride-ammonium hydroxide

c. pH metric titration of (i) strong acid with strong base, (ii) weak acid with strong base. Determination of dissociation constant of a weak acid.

Suggested Readings:

Text Books:

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

Reference Books:

1. Garland, C. W., Nibler, J. W. & Shoemaker, D. P. (2003). *Experiments in Physical Chemistry*. 8th Ed.New York : McGraw-Hill.
2. Halpern, A. M. & McBane, G. C.(2003).*Experimental Physical Chemistry*. 3rd Ed. New York : W.H. Freeman & Co.

Semester-I 16CHU113 BASICS AND HYDROCARBON PRACTICAL4H 2C

Course objectives

To develop skills in

- To purify organic compounds by crystallisation.
- To calibrate the thermometer, determine the melting point, and to analyse the effect of
- impurities on the melting point.
- To determine the boiling point of a liquid by distillation method.
- To explain the principles of chromatography and to separate organic compounds by paper and thin layer chromatography.
- To detect the elements present in an organic compound.
- To prepare few organic compounds using standard organic reactions.

Course Outcomes (CO's)

The student will be able to

1. Purify organic compounds by crystallisation.
2. Characterisation of the compounds by elemental analysis, melting point, and effect of impurities on the melting point.
3. To separate organic compounds by paper chromatographic and TLC methods
4. To Preparation of organic compounds.
5. The lab will also provide hands-on opportunities to develop and apply this knowledge.
6. Understood the principles of chromatography and to separate organic compounds by paper and thin layer chromatography

Methodology

Laboratory experiments, Melting point apparatus, paper chromatography, Heating mantles

1. Checking the calibration of the thermometer
2. Purification of organic compounds by crystallization using the following solvents:
   a.Water, b.Alcohol, c.Alcohol-Water
3. Determination of the melting points of unknown organic compounds.
4. Effect of impurities on the melting point – mixed melting point of two unknown organic Compounds
5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation)
6. Chromatography
   a.Separation of a mixture of two amino acids by ascending paperchromatography
   b.Separation of a mixture of two sugars by ascending paper chromatography
   c.Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)
7. Detection of extra elements
8. Organic Preparations
   (i) Bromination of acetanilide / aniline / phenol
   (ii) Nitration of nitrobenzene / toluene.

SuggestedReadings:

Text Books:

1. Mann, F.G. & Saunders, B.C.(2009). *Practical Organic Chemistry.* Pearson Education.

Reference Books:

1. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell A.R. (2012). *Practical Organic*

Chemistry. 5th Ed. Pearson.

பகுதி – I, தமிழ்பருவம் II 16LSU201 : தமிழ் இரண்டாம் தாள் 4-H,4-C

(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)

பாடத்திட்டப் பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், மேம்படுத்துதல்.
- ஆய்வுநோக்கை மேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

- **பாடத்திட்டப் பயன் விளைவு**

1. இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
2. கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
3. தமிழின் வளர்ச்சித் துறையாகிய, 'அறிவியல் தமிழ்' ; 'இணைய தமிழ்' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனை மேம்பாடு.
4. வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
5. சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்குக் கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை வளர்ச்சி.
6. மொழிபெயப்புத் துறைசார்ந்த வேலைவாய்புத் திறன் பெற்றிருத்தல்

அலகு – I :பக்தி இலக்கியம் **(10 மணிநேரம்)**

சைவ, வைணவ இலக்கியங்கள் - தோற்றம் ,வளர்ச்சி, வரலாறு.

1. சைவம் -பெரியபுராணம் - திருமூலநாயனார் புராணம்.

2.வைணவம் - பெரியாழ்வார் திருமொழி: 10 பாடல்கள்.

அலகு – II :சங்கஇலக்கியம் : **(15 மணிநேரம்)**

சங்க இலக்கியங்கள் அறிமுகம்

அ).எட்டுத்தொகை

நற்றிணை : பிரசம் கலந்த – பாலை -110

குறுந்தொகை : கருங்கட்டாக் கலை – குறிஞ்சி- 69

ஐங்குறுநூறு : நெய்தல்-தொண்டிப்பத்து:

திரைஇமிழ் இன்னிசை-171

பதிற்றுப்பத்து : சிதைந்தது மன்ற - 27

பரிபாடல்: பரிபாடல் திரட்டு-மதுரை நகர்ச்சிறப்பு –

உலகம் ஒரு நிறையாத்தான்-6, மாயோன் கொப்பூழ்-7, செய்யாட்கு இழைத்த-9, கார்த்திகை காதில்-10, ஈவாரைக் கொண்டாடி-11.

கலித்தொகை: சுடர்தொடீ கேளாய்: குறிஞ்சிக்கலி- 36

அகநானூறு: அன்னாய் வாழி வேண்டன்னை - குறிஞ்சி - 48

புறநானூறு : யாதும் ஊரே யாவருங் கேளிர் –பொதுவியல்- 192

ஆ). பத்துப்பாட்டு

திருமுருகாற்றுப்படை - பழமுதிர்ச்சோலையின் சிறப்பு

முருகன் இருப்பிடங்கள் – 'சிறுதினை மலரொடு' என்பதிலிருந்துதொடங்கி, 'அறிந்தவாறே' என்பது வரையிலான தொடர்கள்: 218-249.

முருகன் அருள்புரிதல் – 'தெய்வம் சான்ற' என்பதிலிருந்து தொடங்கி, 'நல்குமதி' என்பது வரையிலான தொடர்கள்: 286-295.

அலகு - III :காப்பியம் **(6 மணிநேரம்)**

சிலப்பதிகாரம்:

மங்கல வாழ்த்துப் பாடல்: (21-29) – கண்ணகியின் சிறப்பு:

'நாகநீள் நகரொடு' என்பதிலிருந்து தொடங்கி,

'கண்ணகி என்பாண் மன்னோ' என்பது வரையிலான தொடர்கள்.

நடுகற்காதை: (207-234)- சேரன் செங்குட்டுவன் கண்ணகிக்குக் கோயில் எடுத்தல்: 'அருந்திறலரசர்' என்பதிலிருந்து தொடங்கி, 'மன்னவரேறென்' என்பது வரையிலான தொடர்கள்.

வாழ்த்துக்காதை: (482-485)- செங்குட்டுவனுக்குக் கண்ணகி காட்சியளித்தல்: 'என்னே' என்பதிலிருந்து தொடங்கி, 'விசும்பில் தோன்றுமால்' என்பது வரையிலான தொடர்கள்.

வழக்குரை காதை:பத்தினிப் பெண்டிர் எழுவர் கதை: 'நீர்வார் கண்ணை' என்பதிலிருந்து தொடங்கி, 'புகாரென் பதியே' என்பது வரையிலான தொடர்கள்.

வஞ்சினமாலை: 'வன்னி மரமும்' என்பதிலிருந்து தொடங்கி, 'பதிப்பிறந்தேன்' என்பது வரையிலான தொடர்கள்.

அலகு – IV :சிறுகதை **(10 மணிநேரம்)**

1. **குளத்தங்கரை அரசமரம் – வ.வே.சு.ஐயர்**
2. **காட்டில் ஒரு மான் - அம்பை**
3. **நாற்காலி – கி.ராஜநாராயணன்**
4. **நகரம் – சுஜாதா**

அலகு- V :மொழிப்பயிற்சி **(7 மணிநேரம்)**

படைப்பிலக்கியப் பயிற்சிகள் (கதை, கவிதை, கட்டுரை, உரைநடை)

மொழிபெயர்ப்பு

பாடநூல்:கற்பகச்சோலை – தமிழ்ஏடு.கற்பகம்பல்கலைக்கழகத்தமிழ்த்துறை வெளியீடு.

16CHU201 PHYSICAL CHEMISTRY II(ChemicalSemester-II Thermodynamics and its applications)5H 5C

Instruction Hours/week:L: 5 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

- To provide the basics of chemical thermodynamics and the concept of first law of Thermodynamics.
- To provide the knowledge about the thermo chemistry and to explain about the 2nd law of Thermodynamics.
- To explain the concepts of third law of thermodynamics and systems of variable composition.
- To explain about the usage of chemical thermodynamics in chemical equilibrium.
- To provide a knowledge about solutions and colligative properties.
- To recognise the forces which drive the chemical reactions in forward direction and the concept of the interchange of energy in a system.

Course Outcomes

1. Students will explain and apply the concepts of thermodynamics to chemical and physical systems. Know to calculate Q, W, ΔU and ΔH for various process.
2. Students understood the concepts of thermochemistry and the concept of entropy.
3. Students know about the third law of thermodynamics, free energy functions and about the Systems of Variable Composition
4. Students will be able to derive essential mathematical relationships in thermodynamics, and chemical equlibria.
5. Know to list the colligative properties of solutions, explaining how and why each property is affected by an increase by the amount of solute
6. Recognise the forces which drive the chemical reactions in forward direction and the concept of the interchange of energy in a system.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Chemical Thermodynamics: Intensive and extensive variables; state and path functions;isolated, closed and open systems.

First law: Concept of heat, Q, work, W, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of Q, W, ΔU and ΔH for reversible, irreversible and free expansion of gases (ideal and Van der Waals) under isothermal and adiabatic conditions.

UNIT II

Thermochemistry: Heats of reactions: standard states; enthalpy of formation and enthalpy of combustion and its applications; effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics. Calculation of entropy change for reversible and irreversible processes.

UNIT III

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

Systems of Variable Composition: Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

UNIT IV

Chemical Equilibrium: Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration (Le Chatelier Principle, Quantitatively). Free energy of mixing and spontaneity. equilibrium between ideal gases and a pure condensed phase.

UNIT V

Solutions and Colligative Properties: Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] andamount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Suggested Readings

Text Books:

1. Peter, A. & Paula, J. de.(2011).*Physical Chemistry*. 9th Ed. Oxford University Press.
2. Castellan, G. W. (2004).*Physical Chemistry.* 4th Ed. Narosa.

Reference Books:

1. Engel, T. & Reid, P. (2012).*Physical Chemistry.* 3rd Ed. Prentice-Hall
2. McQuarrie, D. A. & Simon, J. D. (2004). New Delhi: Molecular Thermodynamics Viva Books Pvt. Ltd.
3. Assael, M. J., Goodwin, A. R. H., Stamatoudis, M., Wakeham, W. A. & Will, S. (2011).*Commonly Asked Questions in Thermodynamics*. NY : CRC Press.
4. Levine, I .N. (2010). *Physical Chemistry*. 6th Ed. Tata Mc Graw Hill. •
5. Metz, C.R.(2006). *2000 solved problems in chemistry*. Schaum Series

Semester-II

16CHU202 INORGANIC CHEMISTRY II(Metallurgy and S-Block and P-block elements) 4H 4C

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course objectives

The student will recite knowledge on

- The general principles of metallurgy
- S-block elements
- Complexes of s-block elements
- Chemistry of p-block elements
- Chemistry Hydrides, oxides and oxacids
- Preparation, properties, structure and uses of some types of inorganic compounds.

Course Outcomes

It enabled the students have discuss

1. The basic principles and methods involved in the metallurgy
2. The basic properties of s-block elements and their compounds
3. The complex formation tendency of s-block elements and their structure
4. The basic properties of p-block elements and their compounds.
5. Chemistry Hydrides, oxides and oxacids
6. The preparation, properties, structure and uses of borazine, silicates, silicones, interhalogen compounds, phosphonitrilic and clathrates.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy with reference to cyanide process for silver and gold. Methods of purification of metals: Electrolytic process, Van Arkel-de Boer process and Mond's process, Zone refining.

UNIT II

Chemistry of *s* Block Elements:

(i) General characteristics: melting point, flame colour, reducing nature, diagonal relationships and anomalous behavior of first member of each group.

(ii) Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water.

(iii) Common features such as ease of formation, thermal stability and solubility of the following alkali and alkaline earth metal compounds: hydrides, oxides, peroxides, superoxides, carbonates, nitrates, sulphates.

UNIT III

(i) Complex formation tendency of s-block elements; structure of the followingcomplexes: crown ethers and cryptates of Group I; basic beryllium acetate, beryllium

nitrate, EDTA complexes of calcium and magnesium.
(ii) Solutions of alkali metals in liquid ammonia and their properties.

UNIT IV

Chemistry of *p* Block Elements:
Electronic configuration, atomic and ionic size, metallic/non-metallic character, melting point, ionization enthalpy, electron gain enthalpy, electronegativity, Allotropy of C, P, S; inert pair effect, diagonal relationship between B and Si and anomalous behaviour of first member of each group.

Structure, bonding and properties: acidic/basic nature, stability, ionic/covalent nature, oxidation/reduction, hydrolysis, action of heat of the following:
Hydrides: hydrides of Group 13 (only diborane), Group 14, Group 15 (EH_3 where E = N, P, As, Sb, Bi), Group 16 and Group 17.
Oxides: oxides of phosphorus, sulphur and chlorine
Oxoacids: oxoacids of phosphorus and chlorine; peroxy acids of sulphur
Halides: halides of silicon and phosphorus

UNIT V
Preparation, properties, structure and uses of the following compounds:
- Borazine
- Silicates, silicones,
- Phosphonitrilic halides $\{(PNCl_2)_n$ where n = 3 and 4$\}$
- Interhalogen and pseudohalogen compounds
- Clathrate compounds of noble gases, xenon fluorides (MO treatment of XeF_2).

Suggested Readings:

Text Books:

1. Lee, J.D. (2010). *Concise Inorganic Chemistry*. Pearson Education.
2. Douglas .B.E, Mc Daniel, D.H. & Alexander J.J. (1994). *Concepts & Models of Inorganic Chemistry*.3rdEd. N.Y. : John Wiley Sons.

Reference Books:

1. Greenwood, N.N. & Earnshaw. (2005). *Chemistry of the Elements*, Butterworth-Heinemann.
2. Cotton, F.A. & Wilkinson, G. (1999). *Advanced Inorganic Chemistry*. Wiley, VCH.
3. Miessler, G. L. & Donald, A. Tarr. (2011).*Inorganic Chemistry.*5thEd.(adapted).Pearson,
4. Shriver, D.F., Atkins P.W & Langford, C.H. (2010).*Inorganic Chemistry. 5th*Ed.Oxford University Press.

Semester-II

16CHU203 ORGANIC CHEMISTRY II 5H 5C
(Oxygen containing Functional Groups)

Instruction Hours/week:L:5 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

To provide the students a knowledge on

- Chemistry of halogenated compounds alkyl
- The preparation, properties and relative reactivity of alcohols and phenols
- Preparation, properties and standard reactions of carbonyl compounds.
- Chemistry of Organometallic compounds, Ethers and Epoxides and Addition reactions
- Chemistry of carboxylic acids and their derivatives.
- Chemistry of aryl halidies and their uses

Course Outcomes (CO's)

The students will able to

1. Understand the chemistry of alkyl halides and aryl halides.
2. Understand the preparation, properties and relative reactivity of alcohols and phenols
3. Understand Preparation, properties and standard reactions of carbonyl compounds
4. Understand the preparations, reactions and applications of epoxides, ethers and organometallic compounds
5. Understand the preparations and properties of carboxylic acid and its derivatives.
6. Explain the chemistry of aryl halides.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Chemistry of Halogenated Hydrocarbons:

Alkyl halides: Methods of preparation and properties, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent; nucleophilic substitution vs. elimination.

Aryl halides: Preparation (including preparation from diazonium salts) and properties, nucleophilic aromatic substitution; SNAr, Benzyne mechanism.
Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

UNIT II

Alcohols, Phenols:

Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-BlancReduction; Oxidation of diols by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement;

Phenols: Preparation and properties; Acidity and factors affecting it, Ring substitution

reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism;

UNIT III

Carbonyl Compounds:

Structure, reactivity, preparation and properties; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisan-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α – substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner,$LiAlH_4$, $NaBH_4$, MPV, PDC)

UNIT IV

Organometallic compounds, Ethers and Epoxides and Addition reactions

Organometallic compounds of Mg (Grignard reagent) – Use in synthesis of organic compounds. *Ethers and Epoxides:* Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$

Addition reactions of α, β- unsaturated carbonyl compounds: Michael addition.
Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

UNIT V

Acids and their Derivatives:

General methods of preparation, physical properties and reactions of monocarboxylic acids, effect of substituents on acidic strength. Typical reactions of dicarboxylic acids , hydroxy acids and unsaturated acids.
Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilicsustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann- bromamide degradation and Curtius rearrangement.

Suggested Readings:

Text Books:

1. Morrison, R. T. & Boyd, R. N. (1992). *Organic Chemistry*. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Reference Books:

1. Finar, I. L. (2002). *Organic Chemistry.* Volume 1. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Graham Solomons, T.W. (2012).*Organic Chemistry*. John Wiley & Sons, Inc.

Semester-II16CHU211 CHEMICAL THERMODYNAMICS AND ITS APPLICATIONS PRACTICAL **2H 1C**

Instruction Hours/week:L: 0 T:0 P:2 Marks: Internal:40 External: 60 Total:100

Course Objectives

The Students have a present knowledge

- To measure the heat capacity of a calorimeter
- To determine the enthalpy of neutrilisation.
- To determine the ionisation of solution.
- To determine the enthalpy of hydration of salt.
- To measure the integral enthalpy of solution
- To determine the basicity of a diprotic acid

Course Outcomes (CO's)

It enables the students calculate

1. The heat capacity of a calorimeter
2. The enthalpy of neutrilisation,
3. Calculated the ionisation of solution.
4. Calculated the enthalpy of hydration of salt.
5. The integral enthalpy of solution
6. The basicity of a diprotic acid

Methodology

Calorimeters, thermometers,

Thermochemistry:

(a) Determination of heat capacity of a calorimeter for different volumes using (i) change ofenthalpy data of a known system (method of back calculation of heat capacity of calorimeterfrom known enthalpy of solution of sulphuric acid or enthalpy of neutralization), and (ii) heatgained equal to heat lost by cold water and hot water respectively

(b) Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

(c) Determination of the enthalpy of ionization of ethanoic acid.

(d) Determination of integral enthalpy (endothermic and exothermic) solution of salts.

(e) Determination of basicity of a diprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.

(f) Determination of enthalpy of hydration of salt.

(g) Study of the solubility of benzoic acid in water and determination of ΔH.

SuggestedReadings:

Text Books:

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

Reference Books:

2. Athawale, V. D. & Mathur, P. (2011). *Experimental Physical Chemistry*.New Delhi: New Age International.

Semester-II

16CHU212 S-BLOCK ANDP-BLOCK ELEMENTS PRACTICAL4H 2C

Instruction Hours/week:L: 0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course Objectives

The students have to be analyse

- The estimate the metal ions by iodimetric titrations
- The estimate the metal ions by complexemetric titrations using EDTA
- The carryout the preparations of inorganic metal complexes.
- Prepare cuprous chloride
- Prepare Manganese (III) phosphate
- Prepare potash alum and chrome alum.

Course Outcomes

The students have analyse

1. The iodometric titration methods.
2. The complexometric titration methods
2. The preparation the s and p-block metal complexes.
4. Preparation of cuprous chloride
5. Preparation of Manganese (III) phosphate
6. Preparation of potash alum and chrome alum.

Methodology

Iodimetric titrations, Complexometric titrations, Inorganic preperations.

(A) Iodo / Iodimetric Titrations

(i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodometrically).

(ii) Estimation of antimony in tartar-emetic iodimetrically

(B) Complexometric titrations using disodium salt of EDTA

(i) Estimation of Mg^{2+}, Zn^{2+}

(ii) Estimation of $Ca^{2+}$by substitution method

(C) Inorganic preparations

(i) Cuprous Chloride, Cu_2Cl_2

(ii) Manganese(III) phosphate, $MnPO_4.H_2O$

(iii) Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or
Chrome alum.

Suggested Readings

Text Books

1. Vogel, A.I. (1978). *A Textbook of Quantitative Inorganic Analysis*, ELBS.

Reference Books

2. Marr, G. and Rockett, R.W. (1972). *Practical Inorganic Chemistry,* Van Nostrand Reinhold.
3. Deepak Pant.P. (2010). *Inorganic Chemistry Practical*, BookRix.

Semester-II

16CHU 213 OXYGEN CONTAINING FUNCTIONAL GROUPS PRACTICAL **2H 1C**

Instruction Hours/week:L: 0 T:0 P:2 Marks: Internal:40 External: 60 Total:100

Course Objectives

The Students have a present knowledge

- To analyse the organic functional groups like alcohols, phenols carbonyl and carboxylic acid groups
- To demonstrate the preparations of organic compounds by acylation reactions
- To demonstate the preparations of organic compounds by benzyloation reactions.
- To carry out the iodoform reactions and selective reductions.
- To prepare semicarbazone derivatives of ketones
- To prepare S-Benzylisothiouronium salt of aromatic acids.

Course Outcomes

The student know to classifying the

1. Identification the organic functional groups like alcohols, phenols carbonyl and carboxylic acid groups
2. Preparation organic compounds by acylation reactions
3. Preparation organic compounds by benzoylation reactions.
4. Iodoform reactions and selective reductions.
5. Preparations semicarbazone derivatives of ketones
6. Preparations S-Benzylisothiouronium salt of aromatic acids.

Methodology

Laboratory experiments, acylation, benzyolation

1.Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.

2.Organic preparations:

i. Acetylation of one of the following compounds: amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and phenols (β -naphthol, vanillin, salicylic acid) by any one method:

a. Using conventional method.

b. Using green approach

ii. Benzolyation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-,p-anisidine) and one of the following phenols (β -naphthol, resorcinol, p- cresol)by Schotten-Baumann reaction.

iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).

iv. Selective reduction of meta dinitrobenzene to m-nitroaniline.

v. Hydrolysis of amides and esters.

vi. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone,

cyclohexanone, benzaldehyde.

vii. S-Benzylisothiouronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).

viii. Aldol condensation using either conventional or green method.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization and melting point.

SuggestedReadings

Text Books:

1. Mann, F.G. & Saunders, B.C.(2009). *Practical Organic Chemistry*. Pearson Education.
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. (2012). *Practical Organic Chemistry*. 5th Ed., Pearson.

Reference Books:

1. Ahluwalia, V.K. &Aggarwal, R. (2000).*Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*. University Press.
2. Ahluwalia, V.K. &Dhingra, S. (2000). *Comprehensive Practical Organic Chemistry: Qualitative Analysis*. University Press.

Semester-II

16AEC201 ENVIRONMENTAL STUDIES4H 4C

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal: 40 External: 60 Total:100

Course Objectives

It enables the students to

- The fundamental terms and definitions of environment
- Recall the Renewable and Non-renewable Resources.
- Quote the Biodiversity and Its Conservation
- Outline about Environmental Pollution
- Discuss the disaster management
- Discuss the Social Issues and the Environment

Course outcomes (CO's)

The students know about the explanation of

1. Fundamental terms and definitions of environment
2. Renewable and Non-renewable Resources.
3. Biodiversity and Its Conservation
4. Environmental Pollution
5. Gained knowledge about disaster management
6. Social Issues and the Environment

UNIT-I

Environment Definition, scope and importance, components, Ecosystem Definition, Concept, Scope, importance, Structure and functions of ecosystem. Energy flow, Ecological succession Food chains and food webs. Classification of ecosystem.

UNIT II: Natural Resources

Renewable and Non-renewable Resources:

Natural resources and associated problems. Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources : Use and over-utilization, exploitation. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. Fire accidents and prevention.

UNIT III: Biodiversity and Its Conservation

Introduction, definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT IV: Environmental Pollution

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution , Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Diaster management: Foods, earthquake, cyclone and landslides.

UNIT V: Social Issues and the Environment

From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rahabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions.Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation.Public awareness. Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health.

Suggested Readings:

Text Books

1.Tripathy.S.N. & Sunakar Panda. (2004). *Fundamentals of Environmental Studies*. 2nd Edition. New Delhi: Vrianda Publications Private Ltd.

2. Arvind Kumar .(2004). *A Textbook of Environmental Science*.New Delhi: APH Publishing Corporation.

3. Verma P.S., &.Agarwal. V.K.(2001). *Environmental Biology :Principles of Ecology.* New Delhi: S.Chand and Company Ltd.

Reference Books

1. Anubha Kaushik, C.P.&Kaushik, (2004). *Perspectives in Environmental Studies*. New Delhi: New Age International Pvt. Ltd. Publications.

2. Singh, M.P., Singh, B.S. & Soma S. Dey, (2004). *Conservation of Biodiversity and Natural Resources.*Delhi: Daya Publishing House.

3. Daniel B.Botkin & Edward A.Keller. (1995). *Environmental Science.* NewYork:John Wiley and Sons, Inc.

4. Uberoi, N.K., (2005). *Environmental Studies,*New Delhi, India: Excel Books Publications.

Semester-III

16CHU301 PHYSICAL CHEMISTRY III 4H 4C

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

The students should be able

- To illustrate the phase equilibrium.
- Understand the Clacius-Clapeyron equation and its applications.
- To explain the theory behind three component systems
- To summarize about electrochemical cells and EMF measurements
- To discuss the applications of EMF measurements
- To contrast the fundamentals of surface chemistry

Course Outcomes

The students have gained knowledge to summarise

1. The concept of Phase equilibria and phase diagrams
2. Understood the Clacius-Clapeyron equation and its applications.
3. About three component systems and their characteristic properties
4. Different types of electrochemical cells and EMF measurements
5. Applictions of EMF measurements in determining thermodynamic properties
6. The basics of surface chemistry.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Phase Equilibria: Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and itsapplications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for onecomponent systems (H_2O and S), with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points.

UNIT II

Three component systems: triangular plots, water-chloroform-acetic acid system. Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and non ideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.

UNIT III

Electrochemical Cells: Rules of oxidation/reduction of ions based on half-cell potentials,applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells.

UNIT IV

Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb_2O_3 electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

UNIT V

Surface chemistry: Physical adsorption, chemisorption, adsorption isotherms (Langmuir and Freundlich). nature of adsorbed state. Qualitative discussion of BET.

Suggested Readings:

Text Books:

1. Peter Atkins & Julio De Paula.(2010).*Physical Chemistry*. 9th Ed. Oxford University Press.
2. Castellan, G. W. (2004).*Physical Chemistry*. 4th Ed. Narosa
3. McQuarrie, D. A. & Simon, J. D. (2004).*Molecular Thermodynamics*. New Delhi : Viva Books Pvt. Ltd. • Engel, T. & Reid, P.(2012).*Physical Chemistry.* 3rd Ed. Prentice-Hall

Reference Books

1. Assael, M. J., Goodwin, A. R. H., Stamatoudis, M., Wakeham, W. A. & Will, S. (2011). *CommonlyAsked Questions in Thermodynamics*. NY : CRC Press.
2. Zundhal, S.S. (2011). *Chemistry concepts and applications*. Cengage India • Ball, D. W. (2012). *Physical Chemistry*. Cengage India.
3. Mortimer, R. G. (2009).*Physical Chemistry*. 3rd Ed. Elsevier: NOIDA, UP.
4. Levine, I. N. (2011).*Physical Chemistry*. 6th Ed. Tata McGraw-Hill.
5. Metz, C. R. (2009).*Physical Chemistry*. 2nd Ed. Tata McGraw-Hill.

Semester-III

16CHU302 INORGANIC CHEMISTRY III

(Coordination Chemistry) 4H 4C

Instruction Hours/week:L:40 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

The students should be able

- To discuss the key features of coordination compounds,
- Understand the nomenclature, isomerism and types in coordination compounds.
- To describe thevarious theories to explain the characteristics of coordination compounds.
- To contrast the nature of transition elements and their compounds.
- To contrast about the occurrence, preparation and properties of Lanthanides and actinides.
- To discuss about the fundamentals of Inorganic reaction mechanisms.

Course Outcomes

The students have gained knowledge to summarise

1. Recognise the role played by transition metal complexes play in Inorganic Chemistry.
2. Understood the nomenclature, isomerism and types in coordination compounds.
3. Describe the structure and bonding theories, electronic and magnetic properties of the transition metal complexes and their kinetic studies.
4. Explain the theories of bonding in coordination compounds and their experimental behaviour.
5. Recognise and explain the interaction of metal ions with biological ligands.
6. Explain the role of Inorganic "substances" in living systems and the use of metal ions in medicinal therapy and diagnosis

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Coordination Chemistry:

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

UNIT II

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.

UNIT III

Transition Elements:

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states

and e.m.f. (Latimer diagrams) Different between the first, second and third transition series. Chemistry of Cr, Mn, Fe and Co in various oxidation states with special reference to the following compounds: peroxo compounds of chromium, potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite.

UNIT IV

Lanthanoids and Actinoids:

Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

UNIT V

Inorganic Reaction Mechanism

Introduction to inorganic reaction mechanisms. Substitution reactions in square planarcomplexes, Trans- effect, theories of trans effect. Thermodynamic and Kinetic stability.

Suggested Readings

Text Books:

1. Purcell, K.F & Kotz, J.C. (1980).*An Introduction toInorganic Chemistry.*W.B. Saunders Co.
2. Huheey, J.E. (1993).*Inorganic Chemistry*. Prentice Hall.

Reference Books

1. Cotton, F.A. & Wilkinson, G. (1999).*Advanced Inorganic Chemistry.*Wiley-VCH.
2. Greenwood, N.N. & Earnshaw A. (2006).*Chemistry of the Elements*. Butterworth-Heinemann.
3. Miessler, G. L. &. Tarr, Donald A. (2009).*Inorganic Chemistry.* 3rd Ed.(adapted),Pearson.

Semester-III

16CHU303 ORGANIC CHEMISTRY III 4H 4C

(Nitrogen Containing Functional Groups, Heterocyclic chemistry and natural products)

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

CourseObjectives

The students should be able

- To contrast the preparation and properties of compounds with nitrogen containing functional groups.
- Understand the preparation and properties of diazoniumsalts.
- Learn about polynuclear hydrocarbons,
- Know about five, six and fused membered heterocyclic compounds.
- To discuss the preparation and reactions of alkaloids
- To discuss the preparation and reactions of terpenes.

CourseOutcomes

The students have summarise

1. The preparation and properties of compounds with nitrogen containing functional groups.
2. Understood the preparation and properties of diazonium salts.
3. Learned about the polynuclear hydrocarbons.
4. Knowledge about five, six and fused membered heterocyclic compounds.
5. The preparation and reactions of alkaloids
6. The preparation and reactions of terpenes.

Methodology

Blackboard teaching, Power point presentation and group discussion.

UNIT I

Nitrogen Containing Functional Groups

Preparation and important reactions of nitro compounds, nitriles and isonitriles.

Amines: Preparation and properties: Effect of substituent and solvent on basicity; Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.

UNIT II

Diazonium Salts: Preparation and their synthetic applications.

Polynuclear Hydrocarbons

Aromaticity of polynuclear hydrocarbons, structure elucidation of naphthalene; Preparation and properties of naphthalene, phenanthrene and anthracene.

UNIT III

Heterocyclic Compounds

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis),

UNIT IV

Indole(Fischer indole synthesis and Madelung synthesis), Quinoline and isoquinoline, (Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner- Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction)

UNIT V

Alkaloids

Natural occurrence, General structural features, Isolation and their physiological action, Hoffmann's exhaustive methylation, Emde's modification; Structure elucidation and synthesis of Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

Terpenes

Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral.

SuggestedReadings

Text Books:

1. Morrison, R. T. & Boyd, R. N.(1992). *Organic Chemistry*. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. (2002).*Organic Chemistry*. Volume 1. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Reference Books

1. Finar, I. L.(2002).*Organic Chemistry*: *Stereochemistry and the Chemistry of Natural Products*. Volume 2. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Acheson, R.M. (1976). *Introduction to the Chemistry of Heterocyclic compounds*. John Welly& Sons.
3. Graham Solomons, T.W.(2012).*Organic Chemistry*. John Wiley & Sons, Inc.
4. Kalsi, P. S.(2009).*Textbook of Organic Chemistry*. 1st Ed. New Age International (P) Ltd. Pub.
5. Clayden, J., Greeves, N., Warren, S. & Wothers, P.(2012).*Organic Chemistry*. Oxford University Press.
6. Singh, J.; Ali, S.M. & Singh, J. (2010).*Natural Product Chemistry*. PrajatiParakashan.

Semester-III

16CHU311 PHASE EQUILIBRIA AND CHEMICAL KINETICS4H 2C PRACTICAL

Instruction Hours/week:L: 0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course Objectives

It enables the students to Paraphrase the

- To Determine of critical solution temperature (CST) and
- To Determine of eutectic temperature
- To Determine distribution coefficients of two immisible solutions.
- To construct of the phase diagram using cooling curves or ignition tube method: a. simple eutectic and b. congruently melting systems.
- To apply their knowledge in Potentiometry to laboratory.
- To perform the potentiometric titrations.

Course Outcomes

The students able to determine,

1. Apply their knowledge in Phase equilibria
2. Determination of critical solution temperature (CST) and
3. Determination of eutectic temperature
4. Determination distribution coefficients of two immisible solutions.
5. Apply their knowledge in Potentiometry to laboratory.
6. Perform the titrations potentiometrically.

Methodology

Potentiometer, electrochemical experiments

Phase Equilibria:

I. Determination of critical solution temperature and composition at CST of the phenolwater system and to study the effect of impurities of sodium chloride and succinic acid on it.

II. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method: a. simple eutectic and b. congruently melting systems.

III. Distribution of acetic/ benzoic acid between water and chloroform or cyclohexane.

IV. Study the equilibrium of at least one of the following reactions by the distribution method:

(i) $I_2(aq) + I^-(aq) \rightarrow I_3(aq)$

(ii) $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n^{2+}$

Potentiometry:

V. Perform the following potentiometric titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base iii. Dibasic acid vs. strong base iv. Potassium dichromate vs. Mohr's salt

SuggestedReadings

Text Books:

1. Khosla, B. D., Garg, V. C. & Gulati, A. (2011). *Senior Practical Physical Chemistry*.25. New Delhi: R. Chand& Co.
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. (2003).*Experiments in Physical Chemistry*. 8th Ed. McGraw-Hill: New York.

Reference Books

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

Semester-III

16CHU312 COORDINATION CHEMISTRY PRACTICAL 4H 2C

Instruction Hours/week:L: 0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course Objectives

- Explain the principle of gravimetric analysis
- To estimate the amount of nickel present in the NiDMG
- Prepare coordination complexes
- To measure the 10Dq by spectrophotometrically.
- Justify the properties of coordination complexes
- To synthesise the ligand transfer reaction by substitution method.

Course outcomes

The students have to

1. Determine metals like Ni, Cu and Fe using the principle of gravimetric analysis
2. Estimate the amount of nickel present in the NiDMG
3. Prepare coordination complexes
4. Measurement of 10 Dq by spectrophotometric method
5. Justify the properties of coordination complexes
6. Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g.bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

Methodology

Precipitation and estimation, preparation of complexes, Measurement of properties

Gravimetric Analysis:

i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
ii. Estimation of copper as CuSCN
iii. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
iv. Estimation of Al(III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminium oxinate).

Inorganic Preparations:

i. Tetraamminecopper (II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$
ii. Acetylacetonate complexes of Cu^{2+}/Fe^{3+}
iii. Tetraamminecarbonatocobalt (III) nitrate
iv. Potassium tri(oxalato)ferrate(III)

Properties of Complexes

i. Measurement of 10 Dq by spectrophotometric method
ii. Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

Suggested Readings

TextBook

1. Vogel, A.I. (2002).*A text book of Quantitative Analysis*. ELBS.

Reference Book

1. Marr, G. & Rockett, B.W. (1972).*Practical Inorganic Chemistry*. Van Nostrand Reinhold.

Semester-III

16CHU313 NITROGEN CONTAINING FUNCTIONAL GROUPS, 4H 2C HETEROCYCLICCHEMISTRY AND NATURAL PRODUCTS PRACTICAL

Instruction Hours/week:L: 0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course Objective

This course enables the student to

- Identify the presence of nitro
- Identify the presence of amine
- Identify the presence of amide groups
- Identify functional groups like alcohols.
- Identify functional groups of carboxylic acids.
- Identify the functional groups like phenols , carbonyl compounds and esters

Course Outcome

The students have analyse the

1. Functional group tests for nitrogen containing organic compounds
2. Identification of nitro group
3. Identification of amine group
4. Identification of amide
5. Tests used in the Identification of functional groups like alcohols, carboxylic acids
6. Identification of phenols , carbonyl compounds and esters

Methodology

Qualitative analysis of organic compounds

1.Functional group test for nitro, amine and amide groups.

2.Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols , carbonyl compounds and esters)

SuggestedReadings

Text Books:

1. Mann, F.G. & Saunders, B.C.(2009). *Practical Organic Chemistry*. Pearson Education
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. (2012). *Practical Organic Chemistry*.5th Ed. Pearson.
3. Ahluwalia, V.K. &Aggarwal, R.(2000).*Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*. University Press

Reference Books

1. Ahluwalia, V.K. &Dhingra, S. (2000).*Comprehensive Practical Organic Chemistry: QualitativeAnalysis*. University Press.

Semester-III

16CHU304A PHARMACEUTICAL CHEMISTRY 3H 3C

Instruction Hours/week:L:03 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

The course enables the students to

- Perform the drug discovery process.
- To utalize the software to predict the ADMET.
- Build the synthesis of analgesic, antipyretic, anti-inflammatory agents
- Build the synthetic process of Central Nervous System and cardiovascular drugs.
- Restate the fermentation process
- Modify to prepare antibiotics and related compounds.

Course Outcome

The students have knowledge to create about the

1. Drug discovery
2. Utalization of the software using prediction of ADMET
3. Procedures to prepare analgesic, antipyretic, anti-inflammatory agents
4. Synthesis of Central Nervous System and cardiovascular drugs.
5. Fermentation process and preparation of antibiotics.
6. Modified the preparation of antibiotics and related compounds

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT 1

Drug discovery, design and development; Basic Retrosynthetic approach.

UNIT II

Synthesis of the representative drugs of the following classes: analgesic agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir),

UNIT III

Synthesis of the representative drugs of the following classes: Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

Fermentation

UNIT IV

Aerobic and anaerobic fermentation. Production of Ethyl alcohol and citric acid,

UNIT V

Production of (i) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Suggested Readings

Text Books:

1. Patrick, G.L.(1995). *Introduction to Medicinal Chemistry*.65. UK: Oxford University Press
2. Hakishan, V.K. Kapoor,(1996). *Medicinal and Pharmaceutical Chemistry*, New Delhi: Vallabh Prakashan. Pitampura.

Reference Books

1. William O. Foye, Thomas L., Lemke & David A. William.(2008).*Principles of MedicinalChemistry*. New Delhi: B.I. Waverly Pvt. Ltd.

Semester-III

16CHU304B IT SKILLS FOR CHEMISTS3H 3C

Instruction Hours/week: L:3 T:0 P:0Marks: Internal: 40 External: 60 Total:100

Course Objectives

The course enables the student to gain knowledge in the mathematics and computer science to

- Interpret the Uncertainty in experimental techniques
- Statistical treatment
- Error analysis
- Summarise the types of algeberic operations
- Explain computer programming and to handle numeric data
- Illustrate the numerical modelling

Course Outcomes

1. Interpret the Uncertainty in experimental techniques and Statistical treatment
2. Under stood the knowledge of error analysis.
3. Formulate a set of calculations that can address a relevant research question;
4. Use one or several computer programs and extract useful information;
5. Write a research paper that describes methods, results, and interpretation;
6. Assess the meaning and validity of calculations that appear in the chemical literature

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Mathematics

Fundamentals, mathematical functions, polynomial expressions, logarithms, the exponential function, units of a measurement, interconversion of units, constants and variables, equation of a straight line, plotting graphs. Uncertainty in experimental techniques: Displaying uncertainties, measurements in chemistry, decimal places, significant figures, combining quantities. Uncertainty in measurement: types of uncertainties, combining uncertainties. Statistical treatment. Mean, standard deviation, relative error. Data reduction and the propagation of errors. Graphical and numerical data reduction. Numerical curve fitting: the method of least squares (regression).

UNIT II

Algebraic operations on real scalar variables (e.g. manipulation of Van der Waals equation in different forms).Roots of quadratic equations analytically and iteratively (e.g. pH of a weak acid). Numerical methods of finding roots (Newton-Raphson, binary –bisection, e.g. pH of a weak acid not ignoring the ionization of water, volume of a van der Waals gas, equilibrium constant expressions). Differential calculus: The tangent line and the derivative of a function, numerical differentiation (e.g., change in pressure for small change in volume of a Van der Waals gas, potentiometric titrations). Numerical integration (Trapezoidal and Simpson's rule, e.g. entropy/enthalpy change from heat capacity data).

UNIT III

Computer programming:

Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages. Debugging. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis.

UNIT IV

Introductory writing activities: Introduction to word processor and structure drawing (ChemSketch) software. Incorporating chemical structures, chemical equations, expressions from chemistry (e.g. Maxwell-Boltzmann distribution law, Bragg's law, van der Waals equation, etc.) into word processing documents.

Handling numeric data: Spreadsheet software (Excel), creating a spreadsheet, entering and formatting information, basic functions and formulae, creating charts, tables and graphs. Incorporating tables and graphs into word processing documents. Simple calculations, plotting graphs using a spreadsheet (Planck's distribution law, radial distribution curves for hydrogenic orbitals, gas kinetic theory- Maxwell-Boltzmann distribution curves as function of temperature and molecular weight), spectral data, pressure-volume curves of van der Waals gas (van der Waals isotherms), data from phase equilibria studies. Graphical solution of equations.

UNIT V

Numeric modelling: Simulation of pH metric titration curves. Excel functions LINEST and Least Squares. Numerical curve fitting, linear regression (rate constants from concentrationtime data, molar extinction coefficients from absorbance data), numerical differentiation (e.g. handling data from potentiometric and pH metric titrations, pKa of weak acid), integration (e.g. entropy/enthalpy change from heat capacity data).

Statistical analysis: Gaussian distribution and Errors in measurements and their effect on data sets. Descriptive statistics using Excel.

Suggested Readings

Text Books:

1. McQuarrie, D. A. (2008). *Mathematics for Physical Chemistry*. University Science Books
2. Mortimer, R.(2005). *Mathematics for Physical Chemistry*. 3rdEd. Elsevier
3. Steiner, E. (1996). *The Chemical Maths Book*. Oxford University Press.
4. Yates, P.(2007). *Chemicalcalculations.* 2nd Ed. CRC Press.
5. Harris, D. C. (2007). *Quantitative Chemical Analysis*. 6th Ed. Freeman Chapters 3-5.

Reference Books

1. Levie, R. de. (2001). *How to use Excel in analytical chemistry and in general scientific data Analysis*. Cambridge Univ. Press 487 pages.
2. Noggle, J. H. (1985).*Physical chemistry on a Microcomputer.* Little Brown & Co.
3. Venit, S.M. (1996).*Programming in BASIC: Problem solving with structure and style*. Delhi :Jaico Publishing House.

Semester-III

16CHU314A PHARMACEUTICAL CHEMISTRY PRACTICAL 3H 1C

Instruction Hours/week:L:0 T:0 P:03 Marks: Internal:40 External: 60 Total:100

Course Objective

The course enables the student to

- Develop the synthesis of pharmaceutical drugs like aspirin
- Synthesis of magnesium bisilicate.
- Determine the melting point of aspirin
- Spectral characterization of aspirin
- Determine the melting point of antacid
- Spectral characterization of antacid

Course Outcome

The students restate the

1. Synthesis of pharmaceutical drugs like aspirin
2. Synthesis of magnesium bisilicate.
3. Determination of the melting point of aspirin
4. Spectral characterization of aspirin
5. Determine the melting point of antacid
6. Spectral characterization of antacid

Methodology

Practicals

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).

Suggested Readings

Text Books:

1. Patrick G.L. (1995): Introduction to *Medicinal Chemistry.* UK:Oxford UniversityPress.
2. Hakishan, V.K. Kapoor, (1996)*Medicinal and Pharmaceutical Chemistry*.New Delhi: VallabhPrakashan. Pitampura.

Reference Books

1. William O. Foye, Thomas L., Lemke ,& David A. William.(2008).*Principles of MedicinalChemistry*. New Delhi: B.I. Waverly Pvt. Ltd.

Semester-III

16CHU314B IT SKILLS FOR CHEMISTS PRACTICAL3H 1C

Instruction Hours/week: L:0 T:0 P:3Marks: Internal: 40 External: 60 Total:100

Course Objectives

The course enables the student to

- Describe the rules and the methods to be followed in the computer programming.
- Describe the basic programme of curve fitting
- Describe the numerical differentiation and intergration.
- Interpret Statistical analysis of the numeric data.
- Draw the chemical structure using software
- Understand the statistical significance testing.

Course Outcome

The students have to explained the

1. The rules and the methods to be followed in the computer programming.
2. the basic programme of curve fitting
3. The numerical differentiation and intergration.
4. Interpretion of Statistical analysis of the numeric data.
5. Draw the chemical structure using software
6. Under stood the statistical significance testing.

Methodology

Computer programming, Chem draw or related softwares.

BASIC programs for curve fitting, numerical differentiationand integration (Trapezoidal rule, Simpson's rule), finding roots (quadratic formula, iterative, Newton-Raphson method).
Structure drawing software.

Statistical significance testing: The *t* test. The *F* test.

Presentation: Presentation graphics

SuggestedReadings

Text Books:

1. McQuarrie, D. A.(2008). *Mathematics for Physical Chemistry*. University Science Books
2. Mortimer, R. (2005).*Mathematics for Physical Chemistry*. 3rdEd. Elsevier.
3. Steiner, E. (1996).*The Chemical Maths Book.* Oxford University Press. Yates, P.(2007)*Chemical calculations*. 2ndEd. CRC Press.
4. Harris, D. C. (2007). *Quantitative Chemical Analysis*. 6th Ed. Freeman Chapters 3-5.

Reference Books

1. Levie, R. de. (2001). *How to use Excel in analytical chemistry and in general scientific data analysis*, Cambridge Univ. Press 487 pages.
2. Noggle, J. H.(1985).*Physical chemistry on a Microcomputer.* Little Brown & Co.
3. Venit, S.M. (1996).*Programming in BASIC: Problem solving with structure and style*. Delhi : Jaico Publishing House.

Semester-IV

16CHU401 PHYSICAL CHEMISTRY IV(Electrochemistry) 4H 4C

Instruction Hours/week:L:4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

The course enables the students to

- Explain the types of conductance measurements and the factors affecting it
- Describe the ionic mobilities and the applications of conductance measurements
- Discuss the order and molecularity of reactions and the integrated rate expressions for different types of first order reactions.
- To knowledge about chemical kinetics
- Summarize the fundamentals of catalysis
- Restate the fundamentals of photochemistry.

Course Outcome

The students have to restated

1. The types of conductance measurements and the factors affecting it.
2. The ionic mobilities and the applications of conductance measurements
3. The order and molecularity of reactions and the integrated rate expressions for different types of first order reactions.
4. Gained knowledge about chemical kinetics.
5. The fundamentals of catalysis
6. The fundamentals of photochemistry.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Conductance: Quantitative aspects of Faraday's laws of electrolysis Arrhenius theory ofelectrolytic dissociation. Conductivity, equivalent and molar conductivity and their variationwith dilution for weak and strong electrolytes. Molar conductivity at 29 infinite dilution.Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect,Debye-Falkenhagen effect, Walden's rules.

UNIT II

Ionic velocities, mobilities and their determinations,transference numbers and their relation to ionic mobilities, determination of transferencenumbers using Hittorf and Moving Boundary methods. Applications of conductancemeasurement: (i) degree of dissociation of weak

electrolytes, (ii) ionic product of water (iii)solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v)hydrolysis constants of salts.

UNIT III

Chemical Kinetics: Order and molecularity of a reaction, rate laws in terms of the advancementof a reaction, differential and integrated form of rate expressions up to second order reactions,experimental methods of the determination of rate laws, kinetics of complex reactions (integratedrate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii)consecutive reactions and their differential rate equations (steady-state approximation in reactionmechanisms) (iv) chain reactions.

Unit IV

Temperature dependence of reaction rates; Arrheniusequation; activation energy. Collision theory of reaction rates, Lindemann mechanism,qualitative treatment of the theory of absolute reaction rates.
Catalysis: Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Unit V
Photochemistry: Characteristics of electromagnetic radiation, Lambert-Beer's law and itslimitations, physical significance of absorption coefficients. Laws, of photochemistry, quantumyield, actinometry, examples of low and high quantum yields, photochemical equilibrium and thedifferential rate of photochemical reactions, photosensitised reactions, quenching. Role of
photochemical 34 reactions in biochemical processes, photostationary states,chemiluminescence.

Suggested Readings
Text Books:

1. Atkins, P.W & Paula, J.D.(2011).*Physical Chemistry*. 9th Ed. Oxford University Press.
2. Castellan, G. W.(2004).*Physical Chemistry*. 4th Ed. Narosa.
3. Mortimer, R. G. (2009).*Physical Chemistry*. 3rd Ed. Elsevier: NOIDA, UP.
4. Barrow, G. M.(2006). *Physical Chemistry*. 5th Ed. New Delhi : Tata McGraw Hill.

Reference Books

1. Engel, T. & Reid, P. (2012). *Physical Chemistry*. 3rd Ed. Prentice-Hall.
2. Rogers, D. W. (2010).*Concise Physical Chemistry*. Wiley.
3. Silbey, R. J., Alberty, R. A. & Bawendi, M. G. (2005).*Physical Chemistry*. 4th Ed. John Wiley & Sons,Inc.

Semester-IV

16CHU402 INORGANIC CHEMISTRY IV(Organometallic Chemistry)4H 4C

Instruction Hours/week:L:4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

This course enables the student to discuss

- The Theoretical Principles in Qualitative Analysis to identify the cations and anions
- The classification of organometallic compounds based on bond type
- The few important metal complexes of commercial importance
- About 18 electron rule
- The catalytic property of organometallic compounds.
- The Metal ions present in biological systems

Course Outcome

The student have discussed

1. The Theoretical Principles in Qualitative Analysis to identify the cations and anions
2. The classification of organometallic compounds based on bond type
3. Few important metal complexes of commercial importance
4. About 18 electron rule
5. The catalytic property of organometallic compounds.
6. The Metal ions present in biological systems

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Theoretical Principles in Qualitative Analysis (H_2S Scheme)

Basic principles involved in analysis of cations and anions. Solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

UNIT II

Organometallic Compounds

Definition and classification of organometallic compounds on the basis of bond type.

Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

UNIT III

Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls. Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene.

UNIT IV

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine, Cisplatin as an anti-cancer drug.

Iron and its application in bio-systems, Haemoglobin, Myoglobin; Storage and transfer of iron.

UNIT V

Catalysis by Organometallic Compounds

Study of the following industrial processes and their mechanism:

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

Suggested Readings

Text Books:

1. Cotton, F.A., Wilkinson, G., & Gaus, P.L.(1993). *Basic Inorganic Chemistry*.3rd Ed. Wiley India.
2. Huheey, J. E., Keiter, E.A. & Keiter, R.L. (2006). *Inorganic Chemistry: Principles ofStructure and Reactivity*. 4th Ed.Harper Collins.Pearson.
3. Sharpe, A.G. (2005). *Inorganic Chemistry*, 4th Indian Reprint. Pearson Education.
4. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J.(1994).*Concepts and Models in Inorganic Chemistry*. 3rdEd.NY*:*John Wiley and Sons.
5. Greenwood, N.N. & Earnshaw, A. (1997). *Chemistry of the Elements*.2nd Ed, Elsevier, (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
6. Lee, J.D. (2008). *Concise Inorganic Chemistry*.5th Ed.John Wiley and sons.

Reference Books

1. Powell, P. (1988). *Principles of Organometallic Chemistry*, Chapman and Hall.
2. Shriver, D.D., Atkins, P. and Langford, C.H. (1994).*Inorganic Chemistry*.2nd Ed. OxfordUniversity Press.
3. Miessler, G. L. & Tarr, Donald A. (2010).*Inorganic Chemistr.* 4th Ed.Pearson.
4. Crabtree, Robert H. (2000). *The Organometallic Chemistry of the Transition Metals*.NY: John Wiley New York.
5. Spessard, Gary O., & Miessler, Gary L. (1996). *Organometallic Chemistry*. Upper SaddleRiver, NJ: Prentice-Hall.

Semester-IV

16CHU403 ORGANIC CHEMISTRY IV(Organic spectroscopy)4H 4C

Instruction Hours/week:L:4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

This course enables the students to

- Discuss the principle and the theory behind the UV spectroscopy.
- Discuss the principle and the theory behind the IR spectroscopy.
- Explain the principle and the theory behind the NMR spectroscopy.
- Summarize about the occurrence, classification and their biological importance carbohydrates
- Justify about the classification of dyes.
- Justify about polymers and their types, prepartion and uses.

Course Outcome

The Student have gained knowledge about

1. The principle and the theory behind the UV spectroscopy.
2. The principle and the theory behind the IR spectroscopy.
3. The principle and the theory behind the NMR spectroscopy.
4. The occurrence, classification and their biological importance carbohydrates
5. The classification of dyes
6. Preparation ,types, properties and uses of polymers.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT 1

Organic Spectroscopy

General principles to absorption and emission spectroscopy.

UV Spectroscopy: Types of electronic transitions, λ_{max}, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems: α,β-unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

UNIT II

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in

functional group analysis.

UNIT III

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpetation of NMR spectra of simple compounds.
Applications of IR, UV and NMR for identification of simple organic molecules.

UNIT IV

Carbohydrates

Occurrence, classification and their biological importance.
Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani- Fischer synthesis and Ruff degradation;
Disaccharides – Structure elucidation of maltose, lactose and sucrose.
Polysaccharides – Elementary treatment of starch, cellulose and glycogen.

UNIT V

Dyes

Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing;
Synthesis and applications of: Azo dyes – Methyl orange; Triphenyl methane dyes - Malachite green and Rosaniline ; Phthalein Dyes – Phenolphthalein; Natural dyes – structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.

Polymers

Introduction and classification including di-block, tri-block and amphiphilic polymers;
Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes;
Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene); Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction
to; Biodegradable and conducting polymers with examples.

Suggested Readings

Text Book:

1. Kalsi, P. S.(2009).*Textbook of Organic Chemistry*. 1st Ed. New Age International (P) Ltd. Pub.
2. Morrison, R. T. & Boyd, R. N.(1992).*Organic Chemistry*. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Billmeyer, F. W.(1984).*Textbook of Polymer Science*. John Wiley & Sons, Inc.
4. Gowariker, V. R., Viswanathan, N. V. &Sreedhar, J.(2003).*Polymer Science*. New Age

International (P) Ltd. Pub.

Reference Books

1. Finar, I. L.(2002). *OrganicChemistry: Stereochemistry and the Chemistry of Natural Products.*Volume 2. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Clayden, J., Greeves, N., Warren, S. & Wothers, P.(2000).*Organic Chemistry*. Oxford University Press.
3. Singh, J.; Ali, S.M. & Singh, J. (2010).*Natural Product Chemistry*. PrajatiPrakashan.

Semester-IV

16CHU411 ELECTROCHEMISTRY PRACTICAL 4H 2C

Instruction Hours/week:L:0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course Objectives

This course enables the students to

- Perform in the conductance measurement,
- Determine of cell constant
- Determine the conductometric titrations
- Determine the kinetic aspects and rate measurements of different types of reactions.
- Determine the Acid hydrolysis of methyl acetate with hydrochloric acid.
- Determine the Saponification of ethyl acetate

Course Outcome

The Student have interpreted to

1. Measured the conductance
2. Determination of the cell constant
3. Determination of conductometric titrations
4. The kinetic aspects and rate measurements of different types of reactions.
5. Determination the Acid hydrolysis of methyl acetate with hydrochloric acid.
6. Determination of the Saponification of ethyl acetate

Methodology

Measurements with conductivity meters, reaction rate measurements

Conductometry:

I. Determination of cell constant

II. Determination of conductivity, molar conductivity, degree of dissociation and dissociation constant of a weak acid.

III. Perform the following conductometric titrations: i. Strong acid vs. strong base ii. Weakacid vs. strong base iii. Mixture of strong acid and weak acid vs. strong base iv. Strongacid vs. weak base

Chemical Kinetics:

IV. Study the kinetics of the following reactions.

1. Iodide-persulphate reaction (i) Initial rate method; (ii)Integrated rate method
2. Acid hydrolysis of methyl acetate with hydrochloric acid.
3. Saponification of ethyl acetate.
4. Comparison of the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis ofmethyl acetate.

Suggested Readings

Text Books:

1. Khosla, B. D., Garg, V. C. & Gulati, A. (2011).*Senior Practical Physical Chemistry*.New Delhi: R. Chand & Co.
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P.(2003).*Experiments in Physical Chemistry*.8th Ed. New York : McGraw-Hill

Reference Books

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

Semester-IV

16CHU412 ORGANOMETALLIC CHEMISTRY PRACTICAL 4H 2C

Instruction Hours/week:L:0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course Objectives

This lab course enables the student to

- Identify the anions and the cations in a mixture by Qualitative semimicro analysis
- Understand the chemistry of different reactions
- Identify the interfering anion
- Outline the principles behind the spot tests
- chromatographic separations
- Paper chromatographic separation of nickel and cobalt, copper and cadmium

Course Outcome

The students have

1. Identified the anions and the cations in a mixture by Qualitative semi micro analysis
2. Understood the chemistry of different reactions.
3. Identified the interfering anion
4. Define the principles behind the spot tests and
5. Define the Principles of chromatographic separations
6. Paper chromatographic separation of nickel and cobalt, copper and cadmium

Methodology

Qualitative semimicro analysis

Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

CO_3^{2-}, NO^{2-}, S^{2-}, SO_3^{2-},$S_2O_3^{2-}$, CH_3COO^-, F^-,Cl^-, Br^-, I-, NO^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH^{4+}, K^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}

Mixtures should preferably contain one interfering anion, **or** insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2or Al_2O_3) **or** combination of anions e.g. $CO_3^{2-}$and SO_3^{2-}, NO_2-and NO_3^-, Cl-and Br-Cl-and I-, Br-and I, $NO_3^-$and Br^-, $NO_3^-$and I^-

Spot tests should be done whenever possible.

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

i. Ni (II) and Co (II)

ii. Cu(II) and Cd(II)

Suggested Reading

1. Svehla,G. (1996)Vogel's*Qualitative Inorganic Analysis*, Longman, New York.

Semester-IV

16CHU413 ORGANIC SPECTROSCOPY PRACTICAL 4H 2C

Instruction Hours/week:L:0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course objectives

The student will able to develop and identify the

- Extraction caffeine from tea leaves.
- Preparation urea formaldehyde resin
- Qualitative analysis of unknown organic compounds
- Simple organic compounds by IR spectroscopy
- Simple organic compounds by NMR spectroscopy
- Preparation of methyl orange

Course outcome

The students have to catagorize and demonstrate

1. About the Extraction of caffeine from tea leaves.
2. The Preparation of urea formaldehyde resin
3. The qualitative analysis of unknown organic compounds
4. Identify simple organic compounds by IR spectroscopy
5. Identify simple organic compounds by NMR spectroscopy
6. The Preparation of methyl orange

Methodology

Spectroscopic methods UV, IR and NMR

1.Extraction of caffeine from tea leaves.

2.Preparation of urea formaldehyde resin.

3.Qualitative analysis of unknown organic compounds containing monofunctional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, e.g. salicylic acid, cinnamic acid, nitrophenols etc.

4.Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).

5.Preparation of methyl orange.

Suggested Readings

Text Books:

1. Vogel, A.I. (2012).*Quantitative Organic Analysis*. Part 3. Pearson.
2. Mann, F.G. & Saunders, B.C. (2009). *Practical Organic Chemistry*. Pearson Education
3. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. &Tatchell, A.R. (2012). *Practical Organic Chemistry*. 5th Ed. Pearson.

Reference Books

1. Ahluwalia, V.K. &Aggarwal, R. (2000*). Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis.* University Press.
2. Ahluwalia, V.K. &Dhingra, S. (2000).*Comprehensive Practical Organic Chemistry: QualitativeAnalysis*. University Press.

Semester-IV

16CHU404A GREEN METHODS IN CHEMISTRY 3H 3C

Instruction Hours/week:L:3 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course objectives

This course enables the students to

- Summarize the twelve principles of green chemistry
- To know the special emphasis of an atom economy.
- Explain the catalysis and alternate sources of energy.
- Describe the process involved in the real word cases likeSurfactants for CO_2
- Synthetic azo pigments to replace toxic organic and inorganicpigments.
- Determination of environmentally safe marine antifoulant and plastic (poly lactic acid) made from corn.

Course outcome

1. Recognise the impact of green chemistry on human health and the environment.
2. Knowledge about the special emphasis of an atom economy.
3. Demonstrate the knowledge of the twelve principles of Green Chemistrywhich they can apply to a range of work places for a safer, less toxic and heal thier environment.
4. Described the process involved in the real word cases likeSurfactants for CO_2
5. Synthetic azo pigments to replace toxic organic and inorganicpigments.
6. Determination of environmentally safe marine antifoulant and plastic (poly lactic acid) made from corn.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Theory and Hand-on Experiments

Introduction: Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity, green solvents,

UNIT II

Green Chemistry and catalysis and alternative sources of energy, Green energy and sustainability

UNIT III

The following Real world Cases in Green Chemistry should be discussed:

Surfactants for carbon dioxide – Replacing smog producing and ozone depletingsolvents with CO2 for precision cleaning and dry cleaning of garments.

UNIT IV

Designing of environmentally safe marine antifoulant.

Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganicpigments.

UNIT V

An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid) made from corn.

Suggested Readings

Text Books:

1. Anastas, P.T. & Warner, J.K. (2005).*Green Chemistry- Theory and Practical*. Oxford University Press.
2. Matlack, A.S. (2001).*Introduction to Green Chemistry*. Marcel Dekker.

Reference Books

1. Cann, M.C. & Connely, M.E. (2000). *Real-World cases in Green Chemistry,* American Chemical Society. Washington.

Semester-IV

16CHU404B ANALYTICAL CLINICAL BIOCHEMISTRY3H 3C

Instruction Hours/week: L:3 T:0 P:0Marks: Internal: 40 External: 60 Total:100

Course objectives

This course enables the student to

- Classify the basic structure of carbohydrates, and fermentation processes.
- Classification and biological importance of Proteins.
- Classification and biological importance of lipids.
- Properties, functions and biochemical functions of steroid hormones
- Know the about enzyme ,classification , mechanism and factors affectingenzyme activity.
- Identify the biochemistry of diseases.

Courseoutcome

The students have knowledge to categorize

1. The basic structure of carbohydrates.
2. Classification and biological importance of Proteins.
3. Classification and biological importance of lipids.
4. Properties, functions and biochemical functions of steroid hormones
5. Knowledge about enzyme, classification, mechanism and factors affectingenzyme activity.
6. The biochemistry of diseases.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

Unit I

Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle.
Isolation and characterization of polysachharides.

Unit II

Proteins: Classification, biological importance; Primary and secondary and tertiary structures of proteins: α-helix and β- pleated sheets, Isolation, characterization, denaturation of proteins.
Enzymes: Nomenclature, Characteristics (mention of Ribozymes), Classification; Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in "Green Chemistry" and Chemical Industry.

Unit III

Lipids: Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications.

Lipoproteins.

Unit IV

Properties, functions and biochemical functions of steroid hormones.
Biochemistry of peptide hormones.
Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy.
Enzymes: Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition.

Unit V

Biochemistry of disease: A diagnostic approach by blood/ urine analysis.
Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.
Urine: Collection and preservation of samples. 6. Formation of urine. Composition and estimation of constituents of normal and pathological urine.

Suggested Readings

Text Books:

1. Cooper, T.G. (1977). *Tool of Biochemistry.* John Wiley and Sons.
2. Keith Wilson & John Walker.(1994).*Practical Biochemistry*. Cambridge University Press.
3. Alan H Gowenlock,(2005). Varley's.*Practical Clinical Biochemistry*.CBS Publisher.
4. Thomas M. Devlin.(2009).*Textbook of Biochemistry*. Academic Internet Publishers.
5. Berg, J.M., Tymoczko, J.L. & Stryer, L.(2002).*Biochemistry*. W.H. Freeman.

Reference Books

1. Nelson, D. L. & Cox, M. M.(2008).*Lehninger's Principles of Bioch*emistry. 7th Ed.W. H. Freeman.
2. Harwood. (1990). *Series on Analytical Chemistry*. John Wiley & Sons.

Semester-IV

16CHU414A GREEN METHODS IN CHEMISTRY PRACTICAL3H 1C

Instruction Hours/week:L:0 T:0 P:3 Marks: Internal:40 External: 60 Total:100

Course objectives

This course enables the student to

- Apply the principles and the practical aspects of green chemistry
- Prepare biodiesel from vegetable oil.
- Prepare phthalocyaninecomplex of Cu (II).
- Characterise the biodiesel.
- Mechano chemical solvent free synthesis of azomethine.
- Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II)

Course outcome

The students have to use

1. The basic principles and practical aspects like preparations and characterization in green approach.
2. Preparation and characterization of biodiesel from vegetable oil.
3. Characterization of biodiesel from vegetable oil.
4. Preparation of phthalocyaninecomplex of Cu(II).
5. Mechano chemical solvent free synthesis of azomethine.
6. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II).

Methodology

Greener methods of preparation and characterisation

Practical's

1. Preparation and characterization of biodiesel from vegetable oil.
2. Extraction of D-limonene from orange peel using liquid CO2 prepared from dry ice.
3. Mechano chemical solvent free synthesis of azomethine.
4. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II).

SuggestedReadings

Text Books:

1. Anastas, P.T. & Warner, J.K.(2005).*Green Chemistry- Theory and Practical*. Oxford University Press.
2. Matlack, A.S. (2001). *Introduction to Green Chemistry*. Marcel Dekker
3. Cann, M.C. & Connely, M.E. (2000).*Real-World cases in Green Chemistry*, American

Chemical Society. Washington.

Reference Books

1. Ryan, M.A. & Tinnesand, M. (2002).*Introduction to Green Chemistry*. American Chemical Society. Washington.
2. Lancaster, M.(2010).*Green Chemistry: An introductory text.* 2ndEdition.RSC publishing

Semester-IV

16CHU414B ANALYTICAL CLINICAL BIOCHEMISTRY PRACTICAL3H 1C

Instruction Hours/week: L:0 T:0 P:3Marks: Internal: 40 External: 60 Total:100

Course outcome

The course enables the student to

- Identify and estimate carbohydrates.
- Identify and estimate lipids.
- Estimate the iodine number of oils
- Determine the saponification number of oils.
- Determine Cholesterol.
- Determine proteins

Course outcome

The students have to perform

1. The Identification and estimation of carbohydrates, iodine number and saponification number of oils
2. The Identification and estimation of lipids.
3. Estimation of the iodine number of oils
4. Determination the saponification number of oils.
5. Determination of Cholesterol
6. The determination of proteins

Methodology

Identification and estimation of the following:

1. Carbohydrates – qualitative and quantitative.
2. Lipids – qualitative.
3. Determination of the iodine number of oil.
4. Determination of the saponification number of oil.
5. Determination of cholesterol using Liebermann- Burchard reaction.
6. Proteins – qualitative.
7. Isolation of protein.
8. Determination of protein by the Biuret reaction.
9. Determination of nucleic acids

Suggested Readings

Text Books:

6. Cooper, T.G. (1977). *Tool of Biochemistry.* John Wiley and Sons.

7. Keith Wilson & John Walker.(1994).*Practical Biochemistry*. Cambridge University Press.
8. Alan H Gowenlock,(2005). Varley's.*Practical Clinical Biochemistry*.CBS Publisher.
9. Thomas M. Devlin.(2009).*Textbook of Biochemistry*. Academic Internet Publishers.
10. Berg, J.M., Tymoczko, J.L. & Stryer, L.(2002).*Biochemistry*. W.H. Freeman.

Reference Books

3. Nelson, D. L. & Cox, M. M.(2008).*Lehninger's Principles of Bioch*emistry. 7th Ed.W. H. Freeman.
4. Harwood. (1990). *Series on Analytical Chemistry*. John Wiley & Sons.

Semester-V

16CHU501A CHEMOINFORMATICS3H 3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course objectives

This course enables the student to

- Describe the principles of cheminformatics
- Explain the Representation of molecules and chemical reactions
- Predict the searching methods for chemical structures
- Predict the properties of molecules using computational methods
- QSAR studies
- Intepret the computer assisted structure elucidations.

Course outcomes

The students have presented the knowledge about

1. The principles of cheminformatics
2. The Representation of molecules and chemical reactions
3. The searching methods for chemical structures
4. The prediction of the properties of molecules using computational methods
5. QSAR studies
6. The computer assisted structure elucidations

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Introduction to Chemoinformatics: History and evolution of chemoinformatics, Use of chemoinformatics, Prospects of chemoinformatics, Molecular Modelling and Structure elucidation.

UNIT II

Representation of molecules and chemical reactions: Nomenclature, Different types of notations, SMILES coding, Matrix representations, Structure of Molfiles and Sdfiles, Libraries and toolkits, Different electronic effects, Reaction classification.

UNIT III

Searching chemical structures: Full structure search, sub-structure search, basic ideas, similarity search, three dimensional search methods, basics of computation of physical and chemical data and structure descriptors, data visualization.

UNIT IV

Applications: Prediction of Properties of Compounds; Linear Free Energy Relations; Quantitative Structure-Property Relations; Descriptor Analysis; Model Building; Modeling

Toxicity; Structure-Spectra correlations; Prediction of NMR, IR and Mass spectra;

UNIT V

Computer Assisted Structure elucidations; Computer Assisted Synthesis Design, Introduction to drug design; Target Identification and Validation; Lead Finding and Optimization; Analysis of HTS data; Virtual Screening; Design of Combinatorial Libraries; Ligand-Based and Structure Based Drug design; Application of Chemoinformatics in Drug Design.

Suggested Readings

Text Books:

1. Andrew R. Leach & Valerie, J. Gillet (2007). *An introduction to Chemoinformatics.* Springer: The Netherlands.
2. Gasteiger, J. & Engel, T. (2003).*Chemoinformatics: A text-book.* Wiley-VCH.

Reference Book

1. Gupta, S. P. (2011).*QSAR & Molecular Modeling.* New Delhi: Anamaya Pub.

Semester-V

16CHU501B CHEMISTRY OF COSMETICS & PERFUMES3H 3C

Instruction Hours/week: L:3 T:0 P:0Marks: Internal: 40 External: 60 Total:100

Course objectives

This skill enhancement course helps the student to

- Develop the preparation of hair dyes, hair spray and shampoos
- Develop the preparation of Hair spray
- Describe the preparation and uses of lotions,
- Describe the preparation and uses lipsticks
- Describe the preparation and uses talcum powder and Creams.
- Demonstrate the chemistry of essential oils

Course outcome

The students have formulate the knowledge about

1. The preparation of hair dyes, hair spray and shampoos
2. The preparation and uses of lotions,
3. The preparation and uses of lipsticks and
4. The preparation and uses of talcum powder
5. The preparation and uses of creams
6. The chemistry of essential oils

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

Unit I

A general study including preparation and uses of the following: Hair dye, hair spray, Shampoo.

Unit II

preparation and uses of suntan lotions, face powder, lipsticks, talcum powder, nail enamel,

Unit III

preparation and uses of creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.

Unit IV

Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil

Unit V

Essential oils and their importance in cosmetic industries with reference to eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Suggested Readings

Text Books:

1. E. Stocchi. (1990).*Industrial Chemistry*. Vol –I. UK : Ellis Horwood Ltd.
2. P.C. Jain, M. Jain (2004).*Engineering Chemistry*. Delhi: Dhanpat Rai & Sons.

Reference Books

1. Sharma, B.K. & Gaur, H. (1996).*Industrial Chemistry.*Meerut : Goel Publishing House.

Semester-V

16CHU511A CHEMOINFORMATICS PRACTICAL3H 1C

Instruction Hours/week: L:0 T:0 P:3 Marks: Internal:40 External: 60 Total:100

Course objectives

The course helps the student to

- Apply the applications of chemiinformatics in drug design.
- Draw the chemical structure using chemdraw software.
- Molecular docking studies were carried using Autodock software.
- Predict ADME using swissadme software
- Learn Lipinski's rule of five using swissadme software.
- Predict drug likeness

Course outcome

The students know to perform the cheminformatics aspects in the drug designing process.

1. Applied the applications of chemiinformatics in drug design.
2. Draw the chemical structure using chemdraw software.
3. Molecular docking studies were carried using Autodock software.
4. Prediction ADME using swissadme software
5. Learned Lipinski's rule of five using swissadme software.
6. Prediction of drug likeness

Methodology

Computer softwares

Hands-on Exercises

Application of Chemoinformatics in Drug Design

Suggested Readings

Text Books:

1. Andrew R. Leach & Valerie, J. Gillet. (2007). *An introduction to Chemoinformatics.* Springer: The Netherlands.
2. Gasteiger, J. & Engel, T. (2003).*Chemoinformatics: A text-book.* Wiley-VCH.

Reference Book

1. Gupta, S. P. (2011). *QSAR & Molecular Modeling.* New Delhi: Anamaya Pub.

Semester-V

16CHU511B CHEMISTRY OF COSMETICS & PERFUMES PRACTICAL 3H 1C

Instruction Hours/week: L:3 T:0 P:0Marks: Internal: 40 External: 60 Total:100

Course objectives

This course enables the student to

- Prepare of talcum powder.
- Prepare of shampoo.
- Prepare of enamels.
- Prepare of hair remover.
- Prepare of face cream.
- Prepare of nail polish and nail polish remover.

Course outcomes

Students have knowledge to compose about the

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover

Methodology

Preparations of cosmetics and perfumes

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.

SuggestedReadings

Text Books:

1. E. Stocchi. (1990).*Industrial Chemistry*, Vol –I. UK: Ellis Horwood Ltd.
2. P.C. Jain, M. Jain(2004). *Engineering Chemistry*. Delhi: Dhanpat Rai & Sons.

Reference Book

1. Sharma, B.K. & Gaur, H. (1996). *Industrial Chemistry.* Meerut: Goel Publishing House.

Semester-V

16CHU502A POLYMER CHEMISTRY 4H 4C

Instruction Hours/week:L:4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course objectives

This course enables the student to

- Recognize the history of polymeric materials, criteria, kinetics and characterization of polymerisation.
- Criteria for polymeric material formation.
- Learn Kinetics of polymerization.
- Understand Characterisation of polymerisation.
- To know the Structure property relationships of polymer
- Justify the properties of polymers

Course outcome

The students have list the knowledge like

1. History of polymeric materials.
2. Criteria for polymeric material formation.
3. Learned Kinetics of polymerization.
4. Understood Characterisation of polymerisation.
5. Knowledge about Structure property relationships of polymer.
6. Properties of polymers.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.

UNIT II

Kinetics of Polymerization:

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

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

UNIT III

Nature and structure of polymers-Structure Property relationships.
Determination of molecular weight of polymers (*Mn*, *Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

UNIT IV

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

UNIT V

Properties of Polymers (Physical, thermal, Flow & Mechanical Properties).
Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes,
Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

Suggested Readings

Text Books:

1. Seymour R.B., Charles E (2003). *Seymour's Polymer Chemistry: An Introduction.*Marcel Dekker, Inc.
2. G. Odian.(2004). *Principles of Polymerization*. John Wiley.
3. F.W. Billmeyer.(1972).*Text Book of Polymer Science*. John Wiley.
4. P. Ghosh. (2001). *Polymer Science & Technology*. Tata Mcgraw-Hill.

Reference Book

1. R.W. Lenz.(1968). *Organic Chemistry of Synthetic High Polymers*.John Wiley.

Semester-V

16CHU502B APPLICATIONS OF COMPUTERS IN CHEMISTRY 4H 4C

Instruction Hours/week: L:04 T:0 P:0 Marks: Internal: 40 External: 60 Total:100

Course Objectives

This course enables the student to

- Understand the basics of computers in chemistry
- Understand the numerical methods to find the roots of equation
- Understand the differential and integral calculus
- Understand to handle experimental data using simuntaneous equations
- Understand the molecular modelling.
- Learn about MO methods

Course Outcomes

1. Understood the basics of computers in chemistry
2. Understood the numerical methods to find the roots of equation
3. Understood the differential and integral calculus
4. Understood to handle experimental data using simuntaneous equations
5. Understood the molecular modelling.
6. Learnt about MO methods

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Basics:

Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages. Debugging. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis.

UNIT II

Numerical methods:

Roots of equations: Numerical methods for roots of equations: Quadratic formula, iterative method, Newton-Raphson method, Binary bisection and Regula-Falsi.

UNIT III

Differential calculus: Numerical differentiation.

Integral calculus: Numerical integration (Trapezoidal and Simpson's rule), probability distributions and mean values.

UNIT IV

Simultaneous equations: Matrix manipulation: addition, multiplication. Gauss-Siedal method.

Interpolation, extrapolation and curve fitting: Handling of experimental data.

UNIT V

Conceptual background of molecular modelling: Potential energy surfaces. Elementary ideas of molecular mechanics and practical MO methods.

SuggestedReadings

Text Books:

1. Harris, D. C. (2007). *Quantitative Chemical Analysis*. 6th Ed.(Chapters 3-5). Freeman.
2. Levie, R. De. (2001).*How to use Excel in analytical chemistry and in general scientific data analysis*, Cambridge Univ. Press 487 pages.

Reference Books

1. Noggle, J. H. (1985).*Physical chemistry on a Microcomputer.* Little Brown & Co.
2. Venit, S.M.(1996).*Programming in BASIC: Problem solving with structure and style.* Delhi:JaicoPublishing House.

Semester-V

16CHU503A INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE 4H 4C

Instruction Hours/week: L:4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

The course enables the students to

- Understand about the different types of silicate materials like glass, ceramics and cement and their industrial importance
- Understand the different types of fertilizers
- Understand the surface coatings and their industrial importance
- Understand about the different types of batteries and their industrial importance
- Understand about the types of catalysts and their industrial importance
- Understand about the types of explosives and their industrial importance

Course Outcomes

On successful completion of course the students have the knowledge

1. Understood about the different types of silicate materials like glass, ceramics and cement and their industrial importance
2. Understood the different types of fertilizers
3. Understood the surface coatings and their industrial importance
4. Understood about the different types of batteries and their industrial importance
5. Understood about the types of catalysts and their industrial importance
6. Understood about the types of explosives and their industrial importance

Methodology

Blackboard teaching, Power point presentation and group discussion.

UNIT I

Silicate Industries

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses).

Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.
Ceramics: Brief introduction to types of ceramics. Superconducting and semiconducting oxides, fullerenes, carbon nanotubes and carbon fibre.
Cements: Manufacture of cement and the setting process, quick setting cements.

UNIT II
Fertilizers:
Different types of fertilizers (N, P and K). Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates, superphosphate of lime.

Surface Coatings:
Brief introduction to and classification of surface coatings. Paints and pigments - formulation, composition and related properties. Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

UNIT III
Batteries:
Working of the following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

UNIT IV
Catalysis:
General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts.
Application of zeolites as catalysts.

UNIT V
Chemical explosives:
Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

SuggestedReadings
Text Books:

1. Stocchi, E. (1990).*Industrial Chemistry*. Vol I. UK : Ellis Horwood Ltd.,
2. Felder, R. M. & Rousseau, R.W. (2005). *Elementary Principles of Chemical Processes*. New Delhi: Wiley Publishers.

3. Kent, J. A. (ed). (1997).*Riegel's Handbook of Industrial Chemistry*.9th Ed. New Delhi:CBS Publishers.

Reference Books

1. Jain, P. C. and Jain, M. (2005). *Engineering Chemistry*. Delhi: Dhanpat Rai & Sons.
2. Gopalan, R., Venkappayya, D. and Nagarajan, S. (2004). *Engineering Chemistry.*New Delhi: VikasPublications,
3. Sharma, B. K. (2006). *Engineering Chemistry*. Meerut: Goel Publishing House.

Semester-V

16CHU503B ANALYTICAL METHODS IN CHEMISTRY 4H 4C

Instruction Hours/week: L:4 T:0 P:0 Marks: Internal: 40 External: 60 Total:100

Course Objectives

This course enable the student to

- Understand the various Qualitative analysis
- Understand the quantitative aspects of analysis
- Understand the different Optical methods of analysis
- Understand the various methods of Thermal and electroanalytical methods
- Understand various chromatographic separation techniques
- Understand the various instrumentation method of analysis.

Course Outcomes

On successful completion of course the students have the knowledge

1. Understood the various Qualitative analysis
2. Understood the quantitative aspects of analysis
3. Understood the different Optical methods of analysis
4. Understood the various methods of Thermal and electroanalytical methods
5. Understood various chromatographic separation techniques
6. Understood the various instrumentation method of analysis.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Qualitative and quantitative aspects of analysis:

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

UNIT II

Optical methods of analysis:

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;

Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.
Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.
Structural illustration through interpretation of data, Effect and importance of isotope substitution.
Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

UNIT III

Thermal methods of analysis:
Theory of thermogravimetry (TG), basic principle of instrumentation.
Techniques for quantitative estimation of Ca and Mg from their mixture.

Electroanalytical methods:
Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points.
Techniques used for the determination of pKa values.

UNIT IV

Separation techniques:
Solvent extraction: Classification, principle and efficiency of the technique.
Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media. Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods.
Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.

UNIT V

Separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC). Role of computers in instrumental methods of analysis.

SuggestedReadings

Text Books:

1. Christian, G.D. (2004).*Analytical Chemistry*, 6th Ed.New York: John Wiley & Sons.
2. Harris, D. C.(2001).*Exploring Chemical Analysis*. Ed. New York: W.H. Freeman.
3. Khopkar, S.M. (2009). *Basic Concepts of Analytical Chemistry*. New Age, International Publisher.

Reference Books

1. Skoog, D.A., Holler F.J. & Nieman, T.A.(2006).*Principles of Instrumental Analysis*, Cengage Learning India Ed.
2. Mikes, (1979). O. *Laboratory Hand Book of Chromatographic & Allied Methods*, EllesHarwood Series on Analytical Chemistry. John Wiley & Sons.

Semester-V

16CHU504A INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS **4H 4C**

Instruction Hours/week: L:4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

This course enables the students to

- Understand the spectroscopic techniques like IR, spectral analysis
- UV-Visible Spectral analysis
- NMR spectroscopy and
- mass spectroscopy for analytical analysis
- Understand the Chromatographic separation techniques for analysis
- Understand the quantitative techniques like elemental analysis, electro analytical techniques, and XRD analysis

Course Outcomes

On successful completion of course the students have the knowledge

1. Understood the spectroscopic techniques like IR, spectral analysis
2. UV-Visible Spectral analysis
3. NMR spectroscopy and
4. mass spectroscopy for analytical analysis
5. Understood the Chromatographic separation techniques for analysis
6. Understood the quantitative techniques like elemental analysis, electro analytical techniques, and XRD analysis

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Introduction to spectroscopic methods of analysis:

Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

UNIT II

Molecular spectroscopy:

Infrared spectroscopy:

Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat,

differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection. *UV-Visible/ Near IR* – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags).

UNIT III

Separation techniques

Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis.

Immunoassays and DNA techniques

Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).

UNIT IV

Elemental analysis:

Mass spectrometry (electrical discharges).

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

UNIT V

NMR spectroscopy: **P**rinciple, Instrumentation, Factors affecting chemical shift, Spincoupling, Applications.

Electroanalytical Methods: Potentiometry & Voltammetry

Radiochemical Methods

X-ray analysis and electron spectroscopy (surface analysis)

Suggested Readings

Text books:

1. Douglas A. Skoog, James Holler, F. & Stanley Crouch.(2007).*Principles of Instrumental Analysis*. 6th Edition. (ISBN 0-495-01201-7).

2. Willard, Merritt, Dean & Settle.(1989). *Instrumental Methods of Analysis*. 7th ed.

3. P.W. Atkins. (2014). *Physical Chemistry*. Oxford University Press

Reference Books

1. C.N. Banwell.(1966). *Fundamentals of Molecular Spectroscopy*.McGraw Hill

2. Brian Smith.(1998) *Infrared Spectral Interpretations: A Systematic Approach*.CRC press.

3. W.J. Moore.(1999). *Physical Chemistry*. Longman Green & Co. Ltd.,

Semester-V

16CHU504B NOVEL INORGANIC SOLIDS 4H 4C

Instruction Hours/week: L:4 T:0 P:0 Marks: Internal: 40 External: 60 Total:100

Course objectives

The course enables the students have to perform

- The Synthesis and modification of inorganic solids of technological importance
- Understand about the inorganic solids of technological importance
- The Synthesis and properties of nanomaterials
- The Synthesis of engineering materials used for mechanical construction
- The Synthesis and properties of composite materials
- The Synthesis and properties of speciality polymers

Course outcome

The student have identified

1. The Synthesis and modification of inorganic solids
2. Understood about inorganic solids of technological importance
3. The Synthesis and properties of nanomaterials
4. The Synthesis of engineering materials used for mechanical construction
5. The Synthesis and properties of composite materials
6. The Synthesis and properties of speciality polymers

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Synthesis and modification of inorganic solids:

Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods.

Inorganic solids of technological importance:

Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and

black pigments.
Molecular material and fullerides, molecular materials & chemistry – one-dimensional metals, molecular magnets, inorganic liquid crystals.

UNIT II

Nanomaterials:

Overview of nanostructures and nanomaterials: classification.
Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials, bionano composites.

UNIT III

Introduction to engineering materials for mechanical construction:

Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminium and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.

UNIT IV

Composite materials:

Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of composites.

UNIT V

Speciality polymers:

Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrrole, applications of conducting polymers, Ion-exchange resins and their applications. Ceramic & Refractory: Introduction, classification, properties, raw materials, manufacturing and applications.

SuggestedReadings

Text Books:

1. Shriver & Atkins. (2014). *Inorganic Chemistry*, Oxford University Press.
2. Peter Alkins, Tina Overton, Jonathan Rourke,Mark Weller and Fraser Armstrong. (2011-2012). 5th Edition. Oxford University Press.
3. Adam, D.M. (1974) *Inorganic Solids: An introduction to concepts in solid-state structuralchemistry*. John Wiley & Sons.

Reference Books

1. Poole, C.P. & Owens, F.J. (2003). *Introduction to Nanotechnology*.John Wiley & Sons.
2. Rodger, G.E. (2002). *Inorganic and Solid State Chemistry*. Cengage Learning India Edition.

Semester-V

16CHU512A POLYMER CHEMISTRY PRACTICAL4H 2C

Instruction Hours/week:L:0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course objectives

This course enables the student have to apply

- Have hands on experience to prepare different types of polymers by various methods
- To do the purification of polymers
- To characterise the polymers by chemical and instrumental methods.
- To prepare isopthaloyl chloride
- Determine hydroxyl number of a polymer using colorimetric method
- Analyse the polymers

Course outcome

The students have demonstrate and perform

1. The preparation of different types of polymers by various methods
2. The purification of polymers
3. The characterization the polymers by chemical and instrumental methods.
4. Preparation of isopthaloyl chloride
5. Determination of hydroxyl number of a polymer using colorimetric method
6. Analysis of the polymers

Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).

a. Purification of monomer

b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutylonitrile (AIBN)

2. Preparation of nylon 66/6

1. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein

a. Preparation of IPC

b. Purification of IPC
c. Interfacial polymerization
3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resold resin.
7. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:
(a) Polyacrylamide-aq.NaNO2 solution
(b) (Poly vinyl proplylidine (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of ―head-to-head‖ monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
4. Testing of mechanical properties of polymers.
5. Determination of hydroxyl number of a polymer using colorimetric method.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques
3. IR studies of polymers
4. DSC analysis of polymers
5. Preparation of polyacrylamide and its electrophoresis

*at least 7 experiments to be carried out.

SuggestedReadings

Text Books:

1. Malcohm P. Stevens(1999). *Polymer Chemistry: An Introduction*. 3rd Ed. Oxford University Press.
2. Harry R. Allcock, Frederick W. Lampe and James E. Mark, (2003*). Contemporary Polymer Chemistry*. 3rd ed. Prentice-Hall
3. Fred W. Billmeyer, (1984). *Textbook of Polymer Science*. 3rd ed. Wiley-Interscience
4. Joel R. Fried, (2003). *Polymer Science and Technology*. 2nd ed. Prentice-Hall.
5. Petr Munk & Tejraj M. Aminabhavi, (2002).*Introduction to Macromolecular Science*. 2nd ed. John Wiley & Sons

Reference Books

1. L. H. Sperling,. (2005). *Introduction to Physical Polymer Science*. 4th ed. John Wiley & Sons.
2. Malcolm P. Stevens, (2005). *Polymer Chemistry: An Introduction*. 3rd ed. Oxford University Press.
3. Charles E. Carraher,.(2013). *Seymour/ Carraher's Polymer Chemistry*. 9th ed. Jr.

Semester-V

16CHU512B APPLICATIONS OF COMPUTERS IN CHEMISTRY-4H 2C PRATCTICAL

Instruction Hours/week: L:0 T:0 P:4 Marks: Internal: 40 External: 60 Total:100

Course Objectives

This lab course enable the student to do experiments and to

- Understand the basics of computers in chemistry
- Understand to find the roots of equation
- Understand the the numerical differentiation and integration
- Understand integration
- Understand matrix operations.
- Understand matrix operations

Course Outcomes

The students have the knowledge of

1. Understood the basics of computers in chemistry
2. Understood to find the roots of equation
3. Understood the the numerical differentiation and integration
4. Understood integration
5. Understood matrix operations.
6. Understood matrix operations

Methodology

Computer programmes

Computer programs based on numerical methods for

1. Roots of equations: (e.g. volume of van der Waals gas and comparison with ideal gas, pH of a weak acid).
2. Numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations).
3. Numerical integration (e.g. entropy/ enthalpy change from heat capacity data), probability distributions (gas kinetic theory) and mean values.
4. Matrix operations. Application of Gauss-Siedel method in colourimetry.
5. Simple exercises using molecular visualization software.

Suggested Readings

Text Books:

1. McQuarrie, D. A.(2008).*Mathematics for Physical Chemistry*.University Science Books.
2. Mortimer, R.(2005).*Mathematics for Physical Chemistry*. 3rd Ed. Elsevier.
3. Steiner, E. (1996).*The Chemical Maths Book* . Oxford University Press.
4. Yates, P. (2007).*Chemical Calculations.* 2nd Ed. CRC Press.
5. Harris, D. C. (2007). *Quantitative Chemical Analysis*. 6th Ed.Chapters 3-5. Freeman.

Reference Books

1. Levie, R. De. (2001). *How to use Excel in analytical chemistry and in general scientific data analysis*, Cambridge Univ. Press 487 pages.
2. Noggle, J. H. (1985).*Physical Chemistry on a Microcomputer*. Little Brown & Co.
3. Venit, S.M.(1996). *Programming in BASIC: Problem solving with structure and style*.Delhi: Jaico Publishing House.

Semester-V

16CHU513A INORGANIC MATERIALS OFINDUSTRIAL4H 2C IMPORTANCE- PRACTICAL

Instruction Hours/week: L:0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course Objectives

The lab course enables the students to

- Determine the free acidity in fertilizers
- Estimate calcium and phosphoric acid in fertilizers
- Determine the composition of dolomite
- Analysis of metals in alloys
- Estimation of phosphoric acid in superphosphate fertilizer.
- Electroless metallic coatings on ceramic and plastic material.

Course Outcomes

The students have the knowledge of

1. Determineation of the free acidity in fertilizers
2. Estimation calcium and phosphoric acid in fertilizers
3. Determination of the composition of dolomite
4. Analysis of metals in alloys
5. Estimation of phosphoric acid in superphosphate fertilizer.
6. Electroless metallic coatings on ceramic and plastic material.

Methodology

Lab experiments involving titrations

1. Determination of free acidity in ammonium sulphate fertilizer.

2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.
5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).

SuggestedReadings
Text Books:

1. Stocchi, E. (1990). *Industrial Chemistry*, Vol I. UK: Ellis Horwood Ltd.
2. Felder, R. M. & Rousseau, R.W. (2005).*Elementary Principles of Chemical Processes*. New Delhi: Wiley Publishers.
3. Kingery, W. D., Bowen H. K. & Uhlmann, D. R.(1976).*Introduction to Ceramics.* New Delhi:Wiley Publishers.

Reference Books

1. Kent, J. A. (ed). (1997). *Riegel's Handbook of Industrial Chemistry*.9th Ed. New Delhi:CBS Publishers.
2. Jain, P. C. & Jain, M. (2004). *Engineering Chemistry,* Delhi:Dhanpat Rai & Sons,
3. Gopalan, R., Venkappayya, D. & Nagarajan, S. (2004). *Engineering Chemistry.*New Delhi: VikasPublications.
4. Sharma, B. K. (2006). *Engineering Chemistry*. Meerut: Goel Publishing House.

Semester-V

16CHU513B ANALYTICAL METHODS IN CHEMISTRYPRACTICAL4H 2C

Instruction Hours/week: L:0 T:0 P:4 Marks: Internal: 40 External: 60 Total:100

Course Objectives

This lab course enables the students to

- Learn the skills in paper chromatography
- Thin layer chromatographic techniques
- Learn the skills in different types of solvent extraction techniques
- Learn the skills in spectrophotometric method of analysis
- Determine PH measurements
- Separation of mixtures

Course Outcomes

On completion of the course the students have knowledge

1. Learnt the skills in paper chromatography
2. Thin layer chromatographic techniques
3. Learnt the skills in different types of solvent extraction techniques

4. Learnt the skills in spectrophotometric method of analysis
5. Determination PH measurements
6. Separation of mixtures

Methodology

Paper chromatography, TLC, solvent extractions methods

I. Separation Techniques

1. Chromatography:

(a) Separation of mixtures

(i) Paper chromatographic separation of $Fe^{3+,}$ $Al^{3+,}$ and $Cr^{3+.}$

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.

(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.

(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

II. Solvent Extractions:

(i) To separate a mixture of Ni^{2+}, & Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry.

(ii) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium.

3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

4. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

5. Analysis of soil:

(i) Determination of pH of soil.

(ii) Total soluble salt

(iii) Estimation of calcium, magnesium, phosphate, nitrate

6. Ion exchange:

(i) Determination of exchange capacity of cation exchange resins and anion exchange resins.

(ii) Separation of metal ions from their binary mixture.

(iii) Separation of amino acids from organic acids by ion exchange chromatography.

III Spectrophotometry

1. Determination of pKa values of indicator using spectrophotometry.

2 Structural characterization of compounds by infrared spectroscopy.

3 Determination of dissolved oxygen in water.

4 Determination of chemical oxygen demand (COD).

5 Determination of Biological oxygen demand (BOD).

6 Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex by Job's method.

Suggested Readings

Text Books:

1. Christian, Gary D. (2004).*Analytical Chemistry*. 6th Ed. New York : John Wiley & Sons.
2. Harris, Daniel C. (2001).*Exploring Chemical Analysis*. Ed. New York: W.H. Freeman
3. Khopkar, S.M. (2009). *Basic Concepts of Analytical Chemistry*. New Age, Internationa Publisher.

Reference Books

1. Skoog, D.A. Holler F.J. & Nieman, T.A.(2006).*Principles of Instrumental Analysis*, Cengage Learning India Ed.
2. Mikes, O.(1979)*Laboratory Hand Book of Chromatographic & Allied Methods*, John Wiley & Sons.
3. Ditts, R.V. (1974).*Analytical Chemistry; Methods of Separation*. van Nostrand,

Semester-V

16CHU514A INSTRUMENTAL METHODS OFCHEMICAL ANALYSIS- PRACTICAL **4H 2C**

Instruction Hours/week: L:0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course Objectives

The course enables the student to

- Understand the testing of chemicals using UV-Visible spectrophotometer
- Understand the testing of chemicals using IR spectrophotometer
- Understand the testing of chemicals using chemical methods
- Titration curve of an amino acid.
- Potentiometric Titration of a Chloride-Iodide Mixture
- Use of fluorescence to do ―presumptive tests‖ to identify blood or other body fluids.

Course Outcomes

On completion of the course the students have knowledge

1. Understood the testing of chemicals using UV-Visible spectrophotometer
2. Understood the testing of chemicals using IR spectrophotometer
3. Understood the testing of chemicals using chemical methods
4. Titration curve of an amino acid.
5. Potentiometric Titration of a Chloride-Iodide Mixtur
6. Use of fluorescence to do ―presumptive tests‖ to identify blood or other body fluids

Methodology

Absorption measurements and potentiometric titrations

1. Safety Practices in the Chemistry Laboratory
2. Determination of the isoelectric pH of a protein.
3. Titration curve of an amino acid.
4. Determination of the void volume of a gel filtration column.
5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water)
7. IR Absorption Spectra (Study of Aldehydes and Ketones)

8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption
9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride)
12. Potentiometric Titration of a Chloride-Iodide Mixture
14. Nuclear Magnetic Resonance
15. Use of fluorescence to do ―presumptive tests‖ to identify blood or other body fluids.
16. Use of ―presumptive tests‖ for anthrax or cocaine
17. Collection, preservation, and control of blood evidence being used for DNA testing
20. Laboratory analysis to confirm anthrax or cocaine
22. Detection of illegal drugs or steroids in athletes
23. Detection of pollutants or illegal dumping
24. Fibre analysis

At least 10 experiments to be performed.

SuggestedReadings

Text Books:

1.Douglas A. Skoog, James Holler,F. & Stanley Crouch (2007). *Principles of Instrumental Analysis* . 6th Edition. (ISBN 0-495-01201-7).

Reference Books

1. Willard, Merritt, Dean, Settle.(1989). *Instrumental Methods of Analysis*. 7th ed. ACS publications

Semester-V

16CHU514BNOVEL INORGANIC SOLIDSPRACTICAL 4H 2C

Instruction Hours/week: L:0 T:0 P:02 Marks: Internal: 40 External: 60 Total:100

Course objectives

The course helps the student to

- Explain the ion exchange method
- Expalin the cation exchange method
- coprecipitation methods of novel inorganic solids
- Discuss the method for the preparation of nanoparticles
- Nano partical preparation using green method
- Prepare the hydrogel by coprecipitation method

Course outcome

The students have demonstrated

1. The cation exchange method
2. The ion exchange method
3. coprecipitation methods of novel inorganic solids
4. The method for the preparation of nanoparticles
5. Nano partical preparation using green method

Preparation of the hydrogel by coprecipitation method

1. Determination of cation exchange method
2. Determination of total difference of solids.
3. Synthesis of hydrogel by co-precipitation method.

4. Synthesis of metal nanoparticles.

Suggested Reading :

1. Fahlman, B.D. (2004).*Materials Chemistry*, Springer.

Semester-VI

16CHU601A BASIC ANALYTICAL CHEMISTRY 3H 3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course objectives

The course enables the students have to interpret

- The interdisciplinary nature of analytical chemistry
- The various methods involved in the analysis of soil ,
- Analyse water
- Analys food products
- Concepts of *p*H
- The various methods involved in the analysis of cosmetics

Course outcome

The course enables the students have to interpreted

1. The interdisciplinary nature of analytical chemistry
2. The various methods involved in the analysis of soil ,
3. Analysis water
4. Analysis of food products
5. Concepts of *p*H
6. The various methods involved in the analysis of cosmetics

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Introduction: 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 point of view of significant figures.

UNIT II

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators

a. Determination of pH of soil samples.

b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

UNIT III

Analysis of water: 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.

UNIT IV

Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.

a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.

b. Analysis of preservatives and colouring matter.

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

a. Paper chromatographic separation of mixture of metal ion (Fe3+ and Al3+).

b. To compare paint samples by TLC method.

Ion-exchange: Column, ion-exchange chromatography etc.

Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

UNIT V

Analysis of cosmetics: Major and minor constituents and their function

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.

SuggestedReading

Text Books:

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A.(1988).*Instrumental Methods of Analysis*. 7th Ed.Belmont, California, USA : Wadsworth Publishing Co. Ltd.
2. Skoog, D.A. Holler F.J. & Nieman, T.A.(1998). *Principles of Instrumental Analysis*, Cengage Learning India Ed.
3. Skoog, D.A.; West, D.M. & Holler, F.J.(1992).*Fundamentals of Analytical Chemistry* 6thEd.Fort Worth : Saunders College Publishing.

4. Harris, D. C. (2006). *Quantitative Chemical Analysis*. W. H. Freeman and Company Ltd.,
5. Dean, J. A. (1992). *Analytical Chemistry Notebook*. McGraw Hill.

Reference Books

1. Day, R. A. & Underwood, A. L. (1991). *Quantitative Analysis*. Prentice Hall of India.
2. Freifelder, D. (1982).*Physical Biochemistry*.2nd Ed.N.Y. USA: W.H. Freeman and Co.
3. Cooper, T.G. (1977).*The Tools of Biochemistry.*16.N.Y. USA: John Wiley and Sons.
4. Robinson, J.W.(1995).*Undergraduate Instrumental Analysis.*5th Ed.NewDelhi:Marcel Dekker Inc.,

Semester-VI

16CHU601B PESTICIDE CHEMISTRY3H 3C

Instruction Hours/week: L:3 T:0 P:0Marks: Internal: 40 External: 60 Total:100

Course objectives

The course enables the students to design

- The synthesis and manufacture of many natural fertilizers
- The synthesis and manufacture of many synthetic fertilizers
- The synthesis and manufacture of organochlorines
- The synthesis and manufacture organophosphorous compounds
- The synthesis and manufacture of quinine pesticides
- The synthesis and manufacture of anilides

Course outcomes

The students have designed

1. The synthesis and manufacture of many natural fertilizers
2. The synthesis and manufacture of many synthetic fertilizers
3. The synthesis and manufacture of organochlorines
4. The synthesis and manufacture organophosphorous compounds
5. The synthesis and manufacture of quinine pesticides
6. The synthesis and manufacture of anilides

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

Unit I

General introduction to pesticides (natural and synthetic), benefits and adverse effects.

Unit II

Changing concepts of pesticides, structure activity relationship.

Unit III

Synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,)

Unit IV

Synthesis and technical manufacture and uses of Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl)

Unit V

Synthesis and technical manufacture and uses of Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Practicals

1. To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.
2. Preparation of simple organophosphates, phosphonates and thiophosphates

Suggested Reading

1. Cremlyn, R. (1978). *Pesticides. Preparation and Modes of Action*. New York: John Wiley & Sons.

Semester-VI

16CHU611A BASIC ANALYTICAL CHEMISTRYPRACTICAL3H 1C

Instruction Hours/week: L:0 T:0 P:3 Marks: Internal:40 External: 60 Total:100

Course objectives

The course enables the students to design

- The synthesis and manufacture of many natural fertilizers
- The synthesis and manufacture of many synthetic fertilizers
- The synthesis and manufacture of organochlorines
- The synthesis and manufacture organophosphorous compounds
- The synthesis and manufacture of quinine pesticides
- The synthesis and manufacture of anilides

Course outcomes

The students have designed

1. The synthesis and manufacture of many natural fertilizers
2. The synthesis and manufacture of many synthetic fertilizers
3. The synthesis and manufacture of organochlorines
4. The synthesis and manufacture organophosphorous compounds
5. The synthesis and manufacture of quinine pesticides
6. The synthesis and manufacture of anilides

Methodology

Estimation of metal ion by flame photometry, Spectrophotemetric procedures

Applications (Any one):

a. To study the use of phenolphthalein in trap cases.

b. To analyze arson accelerants.

c. To carry out analysis of gasoline.

Instrumental demonstrations:

a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.

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

c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink.

SuggestedReading

Text Books:

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. (1988). *Instrumental Methods of Analysis*. 7th Ed.Belmont, California, USA : Wadsworth Publishing Co. Ltd.
2. Skoog, D.A. Holler F.J. & Nieman, T.A.(1998). *Principles of Instrumental Analysis*, Cengage Learning India Ed.
3. Skoog, D.A.; West, D.M. & Holler, F.J.(1992).*Fundamentals of Analytical Chemistry* 6th Ed.Fort Worth : Saunders College Publishing.
4. Harris, D. C. (2006). *Quantitative Chemical Analysis*. W. H. Freeman and Company Ltd.,
5. Dean, J. A. (1992). *Analytical Chemistry Notebook*. McGraw Hill.

Reference Books

1. Day, R. A. & Underwood, A. L. (1991). *Quantitative Analysis*. Prentice Hall of India.
2. Freifelder, D. (1982).*Physical Biochemistry.*2nd Ed.N.Y. USA: W.H. Freeman and Co.
3. Cooper, T.G. (1977).*The Tools of Biochemistry.*16.N.Y. USA: John Wiley and Sons.
4. Robinson, J.W.(1995). *Undergraduate Instrumental Analysis.*5th Ed.NewDelhi:Marcel Dekker Inc.,

Semester-VI

16CHU611B PESTICIDE CHEMISTRY3H 1C

Instruction Hours/week: L:3 T:0 P:0Marks: Internal: 40 External: 60 Total:100

Course objectives

The lab course enables the student to solve

- the calculation of acidity in given sample of pesticide formulation
- the calculation of alkalinity in given sample of pesticide formulation
- the synthesis of simple organophosphates,
- the synthesis of phosphonates
- the synthesis of thiophosphates
- Alayse organophosphates, phosphonates and thiophosphates

Course outcomes

The students have solved

1. the calculation of acidity in given sample of pesticide formulation
2. the calculation of alkalinity in given sample of pesticide formulation
3. the synthesis of simple organophosphates
4. the synthesis of phosphonates
5. the synthesis of thiophosphates
6. Alaysis of organophosphates, phosphonates and thiophosphates

Methodology

.PH measurements, Fertilizer preparation

Practicals

1. To calculate acidity/alkalinity in given sample of pesticide formulations.
2. Preparation of simple organophosphates, phosphonates and thiophosphates

Suggested Reading:

1. Cremlyn, R.(1978).*Pesticides. Preparation and Modes of Action*. NewYork: John Wiley & Sons.

Semester-VI

16CHU602A MOLECULAR MODELING AND DRUG DESIGN4H 4C

Instruction Hours/week: L:4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Scope

The course deals with the concepts of Molecular Modelling used in drug design

Course objectives

The course enables the students to summarize

- The introductory concepts of molecular modelling
- The force fields involved with different types of interactions
- The Energy Minimization and Computer Simulation
- The Molecular Dynamics & Monte Carlo Simulation
- The Structure Prediction and Drug Design
- QSAR studies

Course outcomes

The students are contrast

1. The introductory concepts of molecular modelling
2. The force fields involved with different types of interactions
3. About the Energy Minimization and Computer Simulation
4. About the Molecular Dynamics & Monte Carlo Simulation
5. About the Structure Prediction and Drug Design
6. QSAR studies

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Introduction to Molecular Modelling:

Introduction. Useful Concepts in Molecular Modelling: Coordinate Systems. Potential Energy Surfaces. Molecular Graphics. Surfaces. Computer Hardware and Software. The Molecular Modelling Literature.

UNIT II

Force Fields:
Fields. Bond Stretching. Angle Bending. Introduction to nonbonded interactions. Electrostatic interactions. van der Waals Interactions. Hydrogen bonding in Molecular Mechanics. Force Field Models for the Simulation of Liquid Water.

UNIT III

Energy Minimization and Computer Simulation:
Minimization and related methods for exploring the energy surface. Non-derivative method, First and second order minimization methods. Computer simulation methods. Simple thermodynamic properties and Phase Space. Boundaries. Analyzing the results of a simulation and estimating Errors.

UNIT IV
Molecular Dynamics & Monte Carlo Simulation:
Molecular Dynamics Simulation Methods. Molecular Dynamics using simple models. Molecular Dynamics with continuous potentials. Molecular Dynamics at constant temperature and pressure. Metropolis method. Monte Carlo simulation of molecules. Models used in Monte Carlo simulations of polymers.

UNIT V

Structure Prediction and Drug Design:
Structure prediction - Introduction to comparative Modeling. Sequence alignment. Constructing and evaluating a comparative model. Predicting protein structures by 'Threading', Molecular docking. Structure based de novo ligand design,
Drug Discovery – Chemoinformatics – QSAR.

SuggestedReadings
Text Books:

1. Leach, A.R. (2001). *Molecular Modelling Principles and Application*, Longman.
2. Haile, J.M. (1997). *Molecular Dynamics Simulation Elementary Methods*, John Wiley and Sons.
3. Gupta, S.P. (2008).*QSAR and Molecular Modeling*. Springer. Anamaya Publishers.

Semester-VI

16CHU602B INDUSTRIAL CHEMICALS AND ENVIRONMENT4H 4C

Instruction Hours/week: L:4 T:0 P:0Marks: Internal: 40 External: 60 Total:100

Course Objectives

The course enables the students to

- Understand the industrial gases and inorganic chemicals which have an impact on the environment
- Understand about the general principles of metallurgy
- Understand the environment and its segments
- Understand about the water pollution and water treatment
- Understand about the energy and the environment
- Understand the environment and its segments

Course outcomes

The students are contrast

1. Understood the industrial gases and inorganic chemicals which have an impact on the environment
2. Understood about the general principles of metallurgy
3. Understood the environment and its segments
4. Understood about the water pollution and water treatment
5. Understood about the energy and the environment
6. Understood the environment and its segments

Methodology

Blackboard teaching, Power point presentation and group discussion.

UNIT I

Industrial Gases and Inorganic Chemicals

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

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

UNIT II

Industrial Metallurgy

General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent.

Hydrometallurgy, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry.

UNIT III

Environmental effects of ozone, Major sources of

air pollution. Pollution by SO2, CO_2, CO, NOx, H_2S and other foul smelling gases. Methods of estimation of CO, NOx, SOx and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

UNIT IV

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment).

Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc.Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

UNIT V

Energy & Environment

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Biocatalysis

Introduction to biocatalysis: Importance in “Green Chemistry” and Chemical Industry.

SuggestedReadings

Text Books:

1. Stocchi, E.(1990).*Industrial Chemistry*, Vol-I. UK.: Ellis Horwood Ltd.
2. Felder,R.M. & Rousseau, R.W.(2004).*Elementary Principles of Chemical Processes*. New Delhi: WileyPublishers.
3. Kent, J. A.(1997).*Riegel’s Handbook of Industrial Chemistry.* New Delhi: *CBS* Publishers.
4. Dara, S. S.(2014). *A Textbook of Engineering Chemistry*. NewDelhi: S. Chand & Company Ltd.
5. K. De.(2007). *Environmental Chemistry*. New Delhi: New Age International Pvt., Ltd.

Reference Books:

1. Khopkar, S. M.(1993).*Environmental Pollution Analysis*. New Delhi: Wiley Eastern Ltd.
2. Manahan,S.E. (2005).*Environmental Chemistry*. CRC Press.
3. Miller, G.T. (2006).*Environmental Science.*11th edition. Brooks/ Cole
4. Mishra,A. (2005).*Environmental Studies*. New Delhi: Selective and Scientific Books.

Semester-VI

16CHU603A GREEN CHEMISTRY 4H 4C

Instruction Hours/week: L:4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

- To introduce the concept of Green chemistry.
- To introduce the 12 principles of Green chemistry
- The tools of Green chemistry.
- To demonstrate how to evaluate a reaction or process
- Determine "Greener" alternatives.
- To focus on the application of greener route to improve industrial processes and to produce important products.

Course Outcomes

1. Introduce the concept of Green chemistry.
2. Introduce the 12 principles of Green chemistry as well as
3. the tools of Green chemistry.
4. .Demonstrate how to evaluate a reaction or process
5. Determination of "Greener" alternatives.
6. Focus on the application of greener routes to improve industrial processes and to produce important products.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

Introduction to Green Chemistry

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry

Principles of Green Chemistry and Designing a Chemical synthesis

Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following: Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts;maximum incorporation of the materials used in the process into the final products , Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard × exposure; waste or pollution prevention hierarchy. Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents.

UNIT II

Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy. Selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups. Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis. Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation. Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.

UNIT III

Examples of Green Synthesis/ Reactions and some real world cases

1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)
2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction
3. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)
4 Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.
5 Designing of Environmentally safe marine antifoulant.

UNIT IV

1. Rightfit pigment: synthetic azopigments to replace toxic organic and inorganicpigments.
2 An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid) made from corn.
3 Healthier fats and oil by Green Chemistry: Enzymatic interesterification for production of no Trans-Fats and Oils
4 Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting

UNIT V

Future Trends in Green Chemistry

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis (C_2S_3); Green chemistry in sustainable development.

Suggested Readings

Text Books:

1. Ahluwalia, V.K. & Kidwai, M.R. (2005). *New Trends in Green Chemistry*, Anamalaya Publishers.
2. Anastas, P.T. & Warner, J.K. (1998). *Green Chemistry - Theory and Practical*. Oxford University Press.
3. Matlack, A.S. (2001). *Introduction to Green Chemistry*. Marcel Dekker.
4. Cann, M.C. & Connely, M.E. (2000). *Real-World cases in Green Chemistry*. Washington: American Chemical Society.

Reference Books:

1. Ryan, M.A. & Tinnesand, M. (2002). *Introduction to Green Chemistry*. Washington: American Chemical Society.
2. Lancaster, M. (2010).*Green Chemistry: An Introductory Text*. 2nd Edition. RSC Publishing.

Semester-VI

16CHU603B MOLECULES OF LIFE 4H 4C

Instruction Hours/week: L:4 T:0 P:0 Marks: Internal: 40 External: 60 Total:100

Course Objectives

The course enable the student to

- Understand the structures of different types of carbohydrates
- Understand the synthesis and functions of proteins
- Understand the functions of enzymes
- Understand the synthesis and functions of nucleic acid
- Understand the classification of lipids
- concept of energy in biosystems

Course Outcomes

1. Understopd the structures of different types of carbohydrates
2. Understood the synthesis and functions of proteins
3. Understood the functions of enzymes
4. Understood the synthesis and functions of nucleic acid
5. Understood the classification of lipids
6. concept of energy in biosystems

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT I

CARBOHYDRATES

Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosachharides, structure of

disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

UNIT II

AMINO ACIDS, PEPTIDES AND PROTEINS

Classification *of Amino Acids,* Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (tbutyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.

UNIT III

ENZYMES AND CORRELATION WITH DRUG ACTION

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action(Including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition(Competitive and Noncompetitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group,-NH2 group, double bond and aromatic ring,

UNIT IV

NUCLEIC ACIDS

Components of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides **(nomenclature**), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA(**types of RNA**), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

UNIT V

LIPIDS

Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

Concept of energy in Biosystems

Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

Suggested Readings

Text Books:

1. Morrison, R. T. & Boyd, R. N.(1992)*Organic Chemistry*. Dorling Kindersley (India) Pvt.Ltd. (Pearson Education).
2. Finar, I. L. (2002). *Organic Chemistry*. Volume 1. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. (2002). *Organic Chemistry*. Volume 2. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Reference Books:

1. Nelson, D. L. & Cox, M. M.(2012)*Lehninger's Principles of Biochemistry*.7th Ed.W. H.Freeman.
2. Berg, J.M., Tymoczko, J.L. & Stryer, L. (2002).*Biochemistry*. W.H. Freeman.

Semester-VI

16CHU612A MOLECULAR MODELING AND DRUG DESIGN PRACTICAL 4H 2C

Instruction Hours/week: L:0 T:0 P:4 Marks: Internal: 40 External: 60 Total:100

Course objectives

The lab course enables the students to analyse

- Qualititative and qualitative calculations involved in the molecular modelling and its usefulness in drug design
- Compare the optimized C-C bond lengths in ethane, ethene, ethyne and benzene.Visualize the molecular orbitals of the ethane σ bonds and ethene, ethyne, benzeneand pyridine π bonds.
- Perform a conformational analysis of butane. (b)
- Determine the enthalpy of isomerization of *cis* and *trans*2-butene.
- Relate the charge on the hydrogen atom in hydrogen halides with their acidcharacter.
- Compare the basicities of the nitrogen atoms in ammonia, methylamine,dimethylamine and trimethylamine.
- Compare the shapes of the molecules: 1-butanol, 2-butanol, 2-methyl-1-propanol,and 2-methyl-2-propanol.

Course outcomes

The students have analysed

1. The Qualititative and qualitative calculations involved in the molecular modelling and its usefulness in drug design
2. Comparision of the optimized C-C bond lengths in ethane, ethene, ethyne and benzene.Visualize the molecular orbitals of the ethane σ bonds and ethene, ethyne, benzeneand pyridine π bonds.
3. Performed a conformational analysis of butane.
4. Determination of the enthalpy ofisomerization of *cis a*nd *trans2*-butene.
5. Relate the charge on the hydrogen atom in hydrogen halides with their acidcharacter.
6. Comparision of the shapes of the molecules: 1-butanol, 2-butanol, 2-methyl-1-propanol, and 2-methyl-2-propanol.
7. Compare the shapes of the molecules: 1-butanol, 2-butanol, 2-methyl-1-propanol,and 2-methyl-2-propanol.

Methodology

Free Computer softwares

i. Compare the optimized C-C bond lengths in ethane, ethene, ethyne and benzene. Visualize the molecular orbitals of the ethane σ bonds and ethene, ethyne, benzene and pyridine π bonds.

ii. (a) Perform a conformational analysis of butane. (b) Determine the enthalpy of isomerization of *cis* and *trans* 2-butene.

iii. Visualize the electron density and electrostatic potential maps for LiH, HF, N_2, NO and CO and comment. Relate to the dipole moments. Animate the vibrations of these molecules.

iv. (a) Relate the charge on the hydrogen atom in hydrogen halides with their acid

character. (b) Compare the basicities of the nitrogen atoms in ammonia, methylamine, dimethylamine and trimethylamine.
v. (a) Compare the shapes of the molecules: 1-butanol, 2-butanol, 2-methyl-1-propanol, and 2-methyl-2-propanol. Note the dipole moment of each molecule. (b) Show how the shapes affect the trend in boiling points: (118 ºC, 100 ºC, 108 ºC, 82 ºC,respectively).
vi. Build and minimize organic compounds of your choice containing the following functional groups. Note the dipole moment of each compound: (a) alkyl halide (b) aldehyde (c) ketone (d) amine (e) ether (f) nitrile (g) thiol (h) carboxylic acid (i) ester (j) amide.
vii. (a) Determine the heat of hydration of ethylene. (b) Compute the resonance energy of benzene by comparison of its enthalpy of hydrogenation with that of cyclohexene.
viii. Arrange 1-hexene, 2-methyl-2-pentene, (*E*)-3-methyl-2-pentene, (*Z*)-3-methyl-2-pentene, and 2,3-dimethyl-2-butene in order of increasing stability.
ix. (a) Compare the optimized bond angles H2O, H2S, H2Se. (b) Compare the HAH bond angles for the second row dihydrides and compare with the results from qualitative MO theory.
Note: Software: ChemSketch, ArgusLab (www.planaria-software.com), TINKER 6.2 (dasher.wustl.edu/ffe), WebLab Viewer, Hyperchem, or any similar software.

Suggested Readings

Text Books:

1. Leach, A.R. (2001). *Molecular Modelling Principles and Application*. Longman.
2. Haile, J.M. (1997). *Molecular Dynamics Simulation Elementary Methods*, John Wiley and Sons.

Reference Book:

1. Gupta, S.P. (2008). *QSAR and Molecular Modeling*. Springer - Anamaya Publishers.

Semester-VI

16CHU612B CHEMISTRY-DSE LAB: INDUSTRIAL CHEMICALS AND ENVIRONMENT PRACTICAL **4H 2C**

Instruction Hours/week: L:0 T:0 P:4 **Marks: Internal: 40 External: 60 Total:100**

Course Objectives

The course will enable the student to

- Determine the dissolved oxygen,
- Determine the CO_2,
- Determine the COD and
- Determine the BOD in water
- Determine the chloride, alkalinity of water
- Determine the sulphate content and alkalinity of water

Course Outcomes

The studends have the knowledge

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO3 and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.

Methodology

Titrations

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO3 and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.
7. Measurement of dissolved CO_2.
8. Study of some of the common bio-indicators of pollution.
9. Preparation of borax/ boric acid.

Suggested Readings

Text Books:

1. Felder, R.M. & Rousseau, R.W.(2004). *Elementary Principles of Chemical Processes*. New Delhi: Wiley Publishers.

2. Kent, J. A.(1997). *Riegel's Handbook of Industrial Chemistry.* New Delhi: *CBS* Publishers.
3. Dara, S. S.(2014). *A Textbook of Engineering Chemistry*. New Delhi: S. Chand & Company Ltd.
4. K. De. (2007). *Environmental Chemistry*. New Delhi: New Age International Pvt., Ltd.

Reference Books:

1. Khopkar, S. M.(1993). *Environmental Pollution Analysis*. New Delhi: Wiley Eastern Ltd.
2. Manahan, S.E. (2005). *Environmental Chemistry*. CRC Press.
3. Miller, G.T. (2006). *Environmental Science.* 11th edition. Brooks/ Cole
4. Mishra, A. (2005). *Environmental Studies*. New Delhi: Selective and Scientific Books.

Semester-VI

16CHU613A GREEN CHEMISTRY PRACTICAL 4H 2C

Instruction Hours/week: L:0 T:0 P:4 Marks: Internal: 40 External: 60 Total:100

Course Objectives

The lab course will enable to

- Select safer raw materials
- Identify to use renewable resources
- Understand avoiding waste
- Understand to use alternate green sources of solvents and energy
- To Avoiding waste
- To Use of enzymes as catalysts

Course Outcomes

1. Select safer raw materials
2. Identifying the use renewable resources
3. Understood avoiding waste
4. Understood to use alternate green sources of solvents and energy
5. Avoiding waste
6. Use of enzymes as catalysts

Methodology

Preparation of nanoparticles, Enzyme catalysis, microwave assisted synthesis.

1. Safer starting materials

Preparation and characterization of nanoparticles using tea leaves.

2. Using renewable resources

Preparation of biodiesel from vegetable/ waste cooking oil.

3. Avoiding waste

Principle of atom economy.

Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.

Preparation of propene by two methods can be studied

(I) Triethylamine ion + OH- → propene + trimethylpropene + water

(II) 1-propanol H_2SO_4/propene + water

Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.

4. Use of enzymes as catalysts

Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

5. Alternative Green solvents

Extraction of D-limonene from orange peel using liquid CO_2 prepared form dry ice.

Mechanochemical solvent free synthesis of azomethines

6. Alternative sources of energy

Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).

Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Suggested Readings

Text Books:

1. Anastas, P.T & Warner, J.C. (1998). *Green Chemistry: Theory and Practice.*Oxford University Press.
2. Kirchoff, M. & Ryan, M.A. (2002).*Greener approaches to undergraduate chemistry experiment*. Washington DC: American Chemical Society.
3. Ryan, M.A. (2002). *Introduction to Green Chemistry*. Tinnesand (Ed). Washington DC: American Chemical Society.

Reference Book:

1. Cann, M.C.,& Connelly, M. E. (2008).*Real world cases in Green Chemistry*. American Chemical Society.

Semester-VI

16CHU613B MOLECULES OF LIFE PRACTICAL4H 2C

Instruction Hours/week: L:0 T:0 P:4 Marks: Internal: 40 External: 60 Total:100

Course Objectives

The lab course enable a student to

- Separate amino acids by paper chromatography
- To determine the concentration of glycine solution by formylation method.
- Study of titration curve of glycine
- Study the action of salivary amylase on starch
- Study the effect of temperature on the action of salivary amylase on starch.
- To determine the saponification value of an oil/fat.
- To determine the iodine value of an oil/fat
- Differentiate between a reducing/ nonreducing sugar.
- Extract of DNA from onion/cauliflower
- To synthesise aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.

Course Outcomes

1. Separate amino acids by paper chromatography
2. Determination of the concentration of glycine solution by formylation method.
3. Study of titration curve of glycine
4. Study the action of salivary amylase on starch
5. Study the effect of temperature on the action of salivary amylase on starch.
6. Determination of the saponification value of an oil/fat.
7. Determination the iodine value of an oil/fat
8. Differentiate between a reducing/ nonreducing sugar.
9. Extract of DNA from onion/cauliflower
10. synthesis of aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.

Methodology

Paper chromatography, titrations, extraction of DNA, TLC

1. Separation of amino acids by paper chromatography
2. To determine the concentration of glycine solution by formylation method.
3. Study of titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat
8. Differentiate between a reducing/ nonreducing sugar.
9. Extraction of DNA from onion/cauliflower
10. To synthesise aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.

Suggested Readings

Text Books:

1. Furniss, B.S., Hannaford, A.J., Rogers, V., Smith, P.W.G. &Tatchell, A.R. (1978). *Vogel's Textbook of Practical Organic Chemistry*. ELBS.
2. Ahluwalia, V.K. & Aggarwal, R.(2004). *Comprehensive Practical Organic Chemistry*. Universities Press.

Semester-VI

16CHU691	**PROJECT WORK**	**8H 6C**

Instruction Hours/week: L:0 T:0 P:8Marks: Internal: 40 External: 60 Total:100