

**DEBRA THANA SAHID KSHUDIRAM  
SMRITI MAHAVIDYALAYA  
(AUTONOMUS)**

Gangaram Chak, Chak Shyampur, Debra, West Bengal



*SYLLABUS  
OF*

**BACHELOR OF SCIENCE WITH CHEMISTRY  
(MULTIDISCIPLINARY STUDIES)**

**3 -YEAR UNDERGRADUATE PROGRAMME  
(w.e.f. Academic Year 2024-2025)**

*Based on*

**Curriculum & Credit Framework for Undergraduate  
Programmes (CCFUP), 2023 & NEP, 2020**



**3 -YEAR UNDERGRADUATE PROGRAMME**

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks			
								CA	ESE	Total	
B.Sc. in Life Science or physical science with chemistry	1 <sup>st</sup>	I	<b>Semester- I</b>								
			Major (Disc.-A1)	CEMPMJ101	Atomic Structure, Acid and Bases, Organic chemistry-1, Stereochemistry, Kinetic theory of gases, Real gases Practical	4	3-0-1	15	60	75	
			SEC	SEC01	Cosmetics, Cleaning agent and others	3	0-0-3	10	40	50	
			AEC	AEC01	Communicative English-I	2	2-0-0	10	40	50	
			MDC	MDC01	Multidisciplinary Course-I (to be chosen from list)	3	3-0-0	10	40	50	
			VAC	VAC01	ENVS	4	2-0-2	50	50	100	
		Minor CEM (Disc.-C1)	CEMMI01/C1	Atomic Structure, Acid and Bases, Organic chemistry-1, Stereochemistry, Kinetic theory of gases, Real gases Practical	4	3-0-1	15	60	75		
				Total	20				400		

P MJ= Major Programme (Multidisciplinary), MI = Minor, A/B = Choice of Major Discipline; C= Choice of Minor Discipline; SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, VAC = Value Added Course; CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language, ENVS = Environmental Studies

# Semester-I

## Major (Disc.-A1)

**CEMPMJ101**

**(45 Lectures)**

### ▪ Atomic Structure:

**(10Lectures)**

Review of Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d 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 1s and 2s atomic orbitals. Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

### ▪ Acids and bases

**(7Lectures)**

Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

### ▪ Organic Chemistry-1

**(10Lectures)**

Fundamentals of Organic Chemistry Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

### ▪ Stereochemistry

**(8Lectures)**

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis – trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems)

### ▪ Kinetic Theory of Gases and Real gases

**(8Lectures)**

Concept of pressure and temperature; Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Rate of effusion Nature of distribution of velocities, Maxwell's distribution of speed and kinetic energy; Average velocity, root mean square velocity and most probable velocity; Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases Deviation of gases from ideal behavior; compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van der Waals equation and its features; its derivation and application in explaining real gas behaviour; Existence of critical state, Critical constants in terms of van der Waals constants; Law of corresponding states Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

## Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry ELBS, 1991.*
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry, 3rd ed., Wiley.*
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry, John Wiley & Sons.*

4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006
5. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
6. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
7. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
8. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
9. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
10. Chugh, K.L., Agnish, S.L. *A Text Book of Physical Chemistry* Kalyani Publishers
11. Bahl, B.S., Bahl, A., Tuli, G.D., *Essentials of Physical Chemistry* S. Chand & Co. Ltd.
12. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
13. Mandal, A. K. *Degree Physical and General Chemistry* Sarat Book House
14. Pahari, S., *Physical Chemistry* New Central Book Agency
15. Pahari, S., Pahari, D., *Problems in Physical Chemistry* New Central Book Agency
16. Mukherjee, R.C., *Modern Approach to Physical Chemistry I & II* Bharati Bhawan

## Course code- CEMMI01 Practical (15 Lectures)

### Organic

- Separation, based upon solubility, by using common laboratory reagents like water (cold, hot), dil. HCl, dil. NaOH, dil. NaHCO<sub>3</sub>, etc., of components of a binary solid mixture; purification of any one of the separated components by crystallization and determination of its melting point. The composition of the mixture may be of the following types: Benzoic acid/p-Toluidine; p-Nitrobenzoic acid/p-Aminobenzoic acid; p-Nitrotoluene/p-Anisidine; etc.
- Determination of boiling point of common organic liquid compounds e.g., ethanol, cyclohexane, chloroform, ethyl methyl ketone, cyclohexanone, acetylacetone, anisole, crotonaldehyde, mesityl oxide, etc. [Boiling point of the chosen organic compounds should preferably be less than 160 °C]
- Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)

### Inorganic

- Calibration and use of apparatus.
- Preparation of primary and secondary standard solutions (Oxalic Acid, K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, KMnO<sub>4</sub> etc.)
- Estimation of carbonate and hydroxide present together in mixture

Estimation of carbonate and bicarbonate present together in a mixture

### Reference Books:

1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
2. Das, S. C., Chakraborty, S. B., *Practical Chemistry*.
3. Mukherjee, K. S. *Text book on Practical Chemistry*, New Oriental Book Agency.
4. Ghosal, Mahapatra & Nad, *An Advanced course in practical Chemistry*, New Central Book Agency.
5. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.

## **SEC**

### **SEC01**

(25 Lectures)

A. Preparation and quality analysis of some important chemicals, cleaning agent and cosmetics

- Methyl salicylate
- Soap base
- Hair shampoo
- Dish wash Powder
- Liquid Detergent
- Hand wash Liquid
- Marble floor cleaner
- Phenyl
- Face wash
- Nail polish remover
- Face powder

B. Field visit and submission of the Report

#### **Reference Books:**

1. Stocchi, E. *Industrial Chemistry, Vol, Ellis Horwood Ltd. UK (1990). Jain,*
2. P.C. & Jain, M. *Engineering Chemistry DhanpatRai & Sons, Delhi.Sharma,*
3. B.K. & Gaur, H. *Industrial Chemistry, Goel Publishing House, Meerut (1996).*

#### **Minor (Disc.-C1)**

**Same as CEMPMJ101**

#### **Minor (Disc.-C2)**

**CEM MI 02/C2**

Same as Minor (Disc.-C1)