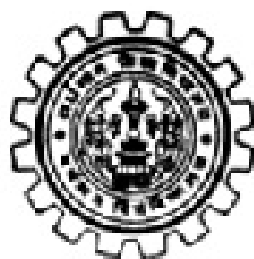


Syllabus of Chemistry (General)
for SEM-I & SEM-II
Courses under CBCS
(to be effective from Academic Year: 2017-18)



The University of Burdwan
Burdwan, West Bengal

B.Sc. (General) Course In CHEMISTRY

Let 1, 2, 3 are three different disciplines of study

Consider Chemistry as Discipline 1

1st Semester

Course Code	Course Title	Course Type	Credit per course	Marks
Discipline 1 (Chemistry)	Core Course (CC) 1 from Chemistry: (Generic Elective T1 & Generic Elective P1) Atomic structure, chemical periodicity, acids and bases, redox reactions, general organic chemistry of aliphatic hydrocarbons (Theo+Prac)	Core Course (CC) – I	4+2	75
Discipline 2 (other subject)	As to be offered by the other department(s)	Core Course (CC) – I	6	75
Discipline 3 (other subject)	As to be offered by the other department(s)	Core Course (CC) – I	6	75
AECC-1	ENVS	Ability Enhancement Compulsory Course – I	4	100
TOTAL			22	325

2nd Semester

Course Code	Course Title	Course Type	Credit per course	Marks
Discipline 1 (Chemistry)	Core Course (CC) 2 from Chemistry: (Generic Elective T2 & Generic Elective P2) States of matter & chemical kinetics, chemical bonding, molecular structure, P-block elements (Theo+Prac)	Core Course (CC) – II	4+2	75
Discipline 2 (other subject)	As to be offered by the other department(s)	Core Course (CC) – II	6	75
Discipline 3 (other subject)	As to be offered by the other department(s)	Core Course (CC) – II	6	75
AECC-2	Communicative Eng./MIL	Ability Enhancement Compulsory Course – II	2	50
TOTAL			20	275

3rd Semester

Course Code	Course Title	Course Type	Credit per course	Marks
Discipline 1 (Chemistry)	Core Course (CC) 3 from Chemistry: (Generic Elective T3 & Generic Elective P3) Chemical energetic, equilibria, organic chemistry (Theo+Prac)	Core Course (CC) – III	4+2	75
Discipline 2 (other subject)	As to be offered by the other department(s)	Core Course (CC) – III	6	75
Discipline 3 (other subject)	As to be offered by the other department(s)	Core Course (CC) – III	6	75
SEC-1	Analytical chemical biochemistry	Skill Enhancement Course	2	50
TOTAL			20	275

4th Semester

Course Code	Course Title	Course Type	Credit per course	Marks
Discipline 1 (Chemistry)	Core Course 4 from Chemistry: (Generic Elective T4 & Generic Elective P4) Solution phase equilibria, conductance, electrochemistry, analytical & environmental chemistry (Theo+Prac)	Core Course (CC) – IV	4+2	75
Discipline 2 (other subject)	As to be offered by the other department(s)	Core Course (CC) – IV	6	75
Discipline 3 (other subject)	As to be offered by the other department(s)	Core Course (CC) – IV	6	75
SEC-2	Pharmaceutical chemistry	Skill Enhancement Course	2	50
TOTAL			20	275

5th Semester

Course Code	Course Title	Course Type	Credit per course	Marks
SEC-3	TBD (??)	Skill Enhancement Course	2	50
Discipline 1 (Chemistry)	DSE-I: Generic Elective T5 & Generic Elective P5 Transition metal & co-ordination chemistry, analytical and industrial chemistry (Theo+Prac)	Discipline Specific Elective	4+2	75
Discipline 2 (other subject)	DSE-I: As to be offered by the other department(s)	Discipline Specific Elective	6	75
Discipline 3 (other subject)	DSE-I: As to be offered by the other department(s)	Discipline Specific Elective	6	75
TOTAL			20	275

6th Semester

Course Code	Course Title	Course Type	Credit per course	Marks
SEC-4	TBD (??)	Skill Enhancement Course	2	50
Discipline 1 (Chemistry)	DSE-II: Generic Elective T5 & Generic Elective P5 Functional group organic chemistry and industrial chemistry (Theo+Prac)	Discipline Specific Elective	4+2	75
Discipline 2 (other subject)	DSE-II: As to be offered by the other department(s)	Discipline Specific Elective	6	75
Discipline 3 (other subject)	DSE-II: As to be offered by the other department(s)	Discipline Specific Elective	6	75
TOTAL			20	275

Introduction

The syllabus for Chemistry (Gen.) at undergraduate level using the Choice Based Credit system has been framed in compliance with model syllabus given by UGC, New Delhi and State Council under Department of Higher Education, Government of West Bengal.

The main objective of framing this new syllabus is to give the students a comprehensive understanding of the subject giving substantial heftiness to both the core content and techniques used in Chemistry. The syllabus has given equal importance to the three main branches of Chemistry – Physical, Inorganic and Organic.

The ultimate goal of the syllabus is that the students at the completion of the course would be able to secure a job. Keeping in mind and in tune with the fast changing nature of the subject, adequate emphasis has been given on new techniques and understanding of the subject.

The affiliated undergraduate colleges under ‘The University of Burdwan’ are requested to take necessary measure to ensure that the students must know the modern instruments used in Chemical analysis like ultrasonication, UV-VIS Spectrophotometric analysis, FT-IR Spectroscopy etc.; moreover, the colleges are also requested to take suitable measures to provide computers with Internet facilities to the students as well as the faculty members. As a result of this, the chemistry department of various undergraduate colleges may take the initiative to arrange educational tour for the students studying in 5th and 6th Semester to academic institute/university where the students can access and be enriched with the modern and sophisticated instruments as mentioned above.

It is essential that Chemistry students select their general electives courses from Physics, Mathematics and/or any branch of Life Sciences disciplines.

CHEMISTRY (General)

1st Semester:

Discipline 1 (Chemistry): CC-I (Theo)

4 Credits

Course Title: Atomic Structure, Chemical Periodicity, Acids And Bases, Redox Reactions, General Organic Chemistry & Aliphatic Hydrocarbons

Inorganic Chemistry

1. Atomic Structure

Bohr's theory for hydrogen atom (simple mathematical treatment), atomic spectra of hydrogen and Bohr's model, Sommerfeld's model, quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, Aufbau principle and its limitations. 5 classes

2. Chemical Periodicity

Classification of elements on the basis of electronic configuration: general characteristics of s-, p-, d- and f-block elements. Positions of hydrogen and noble gases. Atomic and ionic radii, ionization potential, electron affinity, and electronegativity; periodic and group-wise variation of above properties in respect of s- and p- block elements. 5 classes

3. Acids and bases

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. 5 classes

4. Redox reactions

Balancing of equations by oxidation number and ion-electron method oxidimetry and reductimetry. 3 classes

Organic Chemistry

1. Fundamentals of Organic Chemistry

Electronic displacements: inductive effect, resonance and hyperconjugation; cleavage of bonds: homolytic and heterolytic; structure of organic molecules on the basis of VBT; nucleophiles electrophiles; reactive intermediates: carbocations, carbanions and free radicals. 5 classes

2. Stereochemistry

Different types of isomerism; geometrical and optical isomerism; concept of chirality and optical activity (up to two carbon atoms); asymmetric carbon atom; elements of symmetry (plane and centre); interconversion of Fischer and Newman representations; enantiomerism and diastereomerism, meso compounds; threo and erythro, D and L, cis and trans nomenclature; CIP Rules: R/S (upto 2 chiral carbon atoms) and E/Z nomenclature. 5 classes

3. Nucleophilic Substitution and Elimination Reactions

Nucleophilic substitutions: SN1 and SN2 reactions; eliminations: E1 and E2 reactions (elementary mechanistic aspects); Saytzeff and Hofmann eliminations; elimination vs substitution. 5 classes

4. Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structures. 3 classes

5. Alkanes: (up to 5 Carbons). Preparation: catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: mechanism for free radical substitution: halogenation. 5 classes

6. Alkenes: (up to 5 Carbons). Preparation: elimination reactions: dehydration of alcohols and dehydrohalogenation of alkyl halides; cis alkenes (partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alkaline KMnO₄) and trans-addition (bromine) with mechanism, addition of HX [Markownikoff's (with mechanism) and anti-Markownikoff's addition], hydration, ozonolysis, oxymercuration-demercuration and hydroboration-oxidation reaction. 9 classes

7. Alkynes: (up to 5 Carbons). Preparation: acetylene from CaC₂ and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. 5 classes

8. Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO₄, ozonolysis and oxidation with hot alkaline KMnO₄. 5 classes

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 Ind
5. Sethi, A. Conceptual Organic Chemistry; New Age International Publisher.
6. Parmar, V. S. A Text Book of Organic Chemistry, S. Chand & Sons.
7. Madan, R. L. Organic Chemistry, S. Chand & Sons.
8. Wade, L. G., Singh, M. S., Organic Chemistry.
9. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
10. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
11. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
12. Sen Gupta, Subrata. Basic Stereochemistry of Organic molecules.
13. Kalsi, P. S. Stereochemistry Conformation and Mechanism, Eighth edition, New Age International, 2014.
14. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
15. Ekambaram, S. [General Chemistry, Pearson.](#)

Discipline 1 (Chemistry): CC-I (Prac)

2 Credits

Course Title: Atomic Structure, Chemical Periodicity, Acids And Bases, Redox Reactions, General Organic Chemistry & Aliphatic Hydrocarbons**Inorganic Chemistry**

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO_4 .
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
4. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$.

Organic Chemistry

Qualitative Analysis of Single Solid Organic Compound(s)

1. Detection of special elements (N, Cl, and S) in organic compounds.
2. Solubility and Classification (solvents: H_2O , dil. HCl , dil. NaOH)
3. Detection of functional groups: Aromatic- NO_2 , Aromatic $-\text{NH}_2$, $-\text{COOH}$, carbonyl (no distinction of $-\text{CHO}$ and $>\text{C}=\text{O}$ needed), $-\text{OH}$ (phenolic) in solid organic compounds.

Experiments 1 to 3 with unknown (at least 6) solid samples containing not more than two of the above type of functional groups should be done.

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. Vogel, A. I. Elementary Practical Organic Chemistry, Part 2: Qualitative Organic Analysis, CBS Publishers and Distributors.
6. 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.
7. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

2nd Semester:

Discipline 1 (Chemistry): CC-II (Theo)

4 Credits

Course Title: States of Matter & Chemical Kinetics, Chemical Bonding & Molecular Structure, P-Block Elements

Physical Chemistry

1. Kinetic Theory of Gases and Real gases

a. 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);

3 classes

Rate of effusion

b. 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

5 classes

c. 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

5 classes

d. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only)

2 classes

2. Liquids

a. Definition of Surface tension, its dimension and principle of its determination using stalagmometer; Viscosity of a liquid and principle of determination of coefficient of viscosity using Ostwald viscometer; Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

5 classes

3. Solids

a. Forms of solids, crystal systems, unit cells, Bravais lattice types, Symmetry elements; Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices; Miller indices of different planes and interplanar distance, Bragg's law; Structures of NaCl, KCl and CsCl (qualitative treatment only); Defects in crystals; Glasses and liquid crystals.

5 classes

4. Chemical Kinetics

a. 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 **5 classes**

b. Temperature dependence of rate constant; Arrhenius equation, energy of activation; Collision theory; Lindemann theory of unimolecular reaction; outline of Transition State theory (classical treatment). **5 classes**

Inorganic Chemistry

1. Chemical Bonding and Molecular Structure

a. Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character. **5 classes**

b. Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. **3 classes**

c. Concept of resonance and resonating structures in various inorganic and organic compounds. **2 classes**

d. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods. (including idea of s- p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches. **5 classes**

2. Comparative study of p-block elements

a. Group trends in electronic configuration, modification of pure elements, common oxidation states, inert pair effect, and their important compounds in respect of the following groups of elements: 10 classes

i. B-Al-Ga-In-Tl

ii. C-Si-Ge-Sn-Pb

iii. N-P-As-Sb-Bi

iv. O-S-Se-Te

v. F-Cl-Br-I

Reference Books

1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
2. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
5. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
6. Chugh, K.L., Agnish, S.L. A Text Book of Physical Chemistry Kalyani Publishers.
7. Bahl, B.S., Bahl, A., Tuli, G.D., Essentials of Physical Chemistry S. Chand & Co. Ltd.
8. Palit, S. R., Elementary Physical Chemistry Book Syndicate Pvt. Ltd.
9. Mandal, A. K. Degree Physical and General Chemistry Sarat Book House.
10. Pahari, S., Physical Chemistry New Central Book Agency.
11. Pahari, S., Pahari, D., Problems in Physical Chemistry New Central Book Agency.
12. Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley.
13. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
14. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
15. Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.

Discipline 1 (Chemistry): CC-II (Prac)

4 Credits

Course Title: States of Matter & Chemical Kinetics, Chemical Bonding & Molecular Structure, P-Block Elements

Physical Chemistry

1. Surface tension measurement (use of organic solvents excluded).
 - a. Determination of the surface tension of a liquid or a dilute solution using a Stalagmometer.
 - b. Study of the variation of surface tension of a detergent solution with concentration
2. Viscosity measurement (use of organic solvents excluded)
 - a. Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer
 - b. Study of the variation of viscosity of an aqueous solution with concentration of solute
3. Study the kinetics of the following reactions
 - a. Initial rate method: Iodide-persulphate reaction
 - b. Integrated rate method:
 - i. Acid hydrolysis of methyl acetate with hydrochloric acid
 - ii. Compare the strengths of HCl and H₂SO₄ by studying kinetics of hydrolysis of methyl acetate.

Inorganic Chemistry

Qualitative semi-micro analysis of mixtures containing three radicals. Emphasis should be given to the understanding of the chemistry of different reactions.

Acid Radicals: Cl⁻, Br⁻, I⁻, NO₂⁻, NO₃⁻, S₂⁻, SO₄²⁻, PO₄³⁻, BO₃³⁻, H₃BO₃.

Basic Radicals: Na⁺, K⁺, Ca²⁺, Sr²⁺, Ba²⁺, Cr³⁺, Mn²⁺, Fe³⁺, Ni²⁺, Cu²⁺, NH₄⁺.

Reference Books:

1. University Hand Book of Undergraduate Chemistry Experiments, edited by Mukherjee, G. N., University of Calcutta, 2003.
2. Palit, S.R., Practical Physical Chemistry Science Book Agency
3. Mukherjee, N.G., Selected Experiments in Physical Chemistry J. N. Ghose & Sons
4. Dutta, S.K., Physical Chemistry Experiments Bharati Book Stall
5. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
6. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).