

# VIDYASAGAR UNIVERSITY

Midnapore, West Bengal



*PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF*

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

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**3-YEAR UNDERGRADUATE PROGRAMME**  
*(w.e.f. Academic Year 2023-2024)*

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

**VIDYASAGAR UNIVERSITY**  
**BACHELOR OF SCIENCE IN LIFE SCIENCES/ PHYSICSL SCIENCES with CHEMISTRY**  
*(under CCFUP, 2023)*

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks			
								CA	ESE	TOTAL	
BSc. in Life Sc. / Physical Sc. with Chemistry	1 <sup>st</sup>	I	SEMESTER-I								
			Major (Disc.-A1)	CEMPMJ101	T: Atomic Structure, Redox Reactions and precipitation reactions, general organic chemistry & aliphatic hydrocarbons; P: Practical (To be studied by the students taken Chemistry as Discipline-A)	4	3-0-1	15	60	75	
			SEC	SEC01	To be chosen from SEC-01 of Discipline A/B/C of their Hons. prog.	3	0-0-3	10	40	50	
			AEC	AEC01	Communicative English-1 (common for all programmes)	2	2-0-0	10	40	50	
			MDC	MDC01	Multidisciplinary Course-1 (to be chosen from the list )	3	3-0-0	10	40	50	
			VAC	VAC01	VAC-01: ENVS (common for all programmes)	4	2-0-2	50	50	100	
			Minor (Disc.-C1)	CEM MI01/C1	T:Atomic Structure, Acids and Bases, Redox Reactions & States of Matter; P: Practical (To be studied by the students taken Chemistry as Discipline-C)	4	3-0-1	15	60	75	
		Semester-I Total			20				400		
		II	SEMESTER-II								
			Major (Disc.-B1)		To be decided (Same as like A1 for students taken Chemistry as Discipline-B )	4	3-0-1	15	60	75	
			SEC	SEC02	To be chosen from SEC-02 of Discipline A/B/C of their Hons. prog.	3	0-0-3	10	40	50	
			AEC	AEC02	MIL-1 (common for all programmes)	2	2-0-0	10	40	50	
			MDC	MDC02	Multi Disciplinary Course-02 (to be chosen from the list )	3	3-0-0	10	40	50	
			VAC	VAC02	VAC-02 (to be chosen from the list)	4	4-0-0	10	40	50	
			Minor (Disc.-C2)	CEM MI 02/C2	T:States of Matter & Chemical Kinetics; P: Practical (To be studied by the students taken Chemistry as Discipline-C)	4	3-0-1	15	60	75	
		Summer Intern.	CS	Community Service	4	0-0-4	-	-	50		
		Semester-II Total			24				400		
		TOTAL of YEAR-1			44	-	-	-	800		

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

VIDYASAGAR UNIVERSITY, PASCHIM MIDNAPORE, WEST BENGAL

## MAJOR (MJ)

**MJ A1/B1: Atomic Structure, Redox Reactions and precipitation reactions, general organic chemistry & aliphatic hydrocarbons** Credits 04 (FM: 75)

**MJ A1/B1T: Atomic Structure, Redox Reactions and precipitation reactions, general organic chemistry & aliphatic hydrocarbons** Credits 03 [45L]

### Course contents:

#### *Section A: Inorganic Chemistry-1*

##### **Atomic Structure:**

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 wavefunctions (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.

##### **Redox Reactions and precipitation reactions**

Ion-electron method of balancing equation of redox reaction. Elementary idea on standard redox potentials with sign conventions, Nernst equation (without derivation). Influence of complex formation, precipitation and change of pH on redox potentials; formal potential. Feasibility of a redox titration, redox potential at the equivalence point, redox indicators. Redox potential diagram (Latimer and Frost diagrams) of common elements and their applications. Disproportionation and comproportionation reactions (typical examples)

Solubility product principle, common ion effect and their applications to the precipitation and separation of common metallic ions as hydroxides, sulfides, phosphates, carbonates, sulfates and halides.

#### *Section B: Organic Chemistry-1*

##### **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**

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).

##### **Aliphatic Hydrocarbons**

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

**Alkanes:** (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

**Alkenes:** (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk.  $\text{KMnO}_4$ ) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

**Alkynes:** (Upto 5 Carbons) *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.  $\text{KMnO}_4$ .

### Suggested Readings:

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. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
6. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
7. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
8. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
9. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
10. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
11. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.

## MJ A1/B1P: Atomic structure, Bonding, general organic chemistry & aliphatic hydrocarbons (Practical) Credits 01

### Course Outline:

#### Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with  $\text{KMnO}_4$ .
3. Estimation of water of crystallization in Mohr's salt by titrating with  $\text{KMnO}_4$ .
4. Estimation of  $\text{Fe(II)}$  ions by titrating with  $\text{K}_2\text{Cr}_2\text{O}_7$  using redox indicator..
5. Estimation of  $\text{Cu(II)}$  ions iodometrically using  $\text{Na}_2\text{S}_2\text{O}_3$ .

#### Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Separation of mixtures by Chromatography: Measure the  $R_f$  value in each case (combination of two compounds to be given)
  - (a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
  - (b) Identify and separate the sugars present in the given mixture by paper chromatography.

### Suggested Readings:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

**MINOR (MI)**

**MI-1/C1: Same as Minor-1 (CEMMI01) of Chemistry (Hons) programme**

**Credits 04**  
**Full Marks: 75**

**MI-2/C2: Same as Minor-2 (CEMMI02) of Chemistry (Hons) programme**

**Credits 04**  
**Full Marks: 75**

**SKILL ENHANCEMENT COURSE (SEC)**

**TO BE CHOSEN FROM THE BUCKET OF SECs OF SELECTED DISCIPLINE A/B/C**  
**(As per A/B/C Hons. Prog. Syllabus)**