SEMESTER –II

CHEMISTRY- C- III
ORGANIC CHEMISTRY- I

(Credits: Theory-04, Practicals-02) **End Sem- 60marks**
Theory: 60 Lectures **Mid Sem- 15marks**

Unit -I
BASICS OF ORGANIC CHEMISTRY:

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.
Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.
Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.
Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

(12 Lectures)

Unit - II
STEREOCHEMISTRY

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism, E/Z notations

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

(14 Lectures)

Unit – III
CHEMISTRY OF ALIPHATIC HYDROCARBONS- I

(a) CARBON-CARBON SIGMA BONDS

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

(b) Cycloalkanes and Conformational Analysis

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes (C_2H_6, C_4H_{10}, Cyclohexane), Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

(8 Lectures)

Unit – IV
CHEMISTRY OF ALIPHATIC HYDROCARBONS- II

CARBON-CARBON PI BOND

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroborationoxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes.

Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

(14 Lectures)

Unit - V
AROMATIC HYDROCARBONS

(a) Kekule & Deewar structures of Benzene, Stability, hybrid structure, C –C bond lengths, MO picture. Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples; Aromatic, non-aromatic & anti-aromatic compounds/ions.

(b) Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism.

(c) Orientation- Concept, activating and deactivating substituents, explanation of orientation,ortho/para ratio.

(12 Lectures)

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Reference Books:

• Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

• Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

• Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

• Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.

• Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

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CHEMISTRY LAB-C II LAB

(F.M=25)

(Expt. -15, Viva Voce- 6 & Lab. Record- 4) **Time – 3hrs**

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 above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)

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 and capillary method)

6. Estimation of Phenol, Aniline and Glucose.

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Reference Books

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

• Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)

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CHEMISTRY - C IV
PHYSICAL CHEMISTRY II

(Credits: Theory-04, Practicals-02) **End Sem- 60marks**

Theory: 60 Lectures **Mid Sem- 15 marks**

Time- 3hrs

Unit-I

CHEMICAL THERMODYNAMICS:

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

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, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. **(12 Lectures)**

Unit-II

Second Law: statement of the second law, Carnot's theorem, Carnot's cycle & its efficiency, Concept of entropy; entropy as a function of V & T, P & T. Entropy change in ideal gases and mixing of gases. Calculation of entropy change for reversible and irreversible processes. Entropy change of the universe.

Third Law: Statement of third law, concept of residual entropy, Nernst heat theorem, calculation of absolute entropy of molecules.

(10 Lectures)

Unit-III

(a) 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; thermodynamic equation of state.

(b) 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.

(12 Lectures)

Unit- IV

CHEMICAL EQUILIBRIUM

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants Kp, Kc and Kx. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

(14 Lectures)

Unit- V

Solutions and Colligative Properties

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. 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. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

(12 Lectures)

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Reference Books

• Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press (2011).

• Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004).

• Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).

• McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).

• Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. Commonly Asked Questions in Thermodynamics. CRC Press: NY (2011).

• Levine, I .N. Physical Chemistry 6th Ed., Tata Mc Graw Hill (2010).

• Metz, C.R. 2000 solved problems in chemistry, Schaum Series (2006)

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CHEMISTRY LAB- C IV LAB
(Expt. -15, Viva Voce- 6 & Lab. Record- 4)

Time – 3hrs **(Full Marks -25)**

(a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).
(b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
(c) Calculation of the enthalpy of ionization of ethanoic acid.
(d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
(e) Determination of basicity/proticity of a polyprotic 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 copper sulphate.
(g) Study of the solubility of benzoic acid in water and determination of ΔH.
(h) To study the kinetics of the acid hydrolysis of ester
(i) Determination of percentage of available free chlorine in bleaching powder.
(j) Determination of Partition coefficient of I_2 between benzene and water

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Reference Books

• Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
• Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).

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