



**Netaji Subhas Open University**  
**Bachelor's Degree Programme (BDP) in Chemistry (ECH)**  
**SYLLABUS**

➤ **PROGRAMME OBJECTIVES:**

The objective of the programme is to provide facility for lifelong education in Chemistry to intending learners. The Bachelor Degree in Chemistry is designed accordingly so that the students at the end are able to secure practical training skills required for a profession with chemistry background or Industry. The programme consists of four foundation courses, thirteen elective courses, one Application oriented courses, Environmental Studies and three Subsidiary Papers. The main objective of the programme is to equip individuals with the necessary skills and competencies to enable them to seek jobs and progress in their academic career. The fresher and existing employees can take the advantage of ODL system to increase their skills and competency in this particular field without disturbing their work schedule.

➤ **EXPECTED PROGRAMME OUTCOME:**

After successful completion of this Bachelor's Degree Programme, students may increase their knowledge in the field of Chemistry as well as in the practical laboratory skills and it will help them to increase competencies to seek jobs as well as progress in their further academic career.

➤ **COURSE STRUCTURE:**

**1. Compulsory Subjects: Foundation Courses (Four)**

(a) Humanities and Social Science (FHS)	8 Credits
(b) Science and Technology (FST)	8 Credits
(c) Bengali (FBG)	4 Credits
(d) English (FEG)	4 Credits
<b>Total</b>	<b>24 Credits</b>

**2. Elective Subjects: Elective Chemistry Honours (ECH)**

ECH 01	General Chemistry	4 Credits
ECH 02	Inorganic Chemistry-I	4 Credits
ECH 03	Inorganic Chemistry-II	4 Credits
ECH 04	Practical Chemistry-I	8 Credits
ECH 05	Inorganic Chemistry – III	4 Credits
ECH 06	Physical Chemistry-I	4 Credits
ECH 07	Physical Chemistry-II	4 Credits
ECH 08	Practical Chemistry-II	8 Credits



ECH 09	Physical Chemistry–III	4 Credits
ECH 10	Organic Chemistry–I	4 Credits
ECH 11	Organic Chemistry–II	4 Credits
ECH 12	Practical Chemistry–III	8 Credits
ECH 13&14	Organic Chemistry-III & Biochemistry	4 Credits
<b>Total</b>		<b>64 Credits</b>

### 3. Application Oriented Course

Household Chemistry (AOC–03)	<b>8 Credits</b>
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### 4. Environmental Studies

Environmental Studies	<b>4 Credits</b>
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### 5. Subsidiary Papers (Mathematics)

SMT 1: Subsidiary Mathematics-Paper 1	8 Credits
SMT 2: Subsidiary Mathematics-Paper 2	8 Credits
SMT 3: Subsidiary Mathematics-Paper 3	8 Credits
<b>Total</b>	<b>24 Credits</b>

Total Credits for the Course = (24+64+8+4+24) = 124 Credits or **1550 Marks**

#### ➤ **EVALUATION SYSTEM:**

(a) **Marks distribution for Theory papers:** Internal assessment: 30%; Term-end Examinations: 70%

(b) **Marks distribution for Practical papers:** Term-end Examinations: 100%

#### **Examination system (Subject to Change)**

1st Semester - FBG, FEG, ECH 01 & ECH 04\*

2nd Semester - FHS, ECH 02, ECH 03 & ECH 05

3rd Semester - FST, ECH 06 & ECH 08\*

4th Semester - ECH 07, ECH 09, ECH 10 & SMT 1

5th Semester - ECH 11, ECH 12\* & SMT 2

6th Semester - ECH 13&14, SMT 3, AOC -03 & ENVS

\* Practical Courses

#### ➤ **SEMESTER-WISE DETAILED COURSE CURRICULUM STRUCTURE AT A GLANCE FOR BDP CHEMISTRY:**



		Paper	Paper Code	Paper Type (Theo/Prac)	Assignment	Term End	Pass Mark	Full Marks	Credits
1 <sup>st</sup> Year	Semester - I	Foundation Course in Bengali	FBG	Theo	15	35	17.5	50	4
		Foundation Course in English	FEG	Theo	15	35	17.5	50	4
		General Chemistry	ECH 01	Theo	15	35	17.5	50	4
		Practical Chemistry-1	ECH 04	Prac	0	100	35	100	8
	Semester - II	Foundation Course in Humanities & Social Science	FHS	Theo	30	70	35	100	8
		Inorganic Chemistry-I	ECH 02	Theo	15	35	17.5	50	4
		Inorganic Chemistry-II	ECH 03	Theo	15	35	17.5	50	4
		Inorganic Chemistry – III	ECH 05	Theo	15	35	17.5	50	4
		Environmental Studies	Environmental Studies	Theo	15	35	17.5	50	4
2 <sup>nd</sup> Year	Semester - III	Foundation Course in Science & Technology	FST	Theo	30	70	35	100	8
		Physical Chemistry-I	ECH 06	Theo	15	35	17.5	50	4
		Practical Chemistry-2	ECH08	Prac	0	100	35	100	8
	Semester – IV	Physical Chemistry–II	ECH07	Theo	15	35	17.5	50	4
		Physical Chemistry–III	ECH09	Theo	15	35	17.5	50	4
		Organic Chemistry–I	ECH 10	Theo	15	35	17.5	50	4
		Subsidiary Mathematics-Paper 1	SMT 01	Theo	30	70	35	100	8
3 <sup>rd</sup> Year	Semester – V	Organic Chemistry–II	ECH 11	Theo	15	35	17.5	50	4
		Practical Chemistry–3	ECH 12	Prac	0	100	35	100	8
		Subsidiary Mathematics-Paper 2	SMT 02	Theo	30	70	35	100	8
	Semester – VI	Organic Chemistry-III Biochemistry	ECH 13 & 14	Theo	15	35	17.5	50	4
		Subsidiary Mathematics-Paper 3	SMT 03	Theo	30	70	35	100	8
		Application Oriented Course	AOC-3	Theo	30	70	35	100	8



➤ **DETAILED SYLLABUS FOR THE BACHELOR'S DEGREE PROGRAMME IN CHEMISTRY (ECH)**

**Course Code: ECH 01: Course Title: General Chemistry**

**Block - I: Atoms, Molecules and Structure of Matter – I**

Unit-1: Electric Discharge through Gases, Fundamental Particles, Radioactivity, Rutherford's Atomic Model.

Unit-2: Quantum Theory and Atomic Spectra, Bohr's Theory

Unit-3: Wave Mechanics and its Application in Atomic structure.

Unit-4: Valency (I) - Chemical Bonds and Electronic Theory of Valency

Unit-5: Valency(II)-Valence-Bond Theory and Molecular Orbital Theory.

**Block-II: Structure of Matter–II**

Unit-6: Molar Refraction, Optical Activity

Unit-7: Dipole Moment

Unit-8: Absorption spectroscopy and Molecular Structure of Matter–Ultraviolet, Infrared and Electronic Spectroscopes.

Unit-9: Raman Spectroscopy and Molecular Structure.

Unit-10: Nuclear Chemistry.

**Course Code: ECH 02: Course Title: Inorganic Chemistry–I**

**Block-I: Periodic Table and Oxidation-reduction**

Unit-1: Periodic Table

Unit-2: Periodicity

Unit-3: Oxidation and Reduction

**Block-II: Acids and Bases, Solvents, Structural nature (shape) of Inorganic Compounds, Radioactivity**

Unit-4: Acids and Bases

Unit-5: Non-aqueous Solvents

Unit-6: Structural Nature (Shape) of Inorganic Compounds

Unit-7: Radioactivity

Unit-8: Isotopes and Applications

**Course Code: ECH 03: Course Title: Inorganic Chemistry-II**

**Block-I: S-Block Elements**

Unit-1: Hydrogen

Unit-2: Alkali Metals

Unit-3: Alkaline Earth Metals

**Block-II: P-Block Elements-I**

Unit-4: Elements of Group 13

Unit-5: Elements of Group 14

Unit-6: Elements of Group 15



**Course Code: ECH 04: Course Title: Practical Chemistry-I**

**Block-I: Practical Inorganic Chemistry: Quantitative analysis and preparations**

Unit-1: Experimental Methods and Apparatus

Unit-2: Identification of Anions

Unit-3: Identification of Cations

Unit-4: Preparations of Inorganic Compounds

**Block-II Organic Chemistry: Quantitative analysis and Preparations**

Unit-5: Experimental Methods and Apparatus

Unit-6: Identification of Special Elements of Organic Compounds

Unit-7: Preparation of Organic Compounds.

**Course Code: ECH 05: Course Title: Inorganic Chemistry – III**

**Block I: P-Block Elements-II**

Unit-1: Elements of Group 16

Unit-2: Elements of Group 17

Unit-3: Elements of Group 18

**Block-II: d-and f-Block Elements**

Unit-4: Transition Elements

Unit-5: Inner – Transition Elements

Unit-6: Coordination Compounds

Unit-7: Isolation and Purification of Metals

**Course Code: ECH 06: Course Title: Physical Chemistry-I**

**Block-I: States of Matter**

Unit-1: The Gaseous State: Empirical Properties of Gases

Unit-2: The Kinetic theory of Gases

Unit-3: Real Gases and their Liquefaction

Unit-4: Liquid state of Matter

Unit-5: Solid state of Matter

**Block - I: Chemical Thermodynamics**

Unit-6: The First Law of Thermodynamics

Unit-7: Thermochemistry

Unit-8: The Second Law of Thermodynamics

Unit-9: Free Energy Functions

Unit-10: Entropy and Probability: Statistical Concept

**Course Code: ECH 07: Course Title: Physical Chemistry–II**

**Block - I: Solutions and Phase Rule**

Unit-1: Solution–I

Unit-2: Solution–II

Unit-3: Colligative Properties of Dilute Solutions



Unit-4: Phase Equilibria - I

Unit-5: Phase Equilibria - II

**Block-II: Reaction Equilibrium**

Unit-6: Chemical Equilibria

Unit-7: The Response of Equilibria to Different Conditions

Unit-8: Ionic Equilibria

Unit-9: Buffers and Neutralization

Unit-10: Redox-Indicators; Adsorption Indicator

**Course Code: ECH 08: Course Title: Practical Chemistry-II**

**Block - I: Inorganic Chemistry–Quantitative Analysis**

Unit-1: Acidimetry and Alkalimetry

Unit-2: Quantitative Analysis of Water

Unit-3: Gravimetric and Volumetric Analysis of Metals

**Block-II: Physical and Organic Chemistry–Quantitative Analysis (4, 5, 6)**

Unit-4: Polarimeter, Colourimeter / PH Meter–Applications

Unit-5: Surface Tension, Viscosity and Partition Co-efficient

Unit-6: Estimation of Organic Compounds

**Course Code: ECH 09: Course Title: Physical Chemistry–III**

**Block I: Electrochemistry**

Unit-1: Electrolytic Conductance of Solutions

Unit-2: Applications of Conductance Measurements

Unit-3: Electrochemical Cells

Unit-4: Applications of E.M.F. Measurements

Unit-5: Polarisation, Overvoltage

**Block II: Dynamics of Chemical Reactions and Macromolecules**

Unit-6: Chemical Kinetics–I: Empirical Laws and Mechanism

Unit-7: Chemical Kinetics – II: Theoretical Aspects

Unit-8: Photochemistry

Unit-9: Colloids and Macromolecules

Unit-10: Adsorption and Catalysis

**Course Code: ECH 10: Course Title: Organic Chemistry–I**

**Block-I: Fundamental concepts: Aliphatic Alicyclic and Aromatic Hydrocarbon (I)**

Unit-1: Fundamental concepts – Nature of Chemical Bonds in Organic Chemistry

Unit-2: Atomic Orbitals, Molecular Orbitals and Hybridisation

Unit-3: Saturated Hydrocarbons – Alkanes and Cycloalkanes

Unit-4: Unsaturated Hydrocarbons (I) – Alkenes

Unit-5: Unsaturated Hydrocarbons (II) – Alkynes

Unit-6: Aromatic Hydrocarbons (I) – Benzene and Homologues



**Block - II: Aromatic Hydrocarbons (II), Stereoisomerism, Nature of Organic Reactions**

Unit-7: Aromatic Hydrocarbons (II)–Polynuclear Hydrocarbon (1): Biphenyl

Unit-8: Polynuclear Hydrocarbon (2): Anthracene.

Unit-9: Stereoisomerism in Acyclic Compounds

Unit-10: Stereoisomerism in Cyclic Compounds

Unit-11: Nature of Organic Reactions (I): Substitution Reactions

Unit-12: Nature of Organic Reactions (II): Additional Reactions and Elimination Reactions

**Course Code: ECH 11: Course Title: Organic Chemistry–II**

**Block - I: Substituted Aliphatic and Aromatic Compounds**

Unit-1: Halogen Compounds:Alcohols;Phenols; Ethers and Sulphides

Unit-2: Carbonyl Compounds

Unit-3: Organic Monocarboxylic Acids; Sulphonic Acids and Substituted Acids.

Unit-4: Nitro & Amino Compounds

Unit-5: Diazonium Compounds

**Block-II: Dicarboxylic Acids; Tautomerism ; Organic Compounds with Active Methylene Group ; Organic Compounds of Metals ; Heterocyclic Compounds**

Unit-6: Dicarboxylic Acids

Unit-7: Tautomerism

Unit-8: Cyanoacetic Ester: Malonic Ester: Acetoacetic Ester and Acetyl Acetone

Unit-9: Organic Compounds of Metals

Unit-10: Heterocyclic compounds – Furan; Thiophene; Pyrrole; Pyridine; Indole and Quinoline

**Course Code: ECH 12: Course Title: Practical Chemistry–III**

**Block - I: Biochemistry**

Unit-1: Structure of a Cell and its Functions.

Unit-2: Amino Acid and Protein

Unit-3: Enzyme, Coenzyme, Vitamins and Minerals

Unit-4: Carbohydrate, Lipid and Nucleic Acid.

**Block - II**

Unit-5: Study of Reaction–Kinetic (a) Hydrolysis of Ester, (b) Inversion of Cane Sugar

Unit-6: Estimation of Available Chlorine in Bleaching Powder

Unit-7: Estimation of Iron in Cement

**Course Code: ECH 13&14: Course Title: Organic Chemistry-III& Biochemistry**

**Block-I: Reactive Intermediates; Molecular Rearrangements, Pericyclic Reactions**

Unit-1: Reactive Intermediates in Organic Reactions–Carbenes, Nitrenes

Unit-2: Benzynes

Unit-3: Molecular Rearrangements–I

Unit-4: Molecular Rearrangements–II

Unit-5: Pericyclic Reactions.



## **Block-II: Macromolecules; Spectroscopy–Practical applications in Organic compounds; Colour Constitution of Organic Compounds**

Unit-6: Carbohydrates

Unit-7: Amino Acids and Proteins

Unit-8: Spectroscopy–UV: IR and NMR–Applications in Organic Compounds

Unit-9: Practical applications of Organic Compounds

Unit-10: Dyes, Colour and Constitution of Organic Compounds

## **Block-III: Biomolecules – I and Biomolecules–II**

Unit-1: Cell Structure and Function

Unit-2: Carbohydrates and Lipids

Unit-3: Nucleic Acids and Proteins

Unit-4: Enzymes, Co-enzymes, Vitamins and Minerals

## **Block-IV: Biogenetics and Metabolism**

Unit-5: Bioenergetics: Definition and Source

Unit-6: Metabolism – Carbohydrate Catabolism

Unit-7: Metabolism – Amino Acid Catabolism

Unit-8: Catabolism of Lipids

Unit-9: Citric Acid Cycle

Unit-10: Special Oxidation Unit.

### **➤ REFERENCE BOOKS:**

#### **A) Books on Physical Chemistry**

1. Physical Chemistry–G. W. Casteltan, Narosa Pub.
2. Physical Chemistry – P. W. Atkins
3. Physical Chemistry – I. N. Levine, Mc Graw Hill
4. Text Book of Physical Chemistry–S. Glasstone
5. Physical Chemistry–Maron & Pruton/Maron & Lando
6. Principles of Physical Chemistry – B. R. Puri & L. R. Sharma
7. Text Book of Physical Chemistry (Vol. 1–4) – K. L. Kapoor
8. Physical Chemistry – W. J. Moore
9. Physical Chemistry – P.C. Rakshit
10. Concise Thermodynamics – R. P. Rastogi
11. Thermodynamics – P. C. Rakshit
12. Chemical Kinetics – K. J. Laidler
13. University General Chemistry – C. N. R. Rao
14. Elements of Physical Chemistry–Glasstone & Lewis

#### **B) Books on Inorganic Chemistry**

15. University Chemistry – R. H. Mahan
16. Inorganic Chemistry–D. F. Shriver, R. W. Atkins and C. H. Langford
17. New Concise Inorganic Chemistry – J. D. Lee
18. Theoretical Inorganic Chemistry–M. C. Day, Jr. & J. Selbin
19. General & Inorganic Chemistry–P. K. Dutt





20. Inorganic Chemistry—R. L. Dutta
21. Inorganic Chemistry—A. G. Sharpe
22. General and Inorganic Chemistry (Vols 1, 2)—R. P. Sarkar
23. Fundamental Concepts of Inorganic Chemistry—Gilreath
24. Advanced Inorganic Chemistry—F. A. Cotton and G. Wilkinson
25. Chemistry of the Elements : N. N. Greenwood & Earnshaw
26. Advanced Inorganic Chemistry—S. Satya Prakash, G. D. Tuli, S. K. Basu and N. D. Madan

**C) Books on Organic Chemistry**

27. Organic Chemistry (Vol. 1 and 2) – I. L. Finar
28. Organic Chemistry—R. T. Morrison and R. N. Boyd
29. Advanced Organic Chemistry—J. March
30. Organic Chemistry – Solomon
31. Advanced Organic Chemistry—B. S. Bhal & A. Bhal
32. Basic Stereo Chemistry of Organic Molecules – S. Sengupta
33. Stereo Chemistry of Carbon Compounds – D. Nasipuri
34. Biochemistry – A. Lehninger
35. Biochemistry—Debojyoti Das

**D) Books on Practical Chemistry (for the Courses ECH 04, ECH 08 & ECH 12)**

36. Vogel's Text Book of Quantitative Inorganic Analysis Including Elementary
37. Instrumental Analysis (4<sup>th</sup> Edn.). ELBS & Longman 11978. J. Bassetl, R. C. Denney, G. H. Jeffery & J. Mendham.
38. Quantitative Chemical Analysis – I. M. Kolthoff, E. B. Sandell, E. J. Meehan and S. Bruckensfein (4<sup>th</sup> Edn.), Macmillan, London, 1969
39. Practical Physical Chemistry – A. M. James & F. F. Prichard
40. Findlays Practical Physical Chemistry—B. P. Levitt
41. Experimental Organic Chemistry, Principles & Practice—Hardwoods Moody Backwele Scientific Publisher
42. Selected Experiments in Physical Chemistry. N. G. Mukherjee
43. B. Sc. Practical General : S. Datta
44. University Hand Book of Undergraduate Chemistry Experiments on Quantitative Chemical Analyses : Organic Reactions : Chromatographic Separations and Physicochemical Experiments for Three Year B. Sc. General & Honours Courses—Edited by Prof. G. N. Mukherjee