B. Sc. SEMESTER – I
CHM 111(T): General Chemistry – I

Credit – 4, Hours – 60, Marks - 100

Course Outcomes:

After the completion of this course, student will be able to-

CO-1. Gain the fundamental knowledge of theory of atoms, wave functions, quantum mechanics, different hydrocarbons and organic compounds, radioactive substance and radio activity.

CO-2. Understand the basic concepts of Structure of atom, hydrocarbons, Alcohols, Phenols and Nuclear Chemistry.

CO-3. Understand interpretation, analysis, investigation and solution problems regarding atom, radioactivity, organic compounds and reactions.

CO-4. Gain the skills regarding the solutions of problems related with industries and efficiency to work in industries.

CO-5. Solve the problems related to atom, quantum numbers, organic reaction, Organic reaction mechanism, organic compounds, Nuclear energy and Nuclear Chemistry.

CO-6. Gain research ideas about wave mechanics, organic compounds and Nuclear reaction.

CO-7. Justify the derivations and principles related to structure of atom, organic reaction mechanism, Nuclear reactions and Nuclear energy and also some interdisciplinary ideas.

CO-8. Participate in the discussion, involvement in classroom teaching, laboratory work and field based work.

CO-PO mapping (connecting COs with POs)

The mapping is a matrix with rows and columns as POs

Each element/cell of the matrix has a value in {--, 1,2,3}

The meaning associated with the values are as follows:

-- this CO (row) has nil/insignificant contribution to the PO (column)

1 Relevant and small significant

2 Medium and moderate significant

3 Strong and high level of significant

These values have to be justified in the T-L-A of the course, particularly in terms of the BLOOM level of the question/problems

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	3	2		2				
CO-2	2	3	2			2		
CO-3		2	3		3			1
CO-4				3			2	
CO-5	2	2	3					
CO-6				2			3	2
CO-7					2			3
CO-8	3	2	2			3		

UNIT – I - Structure of atom **[25 Marks]**
[15 Hours]

Bohr's principle and its limitations, Atomic spectrum of Hydrogen atom, Development leading to Quantum or Wave mechanical model of atom, de Broglie equation, Heisenberg's Uncertainty principle and its significance, Need of Quantum mechanical model of atom, Derivation of Schrodinger wave equation, significance of ψ and ψ^2, Quantum mechanical model of atom (Concept of atomic orbital), Difference between orbit and orbital, Quantum numbers and their significance, Radial and angular wave function for hydrogen atom, Radial function plots, Radial probability distribution plots, Shape of s, p and d atomic orbitals, Boundary surface diagram, Relative energies of orbitals, Aufbau principle and its limitations, Pauli Exclusion principle, Hund's rule of maximum multiplicity.

UNIT – II - Aliphatic Hydrocarbons **[25 Marks]**
[15 Hours]

Alkane:

Introduction, IUPAC Nomenclature and Bond line Structure, Methods of Preparation: - Wurtz reaction, Corey–House Synthesis (Gilman reagent), Hydrolysis of R-Mg-X, Decarboxylation of carboxylic acids and Kolbe electrolysis, Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity (with Energy considerations), Nitration of alkane (only reaction).

Alkene:

Introduction, IUPAC Nomenclature and Bond line Structure, Methods of Preparation: - Dehydration of alcohols (with mechanism), Regioselectivity in alcohol dehydration, dehalogenation, dehydrogenation, dehydro halogenation of alkyl halides, The Saytzeff rule, Hofmann elimination (Only introduction,

without mechanism), Mechanisms involved in hydrogenation, electrophilic and free radical additions, Markovnikov's rule, peroxide effect, hydroboration-oxidation, and oxymercuration - reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation (i) with cold alkaline $KMnO_4$ (Baeyer's reagent), (ii) Oxidative cleavage with acidified or hot $KMnO_4$ (iii) Ozonolysis (O_3), Polymerization of alkenes, substitution at the allylic and vinylic positions of alkenes.

Alkynes:

Introduction, IUPAC Nomenclature and Bond line Structure, Methods of Preparation: Dehydrohalogenation, dehalogenation, Acidity of Alkynes (Na,Ag, Cu), Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal ammonia and metal reductions (cis and trans), and polymerization.

UNIT – III – Alcohol, Phenol and Ether **[25 Marks] [15 Hours]**

Introduction of alcohol, phenol and ether, Classification of alcohol, phenol and ether, Nomenclature of alcohol, phenol and ether, Electronic structure of alcohol, phenol and ether.

General methods of preparation of monohydric alcohols: [By the hydrolysis of haloalkanes with aqueous alkali (Hydrolysis of 1^0 halides by SN^2 mechanism, Hydrolysis of 3^0 halides by SN^1 mechanism), By hydration of alkenes with mechanism (according to Markownikoff's rule), Reaction of Grignard reagent to aldehydes and ketone (Preparation of 1^0, 2^0 and 3^0 alcohols), Hydroboration-oxidation (only reaction), Hydrolysis of ester (only reaction), Action of HNO_2 on primary aliphatic amine (only reaction)]

General methods of preparation of Phenols: [Alkali fusion of sulphonates, From benzene diazonium chlorides (by hydrolysis), Cumene process, Decarboxylation of salicylic acid (only reaction)]

Physical properties of alcohols and phenols,

Chemical reactions of alcohols: [With active metal, carboxylic acid, PX_3, PX_5 and $SOCl_2$, Oxidation of 1^0, 2^0 and 3^0 alcohols (only reaction)], Dehydration by Conc. H_2SO_4, Chemical reactions of Phenols: [Acylation, Benzoylation (Schotten-Boumann reaction), Kolbe-Schmidt reaction, Reimer–Tieman reaction, Gattermann's reaction (only reaction)]

Distinction of 1^0, 2^0 and 3^0 alcohols: [Dehydrogenation (action of Cu (Δ)), Lucas test (with mechanism), Victor meyer's test (only reaction)]

Distinction test between alcohols and Phenols: [$FeCl_3$ test, CAN test, Br_2 water test (only reaction)].

General methods for preparation of ether (Clemenson and Williumson's ether synthesis, Reaction with HI (only reactions)

UNIT – IV - Nuclear Chemistry **[25 Marks]**
[15 Hours]

Radioactivity, History of the discovery of radioactivity and analysis of radioactive radiations. Theory of radioactive disintegration (α - particle and β - particle emission).Group displacement law (Example related group displacement law), Radioactive disintegration series (Thorium, Uranium and Actinium series), Rate of radioactive disintegration constant or decay constant, Relationship between half-life period and radioactive disintegration constant, Average life period, Example related decay constant and half-life period, Units of radioactivity, Types of nuclear reactions, Nuclear Fission and fusion reactions, Factors affection on nuclear stability (Mass defect, nuclear binding energy, neutron – proton ratio).

REFERENCE BOOKS

1. **'Introductory Quantum Chemistry'** by A. K. Chandra, 4th Ed., 2017, Tata Mc Graw Hill PublishingCompany Limited, New Delhi.

2. **'Quantum chemistry'** by R. K. Prasad, 2nd Ed.,1996, New Age International publishers.

3. **'Basic Inorganic Chemistry'** by F. A. Cotton, Geoffrey Wilkinson, Carlos A Murilloand Manfred Bochmann, 6th Ed., Wiley publication.

4. **'Concise Inorganic Chemistry'** by J. D. Lee, 5th Ed., 2013, Wiley India.

5. **'Satya Prakash's Modern Inorganic Chemistry'** by Dr. R. D. Madan, 1987, S. Chand, New Delhi.

6. **'Principles of Inorganic Chemistry'** by Puri, Sharma and Kalia, 2018, Vishal Publishing Co., Jallandhar – Delhi.

7. ***'Organic Chemistry'*** *Morrison, R.T. and Boyd, R.N. 6th Ed. 1992, Prentice Hall* International, Inc., London.

8. **'Text book of Organic Chemistry'** by P. L. Soni and H. Chawla, 26/E, 1995, Sultan Chand & Sons Publication, New Delhi.

9. **'Text book of Organic Chemistry'** by P. S. Kalsi, 1999, MacMillan of India Pvt. Ltd.

10. **'Organic Chemistry'** by Bhupinder Mehta, Manju Mehta, 2/E, 2015, Prentice Hall of India Pvt. Ltd, New Delhi.

11. **'Elements of Physical Chemistry'** by Peter Atkins & Julio De Paula, 5/E, Indian Edition, OxfordUniversity Press.

12. **'Physical Chemistry'** by P. W. Atkins, 7/E, 2002, IndianEdition Oxford University Press.

13. '**Principle of Physical Chemistry**' by Puri, Sharma & Pathania, 41/E, Vishal Publishers.

14. '**Essentials of Physical Chemistry**' by Bahl & Tuli, 22/E, S. Chand publication, New Delhi.