

DURGAPUR GOVERNMENT COLLEGE
DEPARTMENT OF CHEMISTRY
Programme Outcome, Course Outcome and Program Specific Outcome

Aims of the Bachelors' Degree Program in Chemistry [As per the UGC LOCF Template(2019)]

1. Broad and balance knowledge in chemistry in addition to understanding of key chemical concepts, principles and theories.
2. To develop students' ability and skill to acquire expertise over solving both theoretical and applied chemistry problems.
3. To provide knowledge and skill to the students' thus enabling them to undertake further studies in chemistry in related areas or multidisciplinary areas that can be helpful for self employment/entrepreneurship.
4. To provide an environment that ensures cognitive development of students in a holistic manner. A complete dialogue about chemistry, chemical equations and its significance is fostered in this framework, rather than mere theoretical aspects
5. To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A chemistry graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment.
6. To mould a responsible citizen who is aware of most basic domain-independent knowledge, including critical thinking and communication.
7. To enable the graduate prepare for national as well as international competitive examinations, especially UGC-CSIR NET and UPSC Civil Services Examination.

Program Learning Outcomes [As per the UGC LOCF Template(2019)]

1. The student graduating with the Degree B.Sc (Honours) Chemistry should be able to acquire
Core competency: Students will acquire core competency in the subject Chemistry, and in allied subject areas.
2. Systematic and coherent understanding of the fundamental concepts in Physical chemistry, Organic Chemistry, Inorganic Chemistry, Analytical Chemistry and all other related allied chemistry subjects.
3. Students will be able to use the evidence based comparative chemistry approach to explain the chemical synthesis and analysis.
4. The students will be able to understand the characterization of materials.
5. Students will be able to understand the basic principle of equipments, instruments used in the chemistry laboratory.
6. Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Chemistry.
7. **Disciplinary knowledge and skill:** A graduate student is expected to be capable of demonstrating comprehensive knowledge and understanding of both theoretical and experimental/applied chemistry knowledge in various fields of interest like Analytical Chemistry, Physical Chemistry, Inorganic Chemistry, Organic Chemistry, Material Chemistry, etc. Further, the student will be capable of using of advanced instruments and related soft-wares for in-depth characterization of materials/chemical analysis and separation technology.
8. **Skilled communicator:** The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.
9. **Critical thinker and problem solver:** The course curriculum also includes components that can be helpful to graduate students to develop critical thinking ability by way of solving problems/numerical using basic chemistry knowledge and concepts.

DURGAPUR GOVERNMENT COLLEGE
DEPARTMENT OF CHEMISTRY

Programme Outcome, Course Outcome and Program Specific Outcome

10. **Sense of inquiry:** It is expected that the course curriculum will develop an inquisitive characteristics among the students through appropriate questions, planning and reporting experimental investigation.
11. **Team player:** The course curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field based situation and industry.
12. **Skilled project manager:** The course curriculum has been designed in such a manner as to enabling a graduate student to become a skilled project manager by acquiring knowledge about chemistry project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.
13. **Digitally literate:** The course curriculum has been so designed to impart a good working knowledge in understanding and carrying out data analysis, use of library search tools, and use of chemical simulation software and related computational work.
14. **Ethical awareness/reasoning:** A graduate student requires to understand and develop ethical awareness/reasoning which the course curriculum adequately provide.
15. **Lifelong learner:** The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available techniques/books/journals for personal academic growth as well as for increasing employability opportunity

Program Outcome for Core (CC) Courses

- P01: Core Competency
- P02: Critical Thinking
- P03: Analytical Reasoning
- P04: Research Skills
- P05: Team Work

Program Outcome for Generic Courses

- P01: Additional Academic knowledge
- P02: Exposure beyond discipline
- P03: Problem Solving
- P04: Analytical Reasoning
- P05: Team Work

Program Outcome for Discipline Specific Elective (DSE)Courses

- P01: Additional Academic Knowledge
- P02: Problem Solving
- P03: Additional analytical skills
- P04: Additional Research Skills

Program Outcome for Skill Enhancement (SE) Courses

- P01: Additional Academic Knowledge
- P02: Exposure beyond discipline
- P03: Analytical Reasoning
- P04: Digital Literacy
- P05: Moral and Ethical Awareness

DURGAPUR GOVERNMENT COLLEGE
DEPARTMENT OF CHEMISTRY
Programme Outcome, Course Outcome and Program Specific Outcome

Course Outcomes

BSCHCEMC101 (Honours) : Inorganic Chemistry -I

Course Outcome (Prescribed in Kazi Nazrul University Syllabus (2020-2021) after introduction of LOCF within the CBCS)

Knowledge on the followings

1. Atomic theory and its evolution.
2. Learning scientific theory of atoms, concept of wave function.
3. Elements in periodic table; physical and chemical characteristics, periodicity.
4. To predict the atomic structure, chemical bonding, and molecular geometry based on accepted models.
5. To understand atomic theory of matter, composition of atom.
6. Identity of given element, relative size, charges of proton, neutron and electrons, and their assembly to form different atoms.
7. Defining isotopes, isobar and isotone.
8. Physical and chemical characteristics of elements in various groups and periods according to ionic size, charge, etc. and position in periodic table.
9. Characterize bonding between atoms, molecules, interaction and energetics, hybridization and shapes of atomic, molecular orbitals, bond parameters, bond- distances and energies.
10. Valence bond theory incorporating concepts of hybridization predicting geometry of molecules.
11. Importance of hydrogen bonding, metallic bonding

BSCHCEMC102 (Honours) : Organic Chemistry -I

Course Outcome (Prescribed in Kazi Nazrul University Syllabus (2020-2021) after introduction of LOCF within the CBCS)

Knowledge on the followings

1. Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms.
2. Stereochemistry of organic molecules – conformation and configuration, asymmetric molecules and nomenclature.
3. Aromatic compounds and aromaticity, mechanism of aromatic reactions.
4. Understanding hybridization and geometry of atoms, 3-D structure of organic molecules, identifying chiral centers.
5. Reactivity, stability of organic molecules, structure, stereochemistry.
6. Electrophile, nucleophiles, free radicals, electronegativity, resonance, and intermediates along the reaction pathways.
7. Mechanism of organic reactions (effect of nucleophile/leaving group, solvent), substitution vs. elimination

DURGAPUR GOVERNMENT COLLEGE
DEPARTMENT OF CHEMISTRY
Programme Outcome, Course Outcome and Program Specific Outcome

BSCHCEMC201 (Honours) : Physical Chemistry-I

Course Outcome ((Prescribed in Kazi Nazrul University Syllabus (2020-2021) after introduction of LOCF within the CBCS)

On completion of this course, the students will be able to understand:

Learning objective:

1. Familiarization with various states of matter.
2. Physical properties of each state of matter and laws related to describe the states.
3. Calculation of lattice parameters.
4. Electrolytes and electrolytic dissociation, salt hydrolysis and acid-base equilibria.
5. Understanding Kinetic model of gas and its properties.
6. Maxwell distribution, mean-free path, kinetic energies.
7. Behavior of real gases, its deviation from ideal behavior, equation of state, isotherm, and law of corresponding states.
8. Liquid state and its physical properties related to temperature and pressure variation.
9. Properties of liquid as solvent for various household and commercial use.
10. Solids, lattice parameters – its calculation, application of symmetry, solid characteristics of simple salts.
11. Ionic equilibria – electrolyte, ionization, dissociation.
12. Salt hydrolysis (acid-base hydrolysis) and its application in chemistry

BSCHCEMC202 (Honours) : Organic Chemistry-II

Course Outcome ((Prescribed in Kazi Nazrul University Syllabus (2020-2021) after introduction of LOCF within the CBCS)

On completion of this course, the students will be able to understand:

Learning objective:

1. Familiarization about classes of organic compounds and their methods of preparation.
2. Basic uses of reaction mechanisms.
3. Name reactions, uses of various reagents and the mechanism of their action.
4. Preparation and uses of various classes of organic compounds.
5. Organometallic compounds and their uses.
6. Organic chemistry reactions and reaction mechanisms.
7. Use of reagents in various organic transformation reactions.

DURGAPUR GOVERNMENT COLLEGE
DEPARTMENT OF CHEMISTRY
Programme Outcome, Course Outcome and Program Specific Outcome

Course Outcomes

BSCHCEMGE101 (Generic) : Basics in Organic and Inorganic Chemistry

Course Outcome (Prescribed in Kazi Nazrul University Syllabus (2020-2021) after introduction of LOCF within the CBCS)

Knowledge on the followings

1. Atomic theory and its evolution.
2. Learning scientific theory of atoms, concept of wave function.
3. Elements in periodic table; physical and chemical characteristics, periodicity.
4. To predict the atomic structure, chemical bonding, and molecular geometry based on accepted models.
5. To understand atomic theory of matter, composition of atom.
6. Identity of given element, relative size, charges of proton, neutron and electrons, and their assembly to form different atoms.
7. Defining isotopes, isobar and isotone.
8. Physical and chemical characteristics of elements in various groups and periods according to ionic size, charge, etc. and position in periodic table.
9. Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms.
10. Reactivity, stability of organic molecules, structure, stereochemistry.
11. Electrophile, nucleophiles, free radicals, electronegativity, resonance, and intermediates along the reaction pathways.
12. Mechanism of organic reactions (effect of nucleophile/leaving group, solvent), substitution vs. elimination.

DURGAPUR GOVERNMENT COLLEGE
DEPARTMENT OF CHEMISTRY
Programme Outcome, Course Outcome and Program Specific Outcome

BSCPCEMC101 (Program) : Basics in Organic and Inorganic Chemistry

Course Outcome (Prescribed in Kazi Nazrul University Syllabus (2020-2021) after introduction of LOCF within the CBCS) Knowledge on the followings

Atomic theory and its evolution.

1. Learning scientific theory of atoms, concept of wave function.
2. Elements in periodic table; physical and chemical characteristics, periodicity.
3. To predict the atomic structure, chemical bonding, and molecular geometry based on accepted models.
4. To understand atomic theory of matter, composition of atom.
5. Identity of given element, relative size, charges of proton, neutron and electrons, and their assembly to form different atoms.
6. Defining isotopes, isobar and isotone.
7. Physical and chemical characteristics of elements in various groups and periods according to ionic size, charge, etc. and position in periodic table.
8. Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms.
9. Reactivity, stability of organic molecules, structure, stereochemistry.
10. Electrophile, nucleophiles, free radicals, electronegativity, resonance, and intermediates along the reaction pathways.
11. Mechanism of organic reactions (effect of nucleophile/leaving group, solvent), substitution vs. elimination.

Program Specific Outcome of Organic Chemistry

Under-graduate Honours Course

Organic chemistry is taught in all 06 Semesters in accordance to the CBCS curriculum of Kazi Nazrul University. The nature of these organic chemistry courses, and their respective marks with credit points are listed below:

Semester	Name of the Subject	Nature	Credit	Marks
I	Organic Chemistry – I (Theory)	Core Course – II	6	50
II	Organic Chemistry – II (Theory)	Core Course – IV	4	50
II	Organic Chemistry – II (Lab)		2	50
III	Organic Chemistry – III (Theory)	Core Course – VI	4	50
III	Organic Chemistry – III (Lab)		2	50
IV	Organic Chemistry – IV (Theory)	Core Course – IX	4	50
IV	Organic Chemistry – IV (Lab)		2	50
V	Organic Chemistry– V (Theory)	Core Course–XI	4	50
V	Organic Chemistry– V (Lab)		2	50
VI	DSE(Dynamic Stereochemistry)	DSE	6	50

Semester-I: Only theoretical paper of organic chemistry is taught in this semester.

This semester includes five units:

- Classification and nomenclature:** This unit is intended to provide the basic understanding of classification and nomenclature of organic compounds.
- Structure, bonding and properties of Organic molecules; Organic acid-bases:** This unit aims to provide basic understanding of the structure, bonding and different properties of organic molecules.
- Organic reaction mechanism : An Introduction:** Understanding the mechanism of organic reactions is an important aspect of organic chemistry. Students will develop the thinking skills related to organic reaction mechanism through this unit.
- Aliphatic and aromatic nucleophilic substitutions:** Substitution reactions are widely applied in organic chemistry in different synthetic schemes. This unit introduces the concept of nucleophilic substitution.
- Static stereochemistry-I :** Stereochemical assignment of organic compounds forms the most important part of each and every organic reaction. Students will be able to learn about the basic stereochemistry of organic compounds through this unit.

Semester-II

This semester includes four units:

- Static Stereochemistry-II:** After getting the basic understanding of static stereochemistry in semester-I, this unit introduces the next level of stereochemical aspects of organic chemistry for students.

Department of Chemistry, Durgapur Government College

Program Outcome/Program Specific Outcome/Course Outcome

- b) **Elimination Reactions:** Elimination reactions are widely applied in organic chemistry in different synthetic schemes. This unit introduces the concept of nucleophilic substitution.
- c) **Electrophilic and radical addition to C - C multiple bonds:** Understanding the electrophilic and radical reactions to C-C multiple bonds is an important aspect of organic chemistry. Students will develop the thinking skills related to organic reaction mechanism of these reactions through this unit.
- d) **Nucleophilic addition to carbonyl group :** A variety of name reactions involve nucleophilic addition to carbonyl group. This unit covers all aspects of such reactions in addition to the reduction & other reactions of carbonyl compounds.

Organic Chemistry-II Lab: Students learn the qualitative analysis of organic compounds through this practical paper, such as detection of special elements, functional groups, recording of melting point etc.

Semester-III

This semester includes three units:

- a) **Molecular rearrangements and Named reactions:** After getting idea of substitution and elimination reactions, students learn about different organic rearrangements and named reactions in this unit.
- b) **Aromatic electrophilic substitutions:** Aromatic electrophilic substitutions are quite important in organic synthetic schemes. Mechanism and types of such reactions are covered in this unit.
- c) **Synthesis, physical properties and reactions :** This unit provides the basic understanding of the properties and reactions of nitrogen containing compounds in this unit.

Organic Chemistry-III Lab: Students learn the quantitative analysis of organic compounds in this laboratory paper, such as estimation of glucose, acetone and aniline.

Semester-IV

This semester includes five units:

- a) **Heterocyclic compounds:** Heterocycles are an important class of organic compounds which find wide applications in organic synthesis. Students learn about these compounds in this unit.
- b) **Alicyclic compounds:** Alicyclic compounds show specialized structural features and reactivity in organic chemistry, which is taught in this unit
- c) **Amino acids and Proteins:** Organic Chemistry shares its importance to understand biological systems Amino acids and Proteins form an integral part of biological systems. Complete introductory teaching of these compounds is provided in this unit.

Department of Chemistry, Durgapur Government College
Program Outcome/Program Specific Outcome/Course Outcome

- d) **Carbohydrate chemistry:** Carbohydrate chemistry is quite important in organic chemistry. Students learn about the classification, structure and reactions of carbohydrates through this unit.
- e) **Alkaloids and Terpenoids:** Alkaloids and terpenoids are important class of organic compounds. Students learn about the these compounds through this unit.
- Organic Chemistry-IV Lab:** Students to identify organic compounds through general reactions and tests in this laboratory paper.

Semester-V

This semester includes three units:

- a) **Methodology in organic synthesis:** After getting idea of different types of reactions, students learn about different methods of organic synthesis in this unit
- b) **Pericyclic reactions:** Pericyclic reactions constitute a completely different form of organic reactions and hence require special mention for a student, which is covered in this unit.
- c) **Spectroscopy:** Structure elucidation and catalysis of organic reactions is carried out by spectroscopic techniques. This unit introduces different spectroscopic methods, UV, IR and NMR to students.

Organic Chemistry-V Lab: Students learn to carry out organic preparation by condensation, nitration, oxidation, hydrolysis and rearrangement reactions

Semester-VI: Dynamic Stereochemistry (Only theoretical paper of organic chemistry is taught in this semester)

This paper includes four units. In the first unit, general introduction to dynamic stereochemistry is provided. Subsequently, students learn the stereochemical aspects of different reactions in this paper. It includes the following four units: **General introduction, Synthetic approach, Stereochemical aspects of a few organic reactions and Alicyclic reactions**

Department of Chemistry, Durgapur Government College
Program Outcome/Program Specific Outcome/Course Outcome

Post-graduate course (Organic Specialization)

Organic chemistry is taught in all 04 Semesters in accordance to the CBCS curriculum of Kazi Nazrul University. The nature of these organic chemistry courses, and their respective marks with credit points are listed below:

Semester	Name of the Subject	Credit	Marks
I	Organic General I	4	50
I	Organic General (Practical)	4	50
II	Organic General II	4	50
III	Advanced Organic General	4	50
III	Organic Major I	4	50
III	Organic Major I Practical	4	50
IV	Organic Major II	4	50
IV	Organic Major II	4	50
IV	Organic Major Practical II	4	50
IV	Organic Term Paper Project	6	50

Semester-I

This semester includes two units:

- a) **Unit-I:** This unit includes Stereochemistry (Static and Dynamic) of organic compounds: concept and application & Organic reaction mechanism. This unit provides advanced knowledge of stereochemical aspects of organic reactions to students. Organic reaction mechanism includes substitution, elimination, addition, rearrangement, free radical, metathesis and click chemistry.
- b) **Unit-II:** This unit includes Ultraviolet and visible (UV-vis) spectroscopy: Application Infrared (IR) spectroscopy: Application; Nuclear Magnetic Resonance (NMR) spectroscopy: General principles and application; Mass-spectrometry: General principles and application & combined spectral applications. Students are provided advanced knowledge of spectroscopy in this unit.

Organic General Lab: Students learn the processes of separation of binary mixtures of solid-solid/liquid-solid/liquid-liquid organic samples and identification of individual components. Students also learn to synthesize organic compounds through important chemical reactions.

Semester-II

This semester includes two units:

- c) **Unit-I:** This unit includes Organic Name reactions, reaction intermediates & synthetic polymers and biopolymers. Students learn about different organic reactions and industrial applications of polymers in this unit.

Department of Chemistry, Durgapur Government College

Program Outcome/Program Specific Outcome/Course Outcome

- d) **Unit-II:** Students learn about the chemistry of natural products and medicinal chemistry (drug designing) in this unit.

Semester-III

This semester includes two core subjects: Advanced Organic General & Organic Major-I. Advanced Organic General is taught to all students of post-graduate course. It includes the following units:

- a) **Unit-I:** This unit includes the concept, practice and aspects of green chemistry in current synthetic chemistry. This unit also provides the understanding of organic synthesis focusing on carbon-heteroatom bonds.
- b) **Unit-II:** This unit includes protection-deprotection and retrosynthetic strategies applied in organic synthesis. This unit also includes the concepts of pericyclic reactions and organic photochemistry.

Organic Major I is taught to students with organic specialization. It includes the following units:

- c) **Unit-I:** This unit includes the concept of VBT and MOT in the molecular structure and reactivity of organic reactions. It also includes the understanding of ORD and CD in organic chemistry. Asymmetric synthetic schemes are also taught in this unit.
- d) **Unit-II:** This unit includes synthesis, properties and reactions of heterocyclic compounds and different aspects of organometallic chemistry.

Organic Major-I Lab: Students learn the quantitative estimation of organic compounds in this unit and they also prepare organic compounds by single or two step processes in this practical paper.

Semester-IV

This semester includes two core subjects: Organic Major-II & Organic Major-III. Both these papers are taught to students with organic specialization:

Organic Major-II includes the following units:

- e) **Unit-I:** This unit includes the advanced techniques in organic synthesis. And organic photochemistry.
- f) **Unit-II:** This unit is intended to teach the Structure-function relationship in carbohydrates, proteins, lipids, nucleic acids and enzymes and coenzyme chemistry.

Organic Major III includes the following units:

- g) **Unit-I:** This unit provides advanced knowledge of pericyclic reactions, supramolecular chemistry and chemical concepts of antibiotics, antidiabetic and cardiovascular drugs.
- h) **Unit-II:** This unit includes the chemistry of polyphenolics, steroidal hormones and biosynthesis of some selected biologically relevant natural products.

Organic Major-II Lab: Students learn to prepare organic compounds through multiple step reactions and they characterize the organic compounds using spectroscopic methods.

Department of Chemistry, Durgapur Government College
Program Outcome/Program Specific Outcome/Course Outcome

Program Specific Outcome of Physical Chemistry

Department of Chemistry, Durgapur Government College offers teaching program of Physical Chemistry to its students both at Under Graduate and Post Graduate level.

Under-graduate Honours Courses

Under Choice Based Credit System (CBCS) of Kazi Nazrul University, in Under Graduate level Physical Chemistry is taught in 05 Semesters, both Theory and Practical.

In Semester II as a Core Course -III, Physical Chemistry-I (Theory) is taught and Physical Chemistry- I (Lab) is done.

The following topics (Theory) are covered :

1. **Properties of Gas (Unit - I),**
2. **Thermodynamics - I (Unit - II)**
3. **Properties of Fluids (Unit - V)**

As well as the following Laboratory Experiments are done (**BCHEM 0202**)

1. Surface tension of a liquid/solution by drop-number method and coefficient of a liquid/solution by Ostwald viscometer.
2. Viscosity

In Semester III as a Core Course - VII, Physical Chemistry-II (Theory) is taught and Physical Chemistry-I I (Lab) is done. Following Topics (Th) are covered

1. **Thermodynamics II & Application (Unit - I)**
2. **Statistical Thermodynamics & Third Law (Unit - II)**
3. **Chemical Kinetics -I (Unit - III)**
4. **Ionic Equilibria (Unit - IV)**
5. **Properties of Solid (Unit - V)**

As well as the following Laboratory Experiments are done (**BCHEM 0306**)

1. Kinetics of decomposition of H_2O_2 by potassium iodide.
2. Solubility/solubility product of Mg-carbonate in presence/absence of common ions and/or neutral electrolytes.

In Semester IV as a Core Course - X, Physical Chemistry-III (Theory) is taught and Physical Chemistry-III (Lab) is done. Following Topics (Th) are covered

1. **Chemical Equilibrium (Unit - I)**

Department of Chemistry, Durgapur Government College
Program Outcome/Program Specific Outcome/Course Outcome

2. Electrochemistry (Unit - II)
3. Chemical kinetics -II (Unit - III)
4. Interface & Dielectrics (Unit - IV)

Physical Chemistry - III Lab (BCHEM 0406)

1. Equilibrium constant of the reaction $KI + I_2 = KI_3$ by partition method. 2. Conductometric titrations of an acid or a base (acid may be monobasic/dibasic, and similarly for the base) 3. Potentiometric titrations of an acid or a base (acid may be monobasic/dibasic, and similarly for the base)

In Semester V, Solid State Chemistry is taught as **Discipline Centric Electives [DCE]** Course

Following Topics (Theory) are covered

1. Basic Concepts and selected structure (Unit-I)
2. Crystallographic Basics (Unit-II)
3. Chemical Bonding in Solids (Unit-III)
4. Properties of Solids (Unit-IV)

In Semester VI as a Core Course - XIV, Physical Chemistry-IV (Theory) is taught and Physical Chemistry-IV (Lab) is done along with two **Discipline Centric Electives [DCE]** Course. Following Topics in Theory are covered

1. Phase Equilibria & Colligative Properties (Unit - I)
2. Symmetry & Group Theory (Unit - II)
3. Quantum Chemistry (Unit - III)
4. Photochemistry & Spectroscopy (Unit - IV)

Physical Chemistry - IV Lab (BCHEM 0604)

1. Kinetics of saponification of ester by conductometric method. 2. Conductometric verification of Ostwald dilution law 3. Colorimetric determination of pK_{in} of methyl red

Following two courses are covered as **Discipline Centric Electives [DCE]** Course.

- (i) Chemistry of Nanomaterials and
- (ii) Quantum Chemistry & Spectroscopy

Department of Chemistry, Durgapur Government College

Program Outcome/Program Specific Outcome/Course Outcome

In first case the following topics are covered

1. **Basic Concepts on Nanomaterials (Unit-I)**
2. **Synthesis and Fabrication of Nanomaterials (Unit-II)**
3. **Special Nanomaterials (Unit-III)**
4. **Characterization, Properties and Applications of Nanomaterials (Unit-IV)**

Quantum Chemistry & Spectroscopy (DCE) is another DCE course. Following topics are covered

1. **Quantum Mechanics (Unit - I)**
2. **Atomic Spectra (Unit - II)**
3. **Molecular Spectroscopy (Unit - III)**

Above are mentioned the Physical Chemistry courses taught in under graduate level both in Theory and Practical Experiments. Each and every course has its own importance and related significance. These are the basic foundation of developing knowledge in college level, but throws light in future study and developing interest for research. As Physical Chemistry is primarily concerned with the interpretation of observed facts connected with matter and its changes and give the proper theoretical interpretation to the reactions and facts, each and every topic of this specific study has a very strong out come. In addition , some of the very rapidly growing areas are keeping their significant contribution in recent advanced studies and research. Nanoscience and Technology is a case in point. It is also a rapidly expanding field. Scientists and engineers are having great success making materials at the nanoscale to take advantage of enhanced properties such as higher strength, lighter weight, increased electrical conductivity, and chemical reactivity compared to their larger-scale equivalents. Students may find keen interest in this area in recent years.

Post Graduate Studies

Under 'Semester system' of Kazi Nazrul University, Physical Chemistry is taught in 04 Semesters, both Theory and Practical in the post-graduate level. Along with Organic Chemistry, 'Physical Chemistry Specialization' is offered to the students in final year. The course and its outcome is highlighted below:

Department of Chemistry, Durgapur Government College
Program Outcome/Program Specific Outcome/Course Outcome

In **Semester I** Physical General I (Theory) (MCHEM 0103) paper is taught. The following topics are covered:

1. Quantum mechanics I 2. Atomic and molecular spectroscopy: principle and application 3. Solutions thermodynamics and electrochemistry and 4. Statistical thermodynamics

In **Semester II** Physical General II (Theory) (MCHEM 0203) paper is taught. The following topics are covered:

1. Symmetry and group theory 2. Quantum mechanics II and 3. Chemical Kinetics

In this Semester Physical General Practical (MCHEM 0205) is also done. The following experiments are performed :

1. Experiments in equilibrium and kinetics
2. Instrumental methods: colorimetry polarimetry, conductometry and potentiometry
3. Data processing and elementary numerical techniques

In **Semester III** 1. Advanced Physical General (MCHEM 0303) and 2. Physical Major I (MCHEM 0306) are taught as theory papers along with practical paper (I) 'Advanced General' and (II) Physical Major Practical I

The following topics are covered:

Advanced Physical General

1. Applications of group theory in chemistry 2. Crystallography and surface chemistry 3. Chemistry of Polymers 4. Biophysical chemistry 5. Spectroscopy

Physical Major I

1. Classical mechanics 2. Approximate methods in quantum chemistry 3. Statistical Mechanics

In this Semester Advanced General and Physical Major Practical 1 are also done.

In **Semester IV** 1. Physical Major II and 2. Physical Major III are taught as theory papers and practical paper 'Physical Major Practical II' along with Physical Term Project.

The following topics are covered:

Physical Major II

Department of Chemistry, Durgapur Government College
Program Outcome/Program Specific Outcome/Course Outcome

1. Quantum mechanics of many electron systems 2. Molecular interaction 3. Irreversible thermodynamics and introductory course on non-equilibrium statistical mechanics 4. Electric and magnetic properties of molecules

Physical Major III

1. Molecular reaction dynamics (MRD) 2. Solid state chemistry 3. Photochemistry and Laser principles 4. Alternative Energy Studies

In this Semester also Physical Major Practical I1 along with Physical Term Project are done.

The topics in Physical Chemistry depicted above are included in the syllabus to meet the demand of advanced studies and research in a very good perspective of present scenario not only in Physical Chemistry but also every sphere of science and technology. Whereas Quantum Mechanics, Statistical Thermodynamics, Group Theory etc. have strong and well established theoretical outcome, Surface Science, Polymer Science, Bio physical Chemistry Solid State Chemistry, Photochemistry and Spectroscopy find light in wide applications in versatile areas. These generate interest of the students not only in the field of Physical Chemistry but also interdisciplinary areas of Science and Technology. Overall it finds a valuable outcome and students would move for further studies and research.

Program Specific Outcome of Inorganic Chemistry

BCHEM 0101 INORGANIC CHEMISTRY – I (CORE-I)

The course content of this semester has been designed to provide the students the fundamental principles of chemistry. After completion the various subunits of the course, the students will be able to know the followings:

- Structure of atom and fundamentals of nuclear chemistry which provides the clear picture of the outermost electronic distribution of atom as well as the constituents of the nucleus.
- Periodic table and periodic properties, which helps the students to study the subject systematically. The chemistry of elements which make up all the material world will be understood from the perspective of the periodic table.
- Chemical bonding in covalent compounds gives the most fundamental idea of why a compound is formed. The knowledge Molecular orbital theory enables the students to explain the inner picture of chemical bonding.

BCHEM 0301 INORGANIC CHEMISTRY - II (CORE-V)

The course content of this semester has been designed to provide the students about the fundamental chemistry of s- block and p-block elements.

- A study of s-block, p-block elements and compounds of Noble gases make students familiar with the various reactions and formation of different compounds of them.
- Idea of acids and bases along with ionic equilibria help students identify various compounds in terms of acid and base and also to compare their relative strength. Concept of pH helps them quantify the acidity of a reaction medium, which is extremely important to understand various chemical phenomena.

BCHEM 0302 INORGANIC CHEMISTRY - II Lab

After completion this course the students will be acquainted with the practical qualitative analysis of various acid radicals as well as basic radicals including the treatment of insoluble materials.

BCHEM 0401 INORGANIC CHEMISTRY - III (Core-VIII)

This portion of the course aims to provide the knowledge of chemistry of d- and f-block elements and fundamental ideas of Coordination chemistry.

Department of Chemistry, Durgapur Government College
Program Outcome/Program Specific Outcome/Course Outcome

- The students will have a strong foundation on chemistry of d- and f- block elements after the completion of the course and better understanding of their reactivity and compounds formed by them.
- The introductory idea of coordination chemistry starting with the concept of Werner's Coordination theory help the students to step into the vast realm of complex compounds, their stereochemistry and stability constant etc.

BCHEM 0402 INORGANIC CHEMISTRY - III

This part of the course has been framed so that the students can acquire the skill of synthesis of various inorganic compounds. This prepares a student to grow a mentality of a future researcher. They learn to prepare various inorganic complexes like Chrome alum, Mohr's salt, Cuprammonium sulphate, sodium nitroprusside, hexamine cobalt(III) chloride, tris ethane 1,2-ammine nickel(II) chloride etc.

BCHEM 0503 INORGANIC CHEMISTRY - IV (Core-XII)

- Learning of Redox potential and Redox equilibria helps the learner to explain the reactions in terms of oxidation and reduction. The study of various EMF diagram and related thermodynamic considerations act as important tool to explain various chemical phenomena.
- The study bioinorganic chemistry helps student understand the role of various metal ions in biological systems and provide them a clear picture of two important aspects of life process like photosynthesis and respiration. Important applications of chelation therapy and uses of complexes make student interested for the further study of medicinal chemistry.
- After the completion of the study of organometallic chemistry learners now begin a journey to a new world of chemistry which is indeed an interdisciplinary study of organic and inorganic chemistry. This study pays the students a huge dividend in their future course of research work.

BCHEM 0504 INORGANIC CHEMISTRY - IV Lab

- Performing practical classes, students will acquire skill of volumetric estimation of chemical components using various redox titrations which include permanganometry, dichromatometry, iodometry and iodimetry.
- Students also become able to estimate volumetrically the metal content in a binary mixture of Fe+Cu, Fe+Cr, Fe+Ca, Ca+Ba, Ca+Mg etc.

BCHEM 0601 INORGANIC CHEMISTRY -V (Core-XIII)

Department of Chemistry, Durgapur Government College
Program Outcome/Program Specific Outcome/Course Outcome

- The students will have an extensive knowledge of Crystal Field Theory, Magnetochemistry, and origin of colour in transition metal chemistry.
- The students will have an introductory concept of statistical mathematics for the interpretation of analytical results. Fundamental concepts of analytical chemistry.
- They will be familiar with solvent extraction as a separating technique. They will also learn how the inner-metalic complexes can be used in Analytical chemistry. The concept of masking and demasking agents, complexometric titrations and other aspects of Analytical chemistry will be acquired by the learner.

BCHEM 0602 INORGANIC CHEMISTRY -IV Lab

- The learners will acquire the skill of complexometric estimation of CaCO_3 and MgCO_3 in a mixture, and determination of Mg^{+2} / Zn^{+2} in a binary mixture using complexometric titration.
- Gravimetrically analysis of Ni^{+2} using DMG, estimation of Cu as CuSCN , and Fe after precipitation as Fe(OH)_3 .
- Determination of cation content of a sample by cation exchanger with the application of ion exchange chromatography.
- Solvent extraction as a separation technique.