



## CHEMISTRY

(Minor)

(4th Semester)

Course No.: **CHM-DSM-252**

**(Fundamentals of Chemistry -II)**

**Contact Hours: 45; Credits: 03**

**Full Marks = 100**[End Semester Exam (70) Internal Assessment (30)]

**Pass Marks = 40** [End Semester Exam (28) Internal Assessment (12)]

### **UNIT-I: s- and p- block elements**

*s-Block Elements (Alkali and Alkaline Earth Metals):*

*Group 1 and Group 2 Elements:* General introduction, electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in variation of properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens, uses. Preparation and Properties of Sodium Carbonate, Sodium Chloride, Sodium Hydroxide and Sodium Hydrogen carbonate, Biological importance of Sodium and Potassium. Calcium oxide and Calcium Carbonate and their industrial uses, Biological importance of Magnesium and Calcium.

*p block Elements:*

*Group 13 Elements:* General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group, Boron-physical and chemical properties, some important compounds, Borax, Boric acid, Boron Hydrides, Aluminium: Reactions with acids and alkalis, uses.

*Group 14 Elements:* General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behavior of first element. Carbon-catenation, allotropic forms, physical and chemical properties; uses of some important compounds: oxides. Important compounds of Silicon and a few uses: Silicon Tetrachloride, Silicones, Silicates and Zeolites, their uses.

### **Unit II: Chemical Thermodynamics**

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature– Kirchhoff's equation.

### **Unit III: Solutions and Phase Equilibria**

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Azeotropes.

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs



Phase Rule. Phase diagrams of one-component systems (water and sulphur).

#### **UNIT-IV: Aliphatic and Aromatic Hydrocarbons**

*Alkanes:* Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution (Halogenation).

*Alkenes:* Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkylhalides (Saytzeff's rule). Reactions: cis-addition (alk.  $\text{KMnO}_4$ ) and trans-addition(bromine), Addition of HX (Markownikoff's and anti Markownikoff's addition), Hydration, Ozonolysis.

*Alkynes:* Preparation: Acetylene from  $\text{CaC}_2$  and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline  $\text{KMnO}_4$ , ozonolysis and oxidation with hot alk.  $\text{KMnO}_4$ .

#### **UNIT-V: Alkyl and Aryl Halides**

*Alkyl Halides:* Types of Nucleophilic Substitution ( $\text{SN}_1$ ,  $\text{SN}_2$  and  $\text{SN}_i$ ) reactions. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis; Elimination vs substitution.

*Aryl Halides:* Preparation: (Chloro, bromo and iodo-benzene) from phenol, Sandmeyer & Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by  $-\text{OH}$  group) and effect of nitro substituent. Benzyne Mechanism:  $\text{KNH}_2/\text{NH}_3$  (or  $\text{NaNH}_2/\text{NH}_3$ ). Reactivity and relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

#### **Reference Books:**

- Puri, Sharma, Kalia; Principles of Inorganic Chemistry, Vishal Publishing Co.
- Puri, Sharma, Pathania; Principles of Physical Chemistry, Vishal Publishing Co.
- Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.
- Ghosh, Sachin Kumar; Advanced General Organic Chemistry: A Modern Approach (vol 1 & 2), NCBA
- Jain, M. K., Sharma, S. C.; Modern Organic Chemistry; Vishal Publishing Co.