BACHELORS WITH CHEMISTRY AS MINOR (CT – I)
SEMESTER 2nd

CHM222N: CHEMISTRY-II

CREDIT: THEORY: 04; PRACTICAL: 02

THEORY (04 CREDITS: CONTACT HOURS: 64)

Course Objectives:

- *To introduce general trends in chemistry of p-block elements.*
- *To understand the chemical behavior of alkyl* halides, alkenes, *alkynes and aromatic compounds.*
- *To understand the concepts of thermodynamics.*

Learning outcomes:

- *The student should be able to comprehend various aspects of p-block elements.*
- *Understand basic concepts of organic reaction mechanisms.*
- *Describe principles of thermodynamics and their* application *to real systems.*

Unit-I p-Block Elements (16 Contact hours)

Boranes: Nomenclature, Classification, Preparation, Properties, Structure and Bonding with special reference to Diborane. Higher boranes (brief idea)
Carbides: Classification, Preparation, Properties and Uses. Intercalation compounds of graphite.
Nitrogen Compounds: Preparation, properties and uses of Hydrazine, oxides and oxoacids of nitrogen.
Oxygen: Chemistry of different forms (atomic, molecular and ozone). Oxides, Fluorides and oxyacids of Sulphur: Structure & Bonding. Hydrogen Peroxide: Preparation, Properties, structure and uses.
Halogens: Comparative chemical reactivity, Properties, Structure & Bonding of hydrogen halides, Interhalogens and Polyhalides. Oxyacids of Chlorine (Structure and Bonding).
Noble gases: Isolation and importance of noble gases, Valence bond treatment of bonding in Fluorides, oxides and oxyfluorides of Xenon:

Unit II: Chemistry of Alkyl Halides, Alkenes and Alkynes (16 Contact Hours)

***Alkyl halides*:** Methods of preparation (two methods) and reactions. Mechanistic details of SN^1 and SN^2; E_1 and E_2 reactions. Effects of structure of alkyl halides, nature of nucleophiles, leaving groups and solvent. Substitution versus Elimination.
Alkenes: Preparation of alkenes from alcohols and alkyl halides through elimination reaction. Hoffman and Saytzev's rules. Mechanistic details including regioselectivity and stereochemical implications of halogenation, hydrohalogenation, hydroboration, epoxidation, hydroxylation and ozonolysis.
Alkynes: Acidic character of alkynes. Catalytic and metal-ammonia reductions of alkynes.

Unit III: Aromatic Substitution Reactions (16 Contact Hours)

Aromaticity: Requirements of aromaticity. Huckel's rule and its significance. Explanation using molecular orbital diagram of benzene. Aromaticity of non-benzenoid compounds like pyrrole, thiophene, furan and aromatic ions (3, 5 and 7-membered rings).
Aromatic electrophilic substitution: General mechanism; formation of sigma and pi complexes. The second substitution: role of activating and deactivating groups. Mechanisms of Gattermann, Huben-Hoesch, Veils-Meir Haack and Riemer-Tieman reactions.
Aromatic nucleophilic substitution:
Discussion of S_N –unimolecular, S_NAr and benzyne mechanisms.

UNIT-IV: Thermodynamics (16 Contact Hours)

Thermodynamic Functions: State and path functions and their differentials. Thermodynamic process, concept of heat and work. Heat capacity, heat capacities at constant volume and constant pressure and their relationship. Joule`s law, Joule-Thomson coefficient and inversion temperature. Calculation of ΔU and ΔH for the expansion of ideal and non-ideal (van der Waals) gases under isothermal and adiabatic co+nditions. Temperature dependence of enthalpy, Kirchhoff's equation.

Bond dissociation energy and its calculation from thermos-chemical data with applications. Second law of thermodynamics: Need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem, Thermodynamic scale of temperature.

Concept of entropy, entropy as a function of V and T, and as a function of P and T. Clausius inequality; entropy as criteria for spontaneity and equilibrium. Entropy change in physical processes, ideal gas expansion and entropy of mixing of ideal gases.

Third law of thermodynamics: Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, Nernst heat theorem, third law of thermodynamics, concept of residual entropy, evaluation of absolute entropy from heat capacity data. ΔG & ΔA as riteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T, Gibbs-Helmholtz equation.

Books Recommended:

1. Concise Inorganic Chemistry; J.D. Lee; 5thEdn., OUP/Wiley India Pvt. Limited, 2008
2. Chemistry of the Elements; N. N. Greenwood, A. Earnshaw; 2nd Edn., Elsevier India, 2010.
3. Principles of Inorganic Chemistry; B.R. Puri, L.R. Sharma and K.C. Kalia; 33rdEdn., Milestone Publishers & Distributors/ Vishal Publishing Co., 2017
4. Advanced General Organic Chemistry: A Modern Approach; S.K. Ghosh; 3rd Revised Edn., New Central, 2010.
5. Organic Chemistry; R.T. Morrison, R.N. Boyd, S. K. Bhattacharjee; 7th Edn., Pearson India, 2011.
6. Organic Chemistry; P.Y. Bruice; 8thEdn., Pearson Education, 2017.
7. Advanced Organic Chemistry; Dr. Jagdamba Singh and LDS Yadav; Pragati edition, 2017.
8. Principles of Physical Chemistry; B.R. Puri, L.R. Sharma and L.S. Pathania; 47th Edn.,Vishal Pubs & Co, 2017.
9. Physical Chemistry; T. Engel, P. Reid,;3rd Edn., Pearson India, 2013.

PRACTICAL: 02 CREDITS (CONTACT HOURS: 64)

Course Objectives:

- To estimate concentrations of constituents in real samples.
- To prepare some important organic compounds and detect their functional groups
- To determine thermodynamic properties of solutions

Learning outcomes:

On completion of the course, the student should be able to:

- Determine concentrations of ions.
- Synthesize and identify functional groups in different organic compounds.
- Determine heat capacity, enthalpy of neutralization and enthalpy of ionization of an acid.

Section A: Inorganic Chemistry

1. Determination of acetic acid concentrations in commercial vinegar using NaOH.

2. Determination of calcium content in chalk as calcium oxalate by permanganometry.
3. Determination of ferrous ions by redox titration (dichromate method).

Section B: Organic Chemistry

1. Functional Group Identification: Aromatic hydrocarbons, unsaturation, carboxylic acids, carbonyl compounds, phenols, alcohols, amines, amides, nitro compounds.
2. Preparation, recrystallization, percent yield and identification (melting point) of the following reactions products (Any two).*
   (a) Bromination of Phenol/Aniline
   (b) Benzoylation of Aniline/Phenol
   (c) 2, 4-dinitrophenylhydrazone formation of aldehyde/Ketones

* *Any other feasible single stage synthesis*

Section C: Physical Chemistry

1. Determination of water equivalent of a calorimeter.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide
3. Determination of enthalpy of ionization of acetic acid.

Books Recommended:

1. Vogel's; text book of Quantitative Inorganic Analysis (revised); Bassett, J.; Denney, R.C.; Jeffery, G. H and Mendham, J.; 6th ed.; ELBS; 2007.
2. Comprehensive Practical Organic Chemistry: Qualitative analysis Ahluwalia, V.K. &Sunita Dhingra; Universities Press, India, 2004.
3. Advanced Practical Organic Chemistry; N. K. Vishnoi; 3rdEdn; Vikas Publishing, 2009.
4. Advanced Practical Physical Chemistry; J.B. Yadav; Krishna Prakashan Media (P)Limited, 2015.
5. Selected Experiments in Physical Chemistry; Mukherjee N.G.& Ghosh, J.N.; S. Chand & Sons.
6. Advanced Physical Chemistry Experiments; J. N. Gurtu, A. Gurtu, PragatiPrakashan, 2008.
7. Experiments in Physical Chemistry; Das, R. C, and Behra, B.; Tata McGraw Hill.