DEBRA THANA SAHID KSHUDIRAM SMRITI MAHAVIDYALAYA (AUTONOMUS)

Gangaram Chak, Chak Shyampur, Debra, West Bengal

SYLLABUS

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN CHEMISTRY

4-YEAR UNDERGRADUATE PROGRAMME

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

Based on

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

4 YEAR UNDERGRADUATE PROGRAMME

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	Total
B.Sc. (Hons.)	1st	I	**Semester- I**							
			Major-1	**CEMHMJ101**	**Fundamental Chemistry -1** Extra nuclear structure of atoms and periodicity, Basic organic chemistry (bonding & physical properties), Stereochemistry-1, Thermodynamics-1, Chemical kinetics-1 **Practical**	4	3-0-1	15	60	75
			SEC	**CEMSEC01**	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.-I)	**CEMMI01**	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
		II	**Semester- II**							
			Major-2	**CEMHMJ102**	**Fundamental Chemistry -2** Kinetic theory and gaseous state, Chemical bonding-I, Redox reaction **Practical**	4	3-0-1	15	60	75
			SEC	**CEMSEC02**	Water soil analysis, TLC, Adulterants, Separation	3	0-0-3	10	40	50
			AEC	**AEC02**	MIL-1	2	2-0-0	10	40	50
			MDC	**MDC02**	Multidisciplinary Course-II (to be chosen from list)	3	3-0-0	10	40	50
			VAC	**VAC02**	Value added course-02	4	4-0-0	10	40	50
			Minor CEM (Disc.-II)	**CEMMI02**	Atomic Structure, Acid and Bases, Organic chemistry-1, Stereochemistry, Kinetic theory of gases, Real gases Practical	4	3-0-1	15	60	75
			Summer Intern.	**CS**	Community Service	4	0-0-4			50
					Total	24				400
					Total of year - 1	44				800

MJ= Major, MI= Minor, SEC= Skill Enhancement Course, AEC= Ability Enhancement Course, 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

Course code- CEMHMJ101 (45 Lectures)

Paper name – Fundamental Chemistry I

Extra nuclear structure of atoms and Periodicity, Basics of Organic Chemistry Bonding and Physical Properties, Stereochemistry – I, Thermodynamics –I, Chemical Kinetics-I.

Group A

- **Extra nuclear structure of atoms and Periodicity (15 Lectures)**

Wave-Particle duality, de Broglie hypothesis, Heisenberg's uncertainty principle, Sommerfeld's theory, Introducing Schrödinger equation. Hydrogen and hydrogen like systems (detailed solution not required) .Concept of Atomic Orbital; shapes of s, p and d orbitals. Radial and angular distribution curves. Extension to multielectronic systems. Aufbau principle and its limitations; Pauli's exclusion principle, Hund's rules and multiplicity, Effective nuclear charge, Shielding and penetration; Slater's rule. The general idea about modern periodic table, atomic and ionic radii, ionization energy, electron affinity and electronegativity –definition, trends of variation in periodic table and their application in explaining and predicting the chemical behavior of elements and compounds. Electronegativity scales (Pauling's, Mulliken's and Allred-Rochow's scales), Inert pair effect.

Group B

- **Basics of Organic Chemistry Bonding and Physical Properties (10 Lectures)**

Valence Bond Theory Nomenclature of Organic Compounds, Concept of hybridisation, shapes and structures of molecules, double bond equivalent (DBE), Resonance (including hyperconjugation) and Resonance energy.

Electronic displacement: Inductive effect, bond polarization and bond polarizability; steric effect, steric inhibition of resonance.

MO Theory Qualitative idea about molecular orbitals, bonding and antibonding interactions, idea about σ, σ*, π, π *, n – MOs; concept of HOMO, LUMO and SOMO; sketch and energy levels of π MOs of i) acyclic p orbital system (C=C, conjugated diene, triene, allyl and pentadienyl systems) ii) cyclic p orbital system (neutral systems: [4], [6] annulenes; charged systems: 3-,4-,5-7 membered ring systems); Hückel's rules for aromaticity up to [8] annulene; concept of antiaromaticity; non-aromatic molecules. Physical properties Melting point/boiling point and solubility of common organic compounds in terms of covalent & non-covalent intermolecular forces; polarity of molecules and dipole moments.

- **Stereochemistry – I: (5 Lectures)**

Bonding geometries of carbon compounds and representation of molecules: tetrahedral nature of carbon and concept of asymmetry; Fischer, sawhorse, flying wedge and Newman projection formulae and their inter translations. Concept of chirality and symmetry: symmetry elements, molecular chirality and centre of chirality; asymmetric and dissymmetric molecules; enantiomers and diastereomers; concept of stereogenicity, chiral centres and number of stereoisomers: systems involving 1/2-chiral centre(s).

Group C

- **Thermodynamics -I : (9 Lectures)**

Concept of systems (open, closed and isolated) and surroundings. State of a system; Intensive and extensive variables. Partial derivatives. Exact and inexact differentials. Path function and State function. Concept of heat and work. Zeroth law of thermodynamics. Concept of thermodynamic reversibility. Concept of internal energy and 1st law of thermodynamics. Enthalpy and heat capacity,

Relations between Cp and Cv. Isothermal and Adiabatic processes; Calculations of ΔU, ΔH, q and w involving ideal gases in different processes. Enthalpy of reaction. Hess's law. Enthalpy of formation and combustion. Kirchhoff's equation.

- **Chemical Kinetics-I: (6 Lectures)**

Concept of order and molecularity. Rate laws for zero, 1st and 2nd order reactions and in general for any n-th order reaction. Determination of order of a reaction by half-life and differential methods. Rate determining step and steady state approximation. Opposing, Consecutive and parallel reactions (first order steps only).Temperature dependence of rate constant and Arrhenius equation

Recommended Text Books:

1. *Lee, J. D. Concise Inorganic Chemistry,5th Ed., Wiley India Pvt. Ltd., 2008.*
2. *Atkins, Overton, Rourke , Weller , Armstrong; Shriver & Atkins' Inorganic Chemistry, 5th Ed., Oxford University Press (2010).*
3. *Finar, I. L. Organic Chemistry (Volume 1), 6th Edition , Pearson Education , 2002 4. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.*
5. *Nasipuri, D. Stereochemistry of Organic Compounds, 4th Edition, New Age International Pvt Ltd , 2020*
6. *Levine, I. N. Physical Chemistry, 6th Edition McGraw-Hill India, 2011*
7. *Castellan, G. W. Physical Chemistry, Narosa , 2004*
8. *Atkins, P. W. & Paula, J. de, Atkins' Physical Chemistry, 11th Edition, Oxford University Press, 2018*
9. *G. L. Miessler, D. A. Tarr, Inorganic Chemistry , 3rd Edition, Pearson India, 2008*
10. *Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.*
11. *Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.*

Course code- CEMHMJ101 (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/pToluidine; p-Nitrobenzoic acid/p-Aminobenzoic acid; p-Nitrotolune/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

- Preparation of primary and secondary standard solutions (Oxalic Acid, $K_2Cr_2O_7$, $KMnO_4$ etc.)
- Estimation of carbonate and bicarbonate present together in mixture.
- Estimation of carbonate and hydroxide present together in mixture.

Physical

- Determination of heat of neutralization of a strong acid by a strong base Determination of heat of solution of Oxalic acid from solubility measurement.
- Study of kinetics of decomposition of H_2O_2
- Study of kinetics of acid-catalysed hydrolysis of methyl acetate.

Reference Books: 1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. Practical Workbook Chemistry (Honours), UGBOS, Chemistry, University of Calcutta, 2015

CEMSEC01 **(25 Lectures)**

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

- 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 Suggested

Readings:

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 CEM (Disc.-I)

Course code- CEMMI01 **(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 hydogenic 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)**

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 (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 & IIBharatiBhawan*
17. *Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.*
18. *Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.*

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/pToluidine; p-Nitrobenzoic acid/p-Aminobenzoic acid; p-Nitrotolune/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, $KMnO_4$ 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.*

Semester-II

Major-2

Course code- CEMHMJ102 (45 Lectures)

Fundamentals of Chemistry-II

Kinetic Theory and Gaseous state, Chemical Bonding – I, Stereochemistry – II, General Treatment of Reaction Mechanism-I

Group A

- **Kinetic Theory and Gaseous state: (8 Lectures)**

Concept of pressure and temperature from kinetic theory of gas. Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions; Kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case; Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Wall collision and rate of effusion Calculation of number of molecules having energy $\geq \varepsilon$, Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases

- **Real gas and Virial equation: (4 Lectures)**

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 behavior ; Existence of critical state, Critical constants in terms of van der Waals constants; Law of corresponding states; Virial equation of state; van der Waals equation expressed in the Virial form and significance of second virial coefficient; Intermolecular forces (Debye, Keesom and London interactions; Lennard-Jones potential - elementary idea.

Group B

- **Chemical Bonding – I**: **(10 Lectures)**

i) Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its application and limitations. Packing of ions in crystals. Born-Lande equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. Defects in solids (elementary idea). Solubility energetics of dissolution process.

ii) Covalent bond: Polarizing power and polarizabilty, ionic potential, Fajan's rules, Lewis structures, formal charge, Valence Bond Theory, The hydrogen molecule (Heitler – London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rules, dipole moments, VSEPR theory, shapes of molecules and ions containing lone pairs (examples from main group chemistry) and multiple bonding (σ and π bond approach).

- **Redox Reactions and precipitation reactions (8 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.

Group C

- **Stereochemistry – II**: **(7 Lectures)**

Chirotopicity and its relationship with stereogenicity; concept of pseudo asymmetry for ABA type systems. Relative and absolute configuration: R/S descriptors; erythro/threo and meso nomenclature of compounds; E/Z descriptors for C=C, combination of R/S- and E/Z isomerisms. Optical activity of chiral compounds: optical rotation, and specific rotation; racemic compounds, racemisation (through cationic, anionic intermediates); resolution of acids and bases via diastereomeric salt formation; optical purity and enantiomeric excess.

- **General Treatment of Reaction Mechanism –I**: **(8 Lectures)**

Reactive intermediates Carbocations (carbenium and carbonium ions), non-classical carbocations, carbanions, carbon radicals: generation and stability, structure and electrophilic / nucleophilic behaviour of reactive intermediates (elementary idea).

Reaction thermodynamics Free energy and equilibrium, enthalpy and entropy factor, calculation of enthalpy change via BDE, intermolecular & intramolecular reactions.

Reaction kinetics Rate constant and free energy of activation; free energy profiles for one-step, and two-step reactions; catalyzed reactions, principle of microscopic reversibility; Hammond's postulate.

Substitution Reaction and Free-radical substitution reaction: halogenation of alkanes, mechanism (with evidence) and stereochemical features; reactivity-selectivity principle in the light of Hammond's postulate.

Reference Books:

1. Lee, J. D. Concise Inorganic Chemistry,5th Ed., Wiley India Pvt. Ltd., 2008.

2. Atkins, Overton, Rourke , Weller , Armstrong; Shriver & Atkins' Inorganic Chemistry, 5th Ed., Oxford University Press (2010).

3. Finar, I. L. Organic Chemistry (Volume 1), 6th Edition , Pearson Education , 2002 4. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.

5. Nasipuri, D. Stereochemistry of Organic Compounds, 4th Edition, New Age International Pvt Ltd , 2020

6. Levine, I. N. Physical Chemistry, 6th Edition McGraw-Hill India, 2011

7. Castellan, G. W. Physical Chemistry, Narosa , 2004

8. Atkins, P. W. & Paula, J. de, Atkins' Physical Chemistry, 11th Edition, Oxford University Press, 2018

9. G. L. Miessler, D. A. Tarr, Inorganic Chemistry , 3rd Edition, Pearson India, 2008

10. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.

11. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.

Course code- CEMHMJ102 (Practical) **(15 Lectures)**

Inorganic

- Estimation of Fe(II) using standardized $KMnO_4$ solution
- Estimation Cu(II) in a mixture using $K_2 Cr_2 O_7$
- Estimation of oxalic acid and sodium oxalate in a given mixture
- Estimation of Fe(II) and Fe(III) in a given mixture using $K_2 Cr_2 O_7$ solution.
- Estimation of Fe(III) and Mn(II) in a mixture using standardized $KMnO_4$ solution.
- Estimation of Fe(III) and Cu(II) in a mixture using $K_2 Cr_2 O_7$. ➢ Estimation of Fe(III) and Cr(III) in a mixture using $K_2 Cr_2 O_7$.

Organic

- Estimation of acetic acid in commercial Vinegar.
- Estimation of Vit-C.
- Estimation of Glucose and Sucrose.
- Identification of a Pure Organic Compound

  Solid compounds: oxalic acid, tartaric acid, citric acid, succinic acid, resorcinol, urea, glucose, cane sugar, benzoic acid and salicylic acid

  Liquid Compounds: formic acid, acetic acid, methyl alcohol, ethyl alcohol, acetone, aniline, dimethylaniline, benzaldehyde, chloroform and nitrobenzene

Reference Books:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

2. Ghosal, Mahapatra&Nad, An Advanced course in practical Chemistry, New Central Book Agency.

Course code- CEMSEC02 **(25 Lectures)**

A. Water and Soil analysis

Water analysis

- pH
- Dissolved oxygen
- BOD and COD

B. Soil analysis

- pH
- Sodium and Potassium

C. TLC separation technique

D. Identification of food Adulterants

E. Extraction

a. Curumine from turmeric

b. Extraction of caffeine from tea/coffee

Reference Books:

1. Douglas A. Skoog, D.M. West , F. james Holler , Stanely R. Crouch, Fundamentals of Analytical Chemistry , Cengage learning India Pvt Ltd. 10th Edition , 2022
2. Daniel C. Harris , Quantitative Chemical Analysis , 10th Edition , W.H. Freeman , 2020

Minor CEM (Disc.-II)

Course code- CEMMI02

Same as minor 1