

BARASAT COLLEGE

DEPARTMENT OF CHEMISTRY

Program Specific Outcomes

B.Sc. Chemistry (Hons) CBCS Syllabus

With effect from 2018-19

At the completion of this program, students will be able to

- **PSO1:** Understand the basic concepts, principles, and applications of various branches of chemistry, viz. Physical, organic, and inorganic chemistry.
- **PSO2:** Set up physicochemical experiments, analyze the data, draw plots, calculate physical constants, and interpret the results.
- **PSO3:** Estimate and analyze inorganic compounds both qualitatively and quantitatively and learn the use of sophisticated analytical instruments.
- **PSO4:** Prepare, purify, and estimate organic compounds and interpret the spectral feature (NMR and IR).
- **PSO5:** Learn the basic tenants of computer programming (Fortran language) and use of data processing software.
- **PSO6:** Prepare and deliver a PowerPoint presentation on the topics leaned during the program.
- **PSO7:** Learn the safety precautions and maintenance protocols of a chemistry laboratory and work cohesively in a group/in a collaborative project.

BARASAT COLLEGE
Course Outcome or Learning Outcome
Three-year B.A. /B.Sc. degree course
Under CBCS semester system
HONOURS COURSE IN CHEMISTRY
With effect from the session: 2018 – 2019

Course Name: Core Course-1
Course Code: CEMACOR01T & CEMACOR01P
Topic Name: ORGANIC CHEMISTRY-I

Course Outcome: At the end of this course a student learns

1. Basics of Organic Chemistry like Bonding and Physical Properties, Valence Bond Theory; Hückel's rules for aromaticity.
2. General Treatment of Reaction Mechanism like Mechanistic classification and Reactive intermediates
3. Stereochemistry and Bonding geometries of carbon compounds and representation of molecules, Concept of chirality and symmetry and Optical activity of chiral compounds
4. To identify and separate some organic compounds.

Course Name: Core Course-2
Course Code: CEMACOR02T & CEMACOR02P
Topic Name: PHYSICAL CHEMISTRY-1

Course Outcome: After successful completion of both theory and practical modules of this course the students will learn:

- (1) The distribution of speed and energy of gas molecules and the difference in behavior of real and ideal gas.
- (2) The three laws of thermodynamics, the condition of spontaneity and equilibria of a chemical process and the principles of thermochemistry.
- (3) The factors that affect rate of a reaction, the theories of reaction rates and the concept of chemical catalysis.
- (4) To calculate rate constants of reactions, heat of neutralization and pH of buffers through hands on experimentation.

Course Name: Core Course-3
Course Code: CEMACOR03T & CEMACOR03P
Topic Name: Inorganic chemistry - I

Course Outcome: After completing the above course successfully, students will be able to have clear ideas on:

1. Atomic structure from both Classical and Quantum Mechanical viewpoints.
2. Chemical periodicity
3. Acid base reactions
4. Redox and precipitation reactions
5. quantitative estimations of various metal ions like Fe (II), Fe (III), Cu (II), Mn (II) etc. using redox titration.

Course Name: Core Course-4
Course Code: CEMACOR04T & CEMACOR04P
Topic Name: ORGANIC CHEMISTRY- II

Course Outcome: After successful completion of the course students will be able to know about the following topic: 1. Stereochemistry like
(a) Chirality arising out of stereo axis (b) Concept of prostereoisomerism (c) Prostereogenic centre and Conformation
2. General Treatment of Reaction Mechanism like
(a) Reaction thermodynamics (b) Concept of organic acids and bases (c) Tautomerism (d) Reaction kinetics
3. Substitution and Elimination Reactions like
(a) Free-radical substitution reaction (b) Nucleophilic substitution reactions (c) Elimination reactions
4. Synthesize some organic compounds followed by their purification.

Course Name: Core Course-5
Course Code: CEMACOR05T & CEMACOR05P
Topic Name: PHYSICAL CHEMISTRY - II

Course Outcome: After successful completion of both theory and practical modules of this course, a student will get an idea of:
(i) The different transport processes viz. diffusion, viscosity, conduction etc. and the application of conductance measurements in estimating several physical parameters.
(ii) Concept of chemical potential and equilibrium constant of a process and the factors affecting them.
(iii) Development of quantum mechanics, its basic postulates and application to model systems like particle in a box and simple harmonic oscillator. (iv) hands on experience in using conductivity bridge to estimate dissociation constant of acid and strength of acids, rate constant of reactions etc.

Course Name: Core Course-6
Course Code: CEMACOR06T & CEMACOR06P
Topic Name: Inorganic chemistry - II

Course Outcome: Passing through the above course successfully, students will be able to express their chemical potentiality on:
1. useful aspects of ionic and covalent bonds
2. details of Molecular Orbital theorem including metallic bond
3. weak chemical forces and their beautiful reflection in various chemical and biochemical systems.
4. radio chemistry and its useful aspects in various fields like chemistry, biology, medicine, agriculture and industry including its safety measure. 5. methods to estimate Vit.C, Cu(II), arsenite, Cu in brass and Cr & Mn in steel by Iodo/iodimetrically.

Course Name: Core Course-7
Course Code: CEMACOR07T & CEMACOR07P
Topic Name: ORGANIC CHEMISTRY-III

Course Outcome: 1. Chemistry of alkenes and alkynes. Addition to C=C: mechanism, Addition to $C\equiv C$
2. Aromatic Substitution Electrophilic aromatic substitution: Ipso substitution: Nucleophilic aromatic substitution: cine substitution, benzyne mechanism,
3. Carbonyl and Related Compounds. Addition to C=O: Exploitation of acidity of α -H of C=O: Elementary ideas of Green Chemistry: Substitution at sp^2 carbon (C=O system): mechanism: BAC2, AAC2, AAC1, AAL1
4. Organometallics Grignard reagent; Organolithiums; Gilman cuprates: Corey-House synthesis; abnormal behavior of Grignard reagents; Organocopper reagents; Reformatsky reaction; Blaise reaction; concept of umpolung and base-nucleophile dichotomy in case of organometallic reagents. 5. qualitative analysis of a single solid organic compound.
After this course one student can grow some idea about the different types of chemical reactions, and their application in the field of boarder line organometallic chemistry and acquire the knowledge of pollution free green chemistry. In practical chemistry: students can do the Qualitative Analysis of Single Solid Organic Compounds.

Course Name: Core Course-8
Course Code: CEMACOR08T & CEMACOR08P
Topic Name: Physical chemistry III

Course Outcome: After successful completion of both the theoretical and practical modules students will learn
(1) the applications of thermodynamic principles in colligative properties of solutions and phase rule.
(2) Principles of electrochemistry and its application in determining physical parameters
(3) Quantum mechanical treatment of rigid rotor and H-atom system and concept of angular momentum
(4) Potentiometric and pH metric practical

Course Name: Core Course-9
Course Code: CEMACOR09T & CEMACOR09P
Topic Name: Inorganic Chemistry III

Course Outcome: After successful completion of both theory and practical modules of the course, the following outcome is expected
1. Understanding of the fundamental problems of extracting and purification of metals from their ores
2. Understanding of chemistry of S and P block elements and their comparative studies
3. Learning of different chemistry of elements and inorganic polymers
4. Understanding and learning of different complex salts formation and their isomerism
5. In- depth understanding of the procedure of preparation of several inorganic complexes and different metal ion determinations by complexo-metric titration through practical classes

Course Name: Core Course-10
Course Code: CEMACOR10T & CEMACOR10P
Topic Name: ORGANIC CHEMISTRY-IV

Course Outcome: Theory:
1. Nitrogen compounds
2. Rearrangements Reactions
3. The Logic of Organic Synthesis (Retrosynthesis)
4. Organic Spectroscopy, UV Spectroscopy, IR Spectroscopy, NMR Spectroscopy
5. quantitative estimation of glucose, vitamin C, aromatic amines, phenol, formaldehyde, acetic acid, urea and saponification value of oil.
After this course, a student can learn different types of chemical reactions with rearrangement reaction mechanism. students can learn the idea of retrosynthesis technique. they can be able to grow their knowledge of the structure and properties of an organic compound spectroscopically. In practical chemistry, students can also be able to estimate organic compounds quantitatively.

Course Name: Core Course-11
Course Code: CEMACOR11T & CEMACOR11P
Topic Name: Inorganic Chemistry-IV

Course Outcome: After successful completion of the course, students will get an idea about
(1) Coordination chemistry, magnetism, color, spectra and calculation of CFSE
(2) Chemistry of transition elements, Lanthanoids and Actinoids
(3) How to estimate ions in solution gravimetrically
(4) Spectrophotometric estimation (5) paper chromatographic separation of some ions and gravimetric estimation of nickel, copper, aluminium and chloride.

Course Name: Core Course-12
Course Code: CEMACOR12T & CEMACOR12P
Topic Name: ORGANIC CHEMISTRY-V

Course Outcome: Theory:
1. Polynuclear hydrocarbons and their derivatives: Heterocyclic compounds: Cyclic Stereochemistry
2. Pericyclic reactions: Electrocyclic reactions: Cycloaddition reactions: Sigmatropic reactions:
3. Carbohydrates : Monosaccharides: Disaccharides: Polysaccharides:
4. Biomolecules : Amino acids: Nucleic acids:
5. In practical classes get acquainted with some methods of chromatographic techniques of purification and separation including TLC, column and paper chromatography. They also get preliminary ideas about ¹H NMR and IR spectra of some compounds.

Course Name: Core Course-13
Course Code: CEMACOR13T & CEMACOR13P
Topic Name: Inorganic Chemistry V

Course Outcome: After completing the course students would get in-depth knowledge about and ability to understand and analyze the application of compounds mentioned below. A detailed expected result is as follows
1. Learning about the essential and beneficial elements in the biological systems
2. Understanding the importance of different biological proteins of Human body
3. Learning the different techniques of toxification and detoxification of metals and get a clear idea about Chelation therapy
4. Gaining knowledge about different organo-metallic compounds and their industrial applications as catalysts.
5. Understanding different inorganic reaction mechanisms and kinetics
6. Learning about qualitative detection and analysis of different anions and cations in practical classes.

Course Name: Core Course-14
Course Code: CEMACOR14T & CEMACOR14P
Topic Name: Physical Chemistry IV

Course Outcome: (1) Molecular Spectroscopy: The students learn in detail the theories that explain the principles of rotational, vibrational and Raman spectroscopy.
The students get a primary introduction to NMR and ESR spectroscopy.
(2) Photochemistry: The students get exposed to the basic principles of photochemistry. They learn about the laws of photochemistry, different photochemical processes, and the kinetic studies of such processes.
(3) Surface phenomenon: The students learn the concepts of surface tension and the related properties of surface. They gain knowledge of adsorption, the basic laws to explain it.
They learn the basic ideas of colloids, particularly their stability. They also learn about different electro-kinetic phenomena and preliminary concepts of association colloids.
(4) In the laboratory, the students learn (i) how to determine the surface tension of a liquid and how can it be used to measure the CMC of a surfactant,
(ii) to study the kinetics of a reaction spectrophotometrically (iii) to verify Beer and Lambert's Law.

Course Name: Discipline Specific Elective-1
Course Code: CEMADSE01T & CEMADSE01P
Topic Name: ADVANCED PHYSICAL CHEMISTRY

Course Outcome: Crystal Structure: Students learn the laws of crystallography, lattice structure of crystalline solids and the basic theory behind the X-ray crystallography. Statistical Thermodynamics: They become acquainted with preliminary concepts of statistical thermodynamics, Boltzmann distribution, molecular partition function and thermodynamic properties. Special selected topics: Students learn about specific heat of solids, Einstein's theory and Debye's T-cubed law to explain this. They become familiar with the third law of thermodynamics and how to approach zero Kelvin using the concept of adiabatic demagnetization. The students get introduced to the subject of polymer science. The students learn about (i) various types of polymers, including conducting polymers. (ii) functionality of monomers, degree of polymerization and the kinetics of polymerization. In the laboratory they learn about Computer programing based on numerical methods for simple problems.

Course Name: Discipline Specific Elective-2
Course Code: CEMADSE02T & CEMADSE02P
Topic Name: Analytical Methods in Chemistry

Course Outcome: (1) The students become aware about sampling methods and sampling errors. They get to know about accuracy and precision, normal law of distribution and they can apply these concepts to solve numerical problems.
(2) The students are exposed to the basic optical methods of analysis viz., UV-vis, IR, flame AAS and flame AES and their principles and applications in estimation of metal ions, geometrical isomers, keto-enol tautomerism and determination of composition of metal complexes.
(3) The students are made aware of thermal and electroanalytical methods and their use in various estimations and Separation techniques like solvent extraction and chromatographic methods. The students also learn about stereoisomeric separation and analysis and about role of computers in instrumental method of analysis.
(4) In the practical classes, the students master the skill of separation methods by paper and thin layer chromatography chromatography and solvent extraction and ion exchange techniques. The students understand the applicative importance of analytical methods as they perform soil analysis and determine BOD and COD of water.

Course Name: Discipline Specific Elective-3
Course Code: CEMADSE04T & CEMADSE04P
Topic Name: GREEN CHEMISTRY

Course Outcome: After successful completion of both theory and practical modules of the course students will be able to
1. Understand the basic principles of green chemistry, its importance to minimize the use of hazardous chemicals, atom economy, and precautions taken for generation of toxic byproducts during chemical reactions.
2. Understand different industrially important synthesis in less polluted way and future trends of green chemistry for sustainable development for better world.
3. Perform hands on experiments using nontoxic materials and water like green solvent. They also have the knowledge to use alternative source of energy in typical green synthesis by avoiding maximum chemical wastage.

Course Name: Discipline Specific Elective-4
Course Code: CEMADSE05T & CEMADSE05P
Topic Name: Inorganic Material of Industrial Importance

Course Outcome: After studying of the course, both theory and practical, the following outcome is expected

1. Learning the procedure of preparation of cement, ceramics and glass and their uses
2. In- depth understanding of the different chemical properties of cement, ceramics and glass
3. Learning the procedure of preparation of important fertilizers and oils, paints, dyes and pigments
4. Learning the procedure of preparation of different types of batteries and alloys and their properties
5. Learning the utility of using different catalysts in different chemical reactions including chemical explosives.

Course Name: Skill Enhancement Course-1
Course Code: CEMSSEC01M
Topic Name: Basic Analytical Chemistry

Course Outcome: After successful completion of the course, students will get an idea about

- (1) Introduction to analytical Chemistry, precision, and accuracy
- (2) Analysis of soil and water
- (3) Analysis of food products and cosmetics
- (4) Principles of chromatography, different types of Chromatography - paper, TLC, column and ion exchange and separation of mixtures.

Course Name: Skill Enhancement Course-2
Course Code: CEMSSEC02M
Topic Name: Analytical clinical biochemistry

Course Outcome: After successful completion of the above course, students will be able to understand clearly:

1. essential features of carbohydrates and proteins
2. utilities and useful aspects of enzymes
3. essentials of lipids and lipoproteins
4. diagnostic approach by blood and urine analysis.

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Course Outcome or Learning Outcome
Three-year B.A. /B.Sc. degree course
Under CBCS semester system
GENERAL COURSE IN CHEMISTRY
With effect from the session: 2018 – 2019

Course Name: Generic Elective/Department Specific Core Course-1
Course Code: CEMHGEC01T & CEMHGEC01P / CEMGCOR01T & CEMGCOR01P
Topic Name: ATOMIC STRUCTURE, CHEMICAL PERIODICITY, ACID AND BASE, REDOX REACTIONS, GENERAL CHEMISTRY & ALIPHATIC HYDROCARBONS

Course Outcome: After the completion of the course students will learn the followings:

1. fundamental of Quantum mechanics and atomic structure, chemical periodicity, acid & base, redox reactions.
2. fundamentals of organic chemistry, concept of Stereochemistry, elementary mechanistic aspects of nucleophilic substitution and Elimination Reactions, fundamental group approach of Aliphatic Hydrocarbons.
3. Estimation of sodium carbonate and sodium bicarbonate present in a mixture, estimation of oxalic acid, water of crystallisation in Mohr's salt, Fe (II) ions and Cu (II) ions by different methods.
4. Qualitative Analysis of Single Organic Compounds.

Course Name: Generic Elective/Department Specific Core Course-2
Course Code: CEMHGEC02T & CEMHGEC02P / CEMGCOR02T & CEMGCOR02P
Topic Name: STATES OF MATTER & CHEMICAL KINETICS, CHEMICAL BONDING & MOLECULAR STRUCTURE, p-BLOCK ELEMENTS

Course Outcome: After successful completion of the theoretical and practical modules of this course the students will learn:

- (1) The general behavior and properties of the different state of matter viz. solid, liquid and gas.
- (2) The different factors that affect the rate of a chemical reaction and the methods of determination of rate and order.
- (3) The various types of bonding involved in a molecular structure and the concept of resonance.
- (4) Properties and reactions of p-block elements (6) Hands on experience in qualitative analysis of inorganic samples and measurement of properties of liquids like viscosity, surface tension etc.

Course Name: Generic Elective/Department Specific Core Course-3
Course Code: CEMHGEC03T & CEMHGEC03P / CEMGCOR03T & CEMGCOR03P
Topic Name: CHEMICAL ENERGETICS, EQUILIBRIA, ORGANIC CHEMISTRY-II

Course Outcome: After successful completion of both theoretical and practical modules of this course the student would acquire knowledge of

- (1) the basic principles and laws of thermodynamics
- (2) the concept of chemical equilibrium and the factors affecting it
- (3) Idea about ionic equilibria, pH and solubility
- (4) Preparation and properties of organic compounds like alcohols, aromatic hydrocarbons etc.
- (5) Hands on determination of pH and identification of organic compounds.

Course Name: Generic Elective/Department Specific Core Course-4
Course Code: CEMHGEC04T & CEMHGEC04P / CEMGCOR04T & CEMGCOR04P
Topic Name: SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE, ELECTRO CHEMISTRY & ANALYTICAL AND ENVIRONMENTAL CHEMISTRY-I

Course Outcome: After successful completion of both theory and practical modules of the course students will be able to

1. Understand the fundamental concept of basic physical chemistry based on solution, phase equilibrium, conductance, and electromotive force. They are also acquainted with the problem-solving technique based on aforesaid physical phenomenon.
2. Understand few analytical concepts based on gravimetric and volumetric analysis. Side by side they are also acquainted with chromatographic methods of analysis using column and thin layer chromatography. They also acquire some knowledge on environmental chemistry, related pollution, their consequence, and probable remedies.
3. Perform some practical based on aforesaid knowledge.

Course Name: Department Specific Elective-1
Course Code: CEMGDSE01T & CEMGDSE01P
Topic Name: Polymer Chemistry

Course Outcome: The students learn about the classification, the nature of molecular forces in polymers, the functionality of monomers, the degree of polymerization. They study the kinetic of addition and condensation polymerization. They become familiar with the determination of molecular weight of polymers, the concept of glass transition temperature. They learn about the preliminary ideas of thermodynamics of polymer solutions. They get ideas on the brief introduction to preparation, structure, properties and application of some important polymers. In the laboratory the students learn how to

- (i) synthesize some of the polymers. (ii) measure the molecular weight and (iii) analyze the polymers.

Course Name: Department Specific Elective-2
Course Code: CEMGDSE03T & CEMGDSE03P
Topic Name: Inorganic Materials of Industrial Importance

Course Outcome: After studying of the course, both theory and practical, the following outcome is expected

1. Learning the procedure of preparation of cement, ceramics and glass and their applications.
2. Learning the procedure of preparation of important fertilizers, paints and pigments
3. Learning the procedure of preparation of different types of batteries and alloys and their properties
4. Learning the utility of using different catalysts in different chemical reactions.
5. Learning of different kinds of explosives
6. hands on experiment in analyzing useful materials like fertilisers, cement, plastic etc.