Department of Chemistry

Suren Das College, Hajo, Kamrup, Assam

Program Outcome, Program Specific Outcome, Course Outcome

CBCS Core-Course under Gauhati University

B. Sc. Chemistry (CBCS)

Program Outcomes (POs)

Department of Chemistry	After successfully completion of three years degree program in Chemistry under CBCS, a student should be able to
Program Outcomes (POs)	**POs-1.** To impart knowledge of General Chemistry covering all the aspects viz. inorganic, organic, physical and analytical Chemistry. **POs-2.** Solve the problem and also think methodically, independently and draw a logical conclusion. **POs-3.** Employ critical thinking and the scientific knowledge to design, carry out, record and analyse the results of chemical reactions. **POs-4.** Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community. **POs-5.** Find out the green route for chemical reaction for sustainable development. **POs-6.** To inculcate the scientific temperament in the students and outside the scientific community.

Semester-I

CHE-HC-1016: INORGANIC CHEMISTRY-I (Credits: Theory-04, Lab-02)

CHE-HC-1026: PHYSICAL CHEMISTRY I (Credits: Theory-04, Lab-02)

Semester-II

CHE-HC-2016: ORGANIC CHEMISTRY I (Credits: Theory-04, Lab-02)

CHE-HC-2026: PHYSICAL CHEMISTRY II (Credits: Theory-04, Lab-02)

Semester-III

CHE-HC-3016: INORGANIC CHEMISTRY-II (Credits: Theory-04, Lab-02)

CHE-HC-3026: ORGANIC CHEMISTRY-II (Credits: Theory-04, Practicals-02)

CHE-HC-3036: PHYSICAL CHEMISTRY-III (Credits: Theory-04, Lab-02)

CHE-SE-3034: Basic Analytical Chemistry (Credits: 04)

Semester-IV

CHE-HC-4016: INORGANIC CHEMISTRY-III (Credits: Theory-04, Lab-02)

CHE-HC-4026: ORGANIC CHEMISTRY-III (Credits: Theory-04, Lab-02)

CHE-HC-4036: PHYSICAL CHEMISTRY-IV (Credits: Theory-04, Lab-02)

CHE-SE-4024: Green Methods in Chemistry (Credits: 04)

Semester-V

CHE-HC-5016: ORGANIC CHEMISTRY-IV (Credits: Theory-04, Lab-02)

CHE-HC-5026: PHYSICAL CHEMISTRY V (Credits: Theory-04, Lab-02)

CHE-HE-5026: Analytical Methods in Chemistry (Credits: Theory-04, Lab -02)

CHE-HE-5056: Polymer Chemistry (Credits: Theory-04, Lab -02)

Semester-VI

CHE-HC-6016: INORGANIC CHEMISTRY-IV (Credits: Theory-04, Lab-02)

CHE-HC-6026: ORGANIC CHEMISTRY-V (Credits: Theory-04, Lab -02)

CHE-HE-6016: Green Chemistry (Credits: Theory-04, Lab -02)

CHE-HE-6056: Dissertation (Credits: Theory-04, Lab -02)

Programme Specific Outcomes (Chemistry Core CBCS)

Programme Specific Outcomes (PSOs)	**PSOs-1.** Gain the knowledge of Chemistry through theory and practical's. **PSOs-2.** To explain nomenclature, stereochemistry, structures, reactivity, and mechanism of the chemical reactions. **PSOs-3.** Identify chemical formula and solve numerical problems. **PSOs-4.** Use modern chemical tools, Models, UV Spectrophotometer, Chemdraw, Charts and Equipments. **PSOs-5.** Know structure-activity relationship. **PSOs-6.** Understand good laboratory practices and safety. **PSOs-7.** Develop research-oriented skills. **PSOs-8.** Make aware and handle the sophisticated instruments/equipments.

Course Outcomes (Chemistry Core CBCS)

Semester-I	
Course	**Outcome** (After completion of these courses students should be able to)
CHE-HC-1016: INORGANIC CHEMISTRY-I	**CO-1.** The students will understand the theoretical background about the basic constituents of matter – atoms, ions and molecules in terms of their electronic structure and reactivity **CO-2.** Knowledge will be gained on the reactivity of chemical species based on their electron transfer affinity. **CO-3.** Understanding will be gained on the periodic classification of elements in the periodic table and changes in properties along the periods and groups in detail. **CO-4.** The laboratory course will help the students to have an exposure to hands-on experience of basic quantitative analytical techniques related to volumetric titrations.
CHE-HC-1026: PHYSICAL CHEMISTRY I	**CO-1.** The students will learn about the kinetic theory of gases, ideal gas and real gases. **CO-2.** In liquid state unit, the students will gain knowledge on the qualitative treatment of the structure of liquids along with the physical properties of liquid, viz, vapour pressure, surface tension and viscosity. **CO-3.** In the molecular and crystal symmetry unit students will be introduced to the elementary idea of symmetry which will be useful to understand solid state chemistry and group theory in some higher courses. **CO-4.** In solid state unit the students will learn the basic solid state chemistry application of x-ray crystallography for the determination of some very simple crystal structures.
	CO-5. The students will also learn about an important topic “ionic equilibria” in this course. **CO-6.** The laboratory course will help the students to have an exposure to hands-on experience in analysing various properties of liquids such as viscosity and surface tension on the basis of the knowledge gained in the theory course.
Semester-II	
Course	**Outcome** (After completion of these courses students should be able to)

CHE-HC-2016: ORGANIC CHEMISTRY I	**CO-1.** The students will learn about basic organic chemistry, the knowledge on different types of aliphatic hydrocarbons: their synthesis processes, reactions and mechanisms. **CO-2.** The students will gain knowledge on the different types of effects such as inductive, electromeric, resonance and mesomeric etc. involved with organic compounds. **CO-3.** Students will be able to explain/analyze the stereo chemical aspects of organic compounds **CO-4.** The laboratory course will help the students to gain an understanding on purification of organic compounds, determining their melting points and boiling points. **CO-5.** The laboratory course will also help the students on knowing the chromatographic techniques (paper and thin layer) involved for the separation of a mixture of organic compounds.
CHE-HC-2026: PHYSICAL CHEMISTRY II	**CO-1.** In this course the students will gain knowledge on the laws of thermodynamics, thermochemistry, thermodynamic functions, relations between thermodynamic properties, Gibbs Helmholtz equation, Maxwell relations etc. **CO-2.** The students are expected to learn about the partial molar quantities, chemical equilibrium, solutions and colligative properties. **CO-3.** The students will be able to understand the chemical systems from thermodynamic point of view. **CO-4.** The laboratory course will help the students to practically determine the thermodynamic properties such as heat capacity, enthalpy of ionization which was covered in the theoretical course.
Semester-III	
Course	**Outcome** (After completion of these courses students should be able to)
CHE-HC-3016: INORGANIC CHEMISTRY-II	**CO-1.** The students would be able to apply theoretical principles of redox chemistry in the understanding of metallurgical processes. **CO-2.** Students will be able to identify the variety of s and p block compounds and comprehend their preparation, structure, bonding, properties and uses. **CO-3.** Students will be able to gain knowledge on the noble gases, their structures and the nature of bonding.

	CO-4. Experiments in this course will boost their quantitative estimation skills and introduce the students to preparative methods in inorganic chemistry.
CHE-HC-3026: ORGANIC CHEMISTRY-II	**CO-1.** The students will be able to gather knowledge on the chemistry of Halogenated Hydrocarbons **CO-2.** Students will be able to describe and classify organic compounds in terms of their functional groups and reactivity. **CO-3.** Experiments in this course will boost their knowledge on testing the presence of different types of functional groups such as alcohols, phenols, carbonyl and carboxylic acid group.
CHE-HC-3036: PHYSICAL CHEMISTRY-III	**CO-1.** The students are expected to learn phase rule and its application in some specific systems. **CO-2.** They will also learn rate laws of chemical transformation, experimental methods of rate law determination, steady state approximation etc. in chemical kinetics unit. **CO-3.** After attending this course, the students will be able to understand different types of surface adsorption processes and basics of catalysis including enzyme catalysis, acid base catalysis and particle size effect on catalysis. **CO-4.** Experiments in this course will boost their knowledge on practical application for determining phase equilibrium and also on determining the kinetics of a chemical reaction.
Semester-IV	
Course	**Outcome** (After completion of these courses students should be able to)
CHE-HC-4016: INORGANIC CHEMISTRY-III	**CO-1.** Students will be able to name coordination compounds according to IUPAC, explain bonding in this class of compounds, understand their various properties in terms of CFSE and predict reactivity. **CO-2.** Students will be able to appreciate the general trends in the properties of transition elements in the periodic table and identify differences among the rows. **CO-3.** Through the experiments students not only will be able to prepare, estimate or separate metal complexes/compounds but also will be able to design experiments independently which they should be able to apply if and when required.

CHE-HC-4026: ORGANIC CHEMISTRY-III	**CO-1.** Students shall demonstrate the ability to identify and classify different types of N-based derivatives **CO-2.** Students will gain knowledge on different types of natural products such as alkaloids and terpenoids. **CO-3.** Students will be able to gain knowledge on polynuclear hydrocarbons. **CO-4.** Through the experiments students will be able to know the detection of N, S and halogens present in organic compounds. **CO-5.** Through the experiments students will also be able to know Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds)
CHE-HC-4036: PHYSICAL CHEMISTRY-IV	**CO-1.** In this course the students will learn theories of conductance and electrochemistry. **CO-2.** Students will also understand some very important topics such as solubility and solubility products, ionic products of water, conductometric titrations etc. **CO-3.** The students are also expected to understand the various parts of electrochemical cells along with Faraday's Laws of electrolysis. **CO-4.** The students will also gain basic theoretical idea of electrical & magnetic properties of atoms and molecules.
Semester-V	
Course	**Outcome** (After completion of these courses students should be able to)
CHE-HC-5016: ORGANIC CHEMISTRY-IV	**CO-1.** Through this course the students are introduced to nucleic acids, amino acids and pharmaceutical compounds. **CO-2.** Students are introduced to the importance of nucleic acids, amino acids and develop basic understanding of enzymes, bioenergetics and pharmaceutical compounds.
	CO-3. Students will be able to explain/describe the important features of nucleic acids, amino acids and enzymes and develop their ability to examine their properties and applications. **CO-4.** The practical course will expose the students to isolate and characterize the natural products.

CHE-HC-5026: PHYSICAL CHEMISTRY V	**CO-1.** The course helps in introducing the students with three important areas- quantum chemistry, molecular spectroscopy **CO-2.** In quantum chemistry unit the students will be taught the postulates of quantum mechanics and the application of quantum mechanical ideas in some simple systems such as particle in a box, rigid rotor, simple harmonic oscillator etc. **CO-3.** In spectroscopy unit, rotational, vibrational, raman, electronic, spin resonance, and electronic spectroscopy are introduced. **CO-4.** The students will able to understand the basics of various aspects of photochemistry. **CO-5.** Experiments in this course will boost their knowledge on UV-visible spectroscopic technique and Colourimetry
Semester-VI	
Course	**Outcome** (After completion of these courses students should be able to)
CHE-HC-6016: INORGANIC CHEMISTRY-IV	**CO-1.** The students will get acquainted with the kinetic and thermodynamic factors governing the reaction path and stability of inorganic compounds. **CO-2.** Through the chapter on organometallic compounds the students will gather knowledge about the importance of metal carbon bond to form complexes and their application as catalysts. **CO-3.** Students will learn factors leading to stability of organometallic compounds, their synthesis, reactivity and uses. **CO-4.** Qualitative inorganic analysis is included which give students an idea and hands on experience of application of inorganic chemistry. Students learn how differential reactivity under different conditions of pH can be used to identify variety of ions in a complex mixture. **CO-5.** Experiments related to synthesis and characterization of coordination compounds supplement the theoretical knowledge.
CHE-HC-6026: ORGANIC CHEMISTRY-V	**CO-1.** Students learn about the different spectroscopic techniques and their applications in organic chemistry. **CO-2.** Students shall be apprised with carbohydrate chemistry **CO-3.** Students will learn about dyes and polymers and their structure, reactivity and chemical properties. **CO-4.** Experiments related to this course supplement the theoretical knowledge.

Course Outcomes (Chemistry Skill Enhancement Courses)

SEC for Semester-III	
Course	**Outcome** (After completion of these courses students should be able to)
CHE-SE-3034: Basic Analytical Chemistry (Credits: 04)	**CO-1.** The students will gain knowledge on different micro and semimicro analytical techniques and help develop the ability to use modern instrumental methods. **CO-2.** Students are able to explain the basic principles of chemical analysis. **CO-3.** Students are able to design/implement microscale and semimicro experiments, record, interpret and analyze data following scientific methodology. **CO-4.** The instrumental demonstrations included in the course helps the students to get hands-on-exposure to the supplement the theoretical knowledge.
Must Read	
1. Willard, H. H. Instrumental Methods of Analysis, CBS Publishers. 2. Skoog & Lerry. Instrumental Methods of Analysis, Saunders College Publications, New York. 3. Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992). 4. Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman. 5. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill. 6. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India. 7. Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982). 8. Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA. 16 (1977). 9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall. 10. Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall. 11. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).	

SEC for Semester-IV	
Course	**Outcome** (After completion of these courses students should be able to)
CHE-SE-4024: Green Methods in	**CO-1.** Students shall be able to describe and evaluate chemical products and processes from environmental perspective

Chemistry (Credits: 04)	**CO-2.** Students will learn about the tools of Green chemistry and twelve principles of Green Chemistry **CO-3.** Students will learn to define and propose sustainable solutions and critically assess the methods for waste reduction and recycling. **CO-4.** The course introduces the students to the real world cases in green chemistry
Must Read	
1. Manahan S.E. (2005) Environmental Chemistry, CRC Press 2. Miller, G.T. (2006) Environmental Science 11th edition. Brooks/Cole 3. Mishra, A. (2005) Environmental Studies. Selective and Scientific Books	

Course Outcomes (Discipline Specific Elective Papers)

DSE for Semester-V	
Course	**Outcome** (After completion of these courses students should be able to)
CHE-HE-5026: ANALYTICAL METHODS IN CHEMISTRY (Credits: Theory-04, Lab -02)	**CO-1.** The course will enable students to have knowledge on the qualitative and quantitative aspects of analysis **CO-2.** This course will help students develop a theoretical understanding about choice of various analytical techniques used for qualitative and quantitative characterization of samples. **CO-3.** The experiments included in the course will help students to gain hands on experience of the techniques discussed in the theoretical section. **CO-4.** Students will be enabled to take judicious decisions while analyzing different samples. **CO-5.** The instrumental demonstrations included in the course helps the students to get hands-on-exposure to the supplement the theoretical knowledge.
Must Read	
1. Mendham, J. et al.: Vogel's Text Book of Quantitative Chemical Analysis; 6th Ed. Pearson Education, 2009. **2.** Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. CBS Publishers & Distributors, 2004. **3.** Christian, Gary D: Analytical Chemistry, 6th Ed. Wiley India (P) Ltd., 2004. **4.** Harris, Daniel C: Exploring Chemical Analysis, 4th Ed. W. H. Freeman, 2008. 45	

5. Khopkar, S.M.: Basic Concepts of Analytical Chemistry, 3rd Ed. New Age, International Publisher, 2009.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, 6th Ed. Thomson Asia Pvt. Ltd. Singapore
7. Mikes, O. and Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.1979
8. Ditts, R.V. *Analytical Chemistry: Methods of separation.*Van Nostrand, New York, 1974.

CHE-HE-5056: Polymer Chemistry (Credits: Theory-04, Lab -02)	**CO-1.** Through the course, the students will be introduced to the theory and applications of polymer chemistry. **CO-2.** The students will learn about the history of polymeric materials **CO-3.** The students will learn the definition and classifications of polymers, kinetics of polymerization, molecular weight of polymers, glass transition temperature, and polymer solutions etc. **CO-4.** The students will learn briefly the preparation, structure and properties of some industrially important and technologically promising polymers.

Must Read

12. Seymour's Polymer Chemistry, Marcel Dekker, Inc.
13. G. Odian: Principles of Polymerization, John Wiley.
14. F.W. Billmeyer: Text Book of Polymer Science, John Wiley.
15. P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill.
16. R.W. Lenz: Organic Chemistry of Synthetic High Polymers.

DSE for Semester-VI

Course	**Outcome** (After completion of these courses students should be able to)
CHE-HE-6016 : GREEN CHEMISTRY (Credits: Theory-04, Lab-02)	**CO-1.** Students will be introduced to green chemistry and its 12 basic principles. **CO-2.** This course will make them conversant with applications of green chemistry to organic synthesis. **CO-3.** Through this course the students will be prepared for taking up entry level jobs in the chemical industry. **CO-4.** They also will have the option of studying further in the area of green chemistry and will learn about the future perspectives.

	CO-5. The experiments included in the course will help the students to learn how to avoid waste and select green chemicals for their synthesis.
Must Read	
4. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005). 5. P.T. Anastas & J.K. Warner: Oxford Green Chemistry- Theory and Practical, University Press (1998). 6. A.S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001). 7. M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000). 8. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002). 9. Pavia, D. L. Lampman, G. H. & Kriz, G.S. W B Introduction to Organic Laboratory Techniques: A Microscale Approach, 4th Ed., Brooks/Cole; 2007.	
CHE-HE-6056: Dissertation (Credits: Theory-04, Lab -02)	**CO-1.** Student will complete a project work and then prepare a report on that. **CO-2.** Students will be introduced to new fields of research **CO-3.** They will learn how to do literature review. **CO-4.** They will learn how to search for research journals using different search engines such as Sci-finder, Scopus, Sci-hub. **CO-5.** They will learn the basics of formulating and drafting a report on the provided research topic.