

DEBRA THANA SAHID KSHUDIRAM
SMRITI MAHAVIDYALAYA
(AUTONOMUS)
Gangaram Chak, Chak Shyampur, Debra, West Bengal

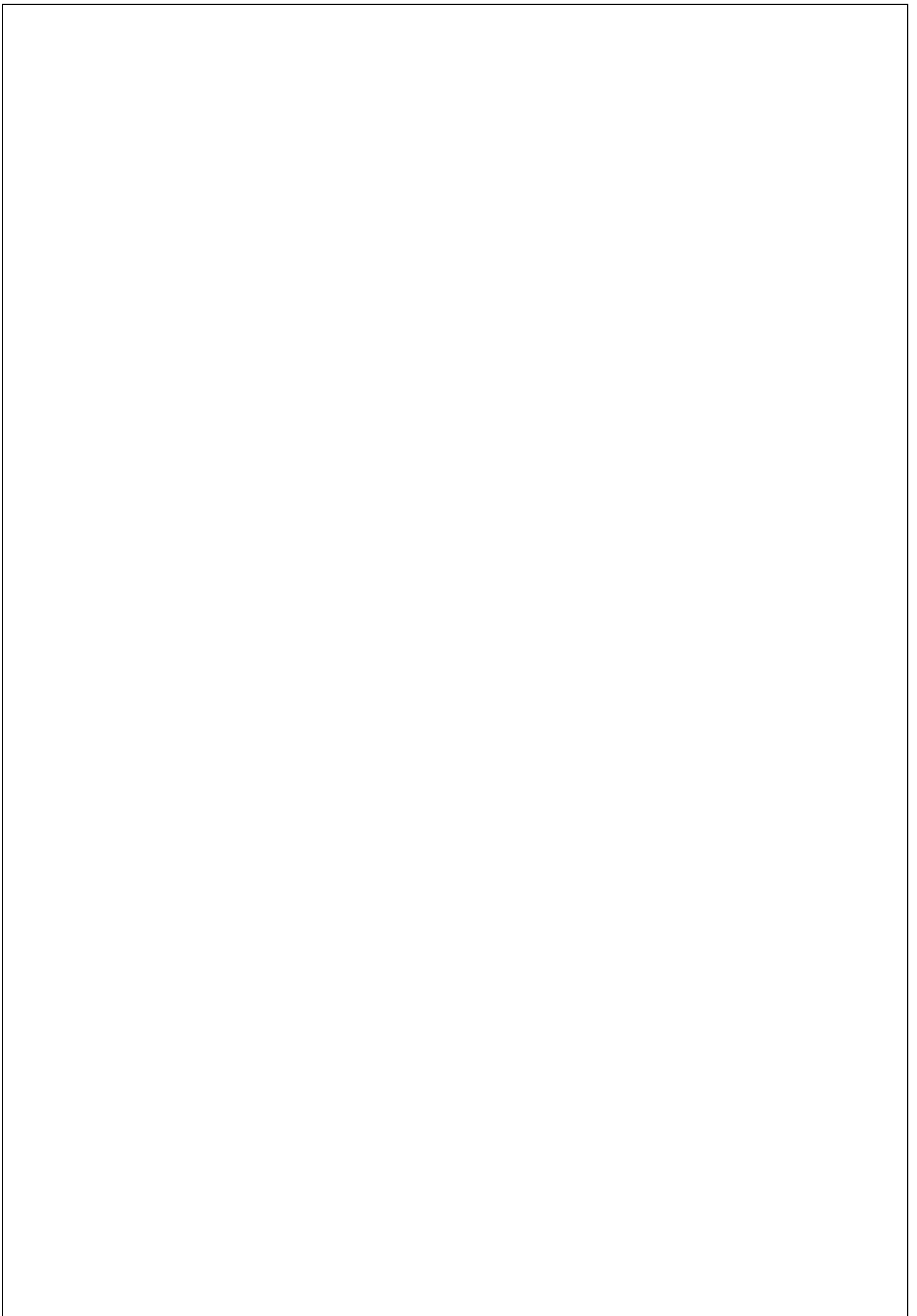


PROPOSED SYLLABUS (DRAFT)
OF
**BACHELOR OF SCIENCE WITH CHEMISTRY (MULTIDISCIPLINARY
STUDIES)**

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 (w.e.f. Academic Year 2024-2025)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks				
								CA	ESE	TOTAL		
B.Sc. in Life Sc. / Physical Sc. with Chemistry	1 st	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

Semester-I

Major (Disc.-A1)

CEMPMJ101

(45 Lectures)

▪ Atomic Structure:

(10 Lectures)

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

(7 Lectures)

Brønsted–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

(10 Lectures)

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

(8 Lectures)

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

(8 Lectures)

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 & IIBharati 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. NaHCO₃, 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, K₂Cr₂O₇, KMnO₄ 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)

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

Reference Books:

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

Minor (Disc.-C1)

Same as CEMPMJ101

Semester-II

Major (Disc.-B1)

Same as CEMPMJ101

SEC SEC02

Same as SEC01

Minor (Disc.-C2)

CEM MI 02/C2

Minor (Disc.-C2)

Paper - CEM MI 02/ C2

Redox Reactions and precipitation reactions, aliphatic hydrocarbons and Chemical Kinetics

- **Redox Reactions and precipitation reactions (16 Lectures)**

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.

- **Aliphatic Hydrocarbons (16 Lectures)**

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. 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 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 KMnO_4 , ozonolysis and oxidation with hot alk. KMnO_4 .

- **Chemical Kinetics (13 Lectures)**

Introduction of rate law, Order and molecularity; Extent of reaction; rate constants; Rates of First, second and nth order reactions and their Differential and integrated forms (with derivation); Pseudo first order reactions; Determination of order of a reaction by half-life and differential method; Opposing reactions, consecutive reactions and parallel reactions Temperature dependence of rate

constant; Arrhenius equation, energy of activation; Collision theory; Lindemann theory of unimolecular reaction; outline of Transition State theory (classical treatment).

Reference Books

1. Clayden, J., Greeves, N., Warren, S. Organic Chemistry, Second edition, Oxford University Press 2012.
2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
3. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
4. Carey, F. A. & Giuliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
5. Mandal, A. K. Degree Physical and General Chemistry Sarat Book House
6. Pahari, S., Physical Chemistry New Central Book Agency
7. Pahari, S., Pahari, D., Problems in Physical Chemistry New Central Book Agency
8. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
9. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
10. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.

Practical

Total - 15 Lectures

1. Estimation of oxalic acid by titrating it with KMnO_4 .
2. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
3. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
4. Study of kinetics of acid-catalysed hydrolysis of methyl acetate
5. Study of kinetics of decomposition of H_2O_2

Reference Books

1. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry Viva Books (2009)
2. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson

3. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007)
4. Palit, S.R., De, S. K. Practical Physical Chemistry Science Book Agency
5. University Hand Book of Undergraduate Chemistry Experiments, edited by Mukherjee, G. N., University of Calcutta