DEPARTMENT OF CHEMISTRY

Biswanath College

Programme Outcomes: B.Sc. in Chemistry

Link to the GU Syllabus:

1. **Chemistru Honours (CBCS): https://sites.google.com/a/gauhati.ac.in/syllabus-ug-cbcs/honours/chemistry**
2. **Chemistry regular (CBCS): https://sites.google.com/a/gauhati.ac.in/syllabus-ug-cbcs/regular/chemistry**
3. **ChemistryMajor&General(Non-CBCS): https://sites.google.com/a/gauhati.ac.in/syllabus-ug-old/undergraduate-courses/tdc-in-chemistry-major**

After successful completion of three year degree program in Chemistry a student should be able to;

1. Demonstrate, solve and understand the major concepts in all disciplines of chemistry.
2. Solve the problem and also think methodically, independently and draw a logical conclusion.
3. Employ critical thinking and the scientific knowledge to design, carry out, record and analyse the results of chemical reactions.
4. Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
5. Find out the green route for chemical reaction for sustainable development.
6. To inculcate the scientific temperament in the students and outside the scientific community.
7. Use modern techniques, decent equipments and chemistry softwares.

Course Outcomes: B. Sc. Chemistry (Honours Course/Major)

Semester I	
Course	**Outcomes**
CHE-HC-1014: Inorganic Chemistry-I	On successful completion, students would have ➢ Clear understanding of the concepts related to atomic and molecular structure, Wave mechanics, Wave functions, quantum numbers, shapes of orbitals. ➢ Periodic properties, Effective nuclear charge, Slater's rule. ➢ Chemical bonding including ionic bond, covalent bond, metallic bond, weak chemical forces and redox behaviour of chemical species.
CHE-HC-1012: LAB	Students will also have hands on experience of standard solution preparation in different concentration units and learn volumetric estimation through acid-base and redox reactions.
CHE-HC-1024:	In gaseous state unit the students will learn

Physical Chemistry I	➢ The kinetic theory of gases, ideal gas and real gases. In this chapter they will learn the most important physical chemistry equation "the equation of state". They will learn to construct a model of the departures of real gases from perfect gases and learn to construct, interpret and use of Van der Waals equation of state. ➢ In liquid state unit, the students are expected to learn the qualitative treatment of the structure of liquid along with the physical properties of liquid, viz. vapour pressure, surface tension and viscosity. ➢ In the molecular and crystal symmetry unit they 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. 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. ➢ The students will also learn another important topic ionic equilibrium. In this chapter they will learn about ionic equilibria involving dissociation of weak acids and weak bases in aqueous solutions, dissociation of sparingly soluble salts in aqueous solutions, dissociation of water, p^H- scale and also about the importance of buffer solution.
CHE-HC-1022: LAB	On successful completion of this course, students will be able to measure the surface tension and viscosity of a given solution using certain method specified in the course and to study the variation of the both property of the solution with concentration of the solute. They will also learn the indexing of a given power diffraction pattern of a cubic crystalline system, about buffer solution, preparation of buffer solution, pH metric and to measure the dissociation constant of a weak acid.
Semester II	
CHE-HC-2014: Organic Chemistry I	On successful completion of this course, students will be able ➢ To identify different classes of organic compounds and learn their nomenclature. ➢ To identify different types of reagents and reaction intermediates. ➢ To understand the shape of the molecules using hybridisation concept ➢ Toexplain/analyze their reactivity, mechanism based on different electronic displacement factors. ➢ To explain/analyze their stereo chemical aspects.

CHE-HC-2012: LAB	In this course, students will have hands on experience on checking the calibration of the thermometer, purification of organic compounds by crystallisation, checking of the purity of organic compound by measuring melting point, determination of boiling point of liquid compounds, chromatographic separation of organic mixtures.
CHE-HC-2024: Physical Chemistry II	➢ In this course the students are expected to learn laws of thermodynamics, thermochemistry, thermodynamic functions, relations between thermodynamic properties, Gibbs Helmholtz equation, Maxwell relations etc. ➢ Moreover the students are expected to learn partial molar quantities, chemical equilibrium, solutions and colligative properties. ➢ After completion of this course, the students will be able to understand the chemical systems from thermodynamic point of view.
CHE-HC-2022: LAB	On successful completion of this course students will have hand on experience on determination of heat capacity of a calorimeter, enthalpy of neutralization, enthalpy of ionization, integral enthalpy, enthalpy of hydration, basicity/protocity of a polyprotic acid by the thermochemical method and study of solubility of benzoic acid in water.
Semester III	
CHE-HC-3014: Inorganic Chemistry-II	On successful completion of this course students would be able ➢ To apply theoretical principles of redox chemistry in the understanding of metallurgical processes. ➢ To identify the variety of s and p block compounds and comprehend their preparation, structure, bonding, properties and uses. ➢ To explain the use of terms Hard and Soft in relation to metal ions and ligands terms of hard and soft interactions and discuss the stability of complexes. ➢ To explain chemistry of noble gases and their compounds; application of VSEPR theory in explaining structure and bonding to know about Inorganic polymers and their uses.
CHE-HC-3012: LAB	Experiments in this course will boost their quantitative estimation skills and introduce the students to preparative methods in inorganic chemistry.
CHE-HC-3024: Organic Chemistry-II	Students will be able ➢ To learn and differentiate between various organic functional groups and method of their synthesis. ➢ To classify organic compounds in terms of their functional groups and

	reactivity. ➢ To explain, analyse and design transformations between different functional groups. ➢ To learn about the different reaction mechanism involves in the given functional group transformations.
CHE-HC-3022: LAB	In this course, students will have hands on experience on test of functional groups present in a given organic sample by systematic analysis, preparation of some organic compounds using conventional method or green approach.
CHE-HC-3034: Physical Chemistry-III	The students are expected to learn ➢ Phase equilibrium and its application in some specific systems. They will also learn the most important thermodynamic property "chemical potential", the Clausius-Clapeyron equation phase diagram for one component system, solid-liquid equilibria involving eutectic, congruent and incongruent melting points etc. ➢ In the Chemical kinetics chapter they will learn rate laws of chemical transformation, experimental methods of rate law determination, steady state approximation, rate determining state approximation etc. ➢ In the Surface chemistry chapter 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.
CHE-HC-3032: LAB	On successful completion, students will be able to conduct the physical experiments of phase eqilibria viz., construction of phase diagram, determination of critical solution temperature and composition of the phenol-water system, study the effect of impurities on critical solution temperature and composition of the phenol-water system, determination of distribution coefficient, study the equilibrium and kinetic of a reaction. They will also able to study a given absorption isotherm.
Semester IV	
CHE-HC-4014: Inorganic Chemistry-III	On successful completion, 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, d-orbital splitting in complexes, chelate effect, polynuclear, labile and inert complexes. ➢ Understanding the nomenclature of coordination compounds/

	complexes, Molecular orbital theory, d- orbital splitting in tetrahedral, octahedral, square planar complexes, chelate effects. ➢ To appreciate the general trends in the properties of transition elements in the periodic table and identify differences among the rows, and chemistry of first raw transition elements. ➢ Understanding the transition metals stability in reactions, origin of colour and magnetic properties. ➢ Understanding the separation of Lanthanides and Actinides, its colour, spectra and magnetic behaviour. ➢ Understanding the bioinorganic chemistry of metal ions in biological systems, Haemoglobin-storage and transfer of iron, Na/K pump, Carbonic anhydrase and Carboxypeptidase, about trace metals. ➢ Toxicity of various metals and mechanism of metal-biological interactions, use of chelating agents in medicine.
CHE-HC-4012: LAB	Through the experiments students 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-4024: Organic Chemistry-III	After the completion of the course, students willlearn ➢ To identify and classify different types of N-based derivatives, alkaloids, terpenes, heterocyclic compounds and polynuclear hydrocarbonds. ➢ To explain their structureand reactivity. ➢ To critically examine their synthesis and reactions mechanism. ➢ About the synthetic applications of diazonium salts. ➢ To identify the natural source of alkaloids and terpenes and systematic elucidation of their structure.
CHE-HC-4022: LAB	In this course, students are expected to learn to detect the extra elements and function groups present in a given organic sample.
CHE-HC-4034: Physical Chemistry-IV	➢ In this course the students will learn theories of conductance and electrochemistry. ➢ Students will also understand some very important topics such as solubility and solubility products, ionic products of water, conductometric titrations etc. ➢ The students are also expected to understand the various parts of electrochemical cells along with Faraday's Laws of electrolysis.

	➢ The students will also gain basic theoretical idea of electrical & magnetic properties of atoms and molecules.
CHE-HC-4032: LAB	On completion of the course, the student should be able to determine a cell constant, equivalent conductance, degree of dissociation and dissociation constant of a weak acid, to perform various conductometric and potentiometric acid-base titrations.
Semester V	
PAPER M 501 : Quantum Chemistry	On completion of the course, the student should be able ➢ To account for the basic principles and concepts of quantum mechanics, solve the Schrödinger equation for model systems of relevance within chemistry and physics. ➢ To describe many-electron atoms with the independent particle model, describe the structure of the periodic system and the connections between the properties of the elements and their electron configurations. ➢ To describe the chemical bonding quantum mechanically with molecular orbital theory, describe the bases behind interaction between light and matter.
PAPER M 502 : Physical Chemistry	In this course students will learn- ➢ In the reaction dynamics chapter they will learn details of what happens to molecules at the climax of reaction encounter, collision theory, transition state theory and their application to derive rate laws. ➢ In the photochemistry chapter they will learn the various mechanisms involved in photochemical reactions along with the concept of fluorescence, phosphorescence and consequences of light absorption with the help of Jablonski diagram. ➢ In the Phase equilibrium they will learn Phase equilibrium and its application in some specific systems. They will also learn the most important thermodynamic property “chemical potential”, the Clausius-Clapeyron equation phase diagram for one component system, solid-liquid equilibria involving eutectic, congruent and incongruent melting points etc. ➢ In the surface chemistry they will learn various adsorption processes, adsorption isotherms, determination of surface area and catalytic activity at the surface.
PAPER M 503 :	In this course the students will able

Organic Chemistry	➢ To change the connectivity of an existing organic backbone by using reactions that result in skeletal rearrangements. ➢ To identify different types of oxidising and reducing agents as well as the properties of the reagents. ➢ To make use of those different reagents in organic synthesis and they can do it in different pathways. ➢ To identify different pericyclic reactions and to predict the condition for allowance of pericyclic reactions. ➢ To draw the MOs for polyenes, identify the FMO's (HOMO &LUMO) participating in the pericyclic reaction& explain the importance of MO's in pericyclic reactions. ➢ To predict the products& the stereochemistry of the product of the Pericyclic reactions. ➢ To explain the structure, bonding and physical and chemical properties of polynuclear aromatic hydrocarbons and heterocyclic compounds. ➢ To critically examine their synthesis and reactions mechanism. ➢ To learn the synthetic method, physical properties and reactivity of organic nitro and amino compounds, organo S and organo P compounds. ➢ To recognise the active methylene compounds, to learn the method of their synthesis and applications in organic synthesis.
PAPER M 504 : Inorganic Chemistry	In this course the students will be able to learn ➢ The symmetry elements and operations, point group classification, Symmetry of octahedron, tetrahedron and square planar complexes. ➢ Structure and symmetry of inorganic compounds, Shape and symmetry of s, p and d orbitals. ➢ The concepts of metal ligand bonding in transition complex compounds, the thermodynamics and kinetic aspects of metal complexes. ➢ To identify the basic concept, terms and importance andthe chemistry of organometallic compounds, homogeneous hydrogenation and carbonyls, the 18-electron rule and its violation. ➢ To learn about the common organometallic reactions and to be able to draw reasonable reaction mechanisms. ➢ Be able to use knowledge about structure and bonding issues to understand the stability and reactivity of simple organometallic

	complexes. ➢ To understand the importance of Na/K salts and calcium in biology ➢ To understand the bioinorganic chemistry of haemoglobin, myoglobin, etc. ➢ To recognize role of porphyrin ring in haemoglobin.
PAPER M 505 : Practical	In this course, students are expected to learn the utilization of quantitative estimation of inorganic ions by volumetry, complexometry, gravimetry, colorimetry, redox and precipitation methods in laboratory. They are also expected to learn the chromatographic method of separation of cations by paper/TLC.
PAPER M 506 : Practical	In this course, students are expected to learn to prepare organic compounds and the quantitative organic analysis.
Semester VI	
PAPER M 601: Spectroscopy	In this course the students will ➢ Learn the most common spectroscopic methods and their possibilities and limitations for studies of molecules in the IR and UV/Vis MW, IR and UV-Vis areas. ➢ Calculate different molecular parameters for simple molecules from their NMR, IR, Raman and UV-Vis spectra. ➢ Account for how spectroscopic methods can be used to determine molecular structures, with focus on the identification of characteristic groups in polyatomic molecules on the basis of their IR and UV-Vis spectra. ➢ Account for different types of electronic transitions and de-excitation process and interpret absorption and fluorescence spectra. ➢ Use UV-Vis absorption and emission spectrometers and be able to account for their function.
PAPER M 602: Physical Chemistry	In this course the students will learn about solids state, Macromolecules and colloids, statistical thermodynamics and data analysis.
PAPER M 603: Organic Chemistry	By the end of the course, the student must ➢ Have deep understanding on the theory andprincipleinvolved in the photochemical and photophysical processes. ➢ Have understanding on the differences between photoreaction and thermal reaction, characteristics of photochemistry, application of photochemical reactions, fundamental laws of photochemistry,

	efficiency in photochemical reactions, significance of Jabolonski diagram. ➢ Have clearunderstanding of what is fibre and polymer, the classification of polymers based on the mechanism of polymerisation reaction, based on properties of the polymer and based on the source, their preparation, properties and applications. ➢ Have a specialised knowledge on the structure of biopolymers have and their importance. ➢ Have understanding on the structures and purposes of basic components of prokaryotic and eukaryotic cells. ➢ Have good knowledge on concentration gradient, ion transport across the cell membrane. ➢ Have clearunderstanding on the catalytic role of enzymes, importance of metalloenzyme, coenzymes and vitamins. ➢ Able to draw the structure of carbohydrates, lipids, proteins, amino acids, haemoglobin and myoglobin and have knowledge on their functions in biological systems. ➢ Have learned the structure of nucleotides, nucleocides, DNA, RNA and the hydrogen bondings of purines and pyrimidines bases in their structure. ➢ Have clear understanding on the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins. ➢ Able to recognise and categorise the classes of natural product. ➢ Have good knowledge on the extraction, separation, isolation and structure elucidation of the natural products. Students must also have understanding on the importance of those natural products. ➢ Have learnt to draw the structure of the carbohydrates, to predict the configuration carbohydrate molecules and knowledge on the methods of their synthesis. ➢ Have deep good understanding of the chemistry of drugs with respect to their pharmacological activity, the drug metabolic pathways, adverse effect and therapeutic value of drugs, knowledge of the Structural Activity Relationship (SAR) of different class of drugs and the chemical synthesis of some drugs, the classificationchiral drugs, asymmetric drug synthesis and the importance of asymmetric synthesis.

	➢ Have understanding onthe fundamentals of biological energy production that is how cells harvest chemical energy by oxidizing glucose to pyruvate and how the products of photosynthesis function as the inputs of cell respiration.
PAPER M 604: Inorganic Chemistry	After the completion of course, students will be able ➢ To understand free ion terms and their splitting, Orgal diagram, selection rule, vibronic coupling and colour of complexes. ➢ To understand the electronic spectra of metal complex ions. ➢ To understand the thermodynamics and kinetic aspects of metal complexes, formation constants, kinetic lability and inertness, Chelate effect. ➢ To explain the terms stepwise stability constant and overall constants. ➢ To give appropriate definitions of the terms inert and labile and state which d- electron configurations are associated with inertness. ➢ To know mechanism of ligand displacement reactions. ➢ To determine of composition of ionic compounds by conductometry. ➢ Theory of redox and complexometric titrations. ➢ Students are able to describe role of different metal ions in biological system. ➢ Toxicity of metal ions, effect of gases and polluted environments. ➢ Importance of metal salts in diet, diagnosis, chemotherapy and as medicines. ➢ To identify and define various types of nuclear transmutation including fission, fusion reactions. ➢ To understand about radioactivity radioactive emissions and decay reactions. ➢ Use of proper isotopic notation to write down and balance a nuclear reaction. ➢ State and compare the differences and similarities between a nuclear change and chemical change. ➢ To calculate each for a given nucleus. ➢ To define binding energy and mass defect and be able to calculate each for a given nucleus. ➢ To understand the concept of rate of change and half-life in the context of nuclear decay. ➢ To understand the basics of nuclear chemistry applications: nuclear

	power, medical treatment, isotopic labelling and carbon dating. ➢ Lanthanoids, Actinoids – separation, color, spectra and magnetic behavior. ➢ Use of lanthanoids/actinoid compounds. ➢ Understanding the separation of lanthanoids and actinoids, its color, spectra and magnetic behavior.
PAPER M 605: Practical	In this course,students will have hands on experience on various physical chemistry experiments viz., determination of cooefficient of viscosity, surface tension, mutual solubility of two liquids, molecular mass of volatile liquid, specific rotation of an optically active substance, specific rotation rate, kinetic of a reaction, distribution coefficient andtest of validity of Beer-Lambert's law. They will also learn to carry out coductometric titration and potentiometric titration.
PAPER M 606: Project Work	In this course students will ➢ Understand the objectives of doing scientific research. ➢ Learnhow to identify the area of research to be conducted, how to proceed for literaturesurvey using a variety of sources and how to write research project withwell laid hypothesis and objectives. ➢ Learn the skills of research design,nature of sample size as well as collection and analysis of data. ➢ Also knowthe skills of writing research report and making oral presentations.

Course Outcomes: B. Sc. Chemistry (General Course/Regular Course/Generic Elective)

Semester I	
Course	**Outcomes**
CHE-RC/HG-1014: Chemistry-1	After completion of this course the students will learn the atomic structure through basic concept of quantum mechanics. They will understand the chemical bonding through VB and MO approaches. In organic part, the students are expected to learn basic ideas used in organic chemistry, stereochemistry, functional groups, alkanes, alkenes and alkynes.
CHE-RC/HG-1012-LAB: Chemistry-1	In this course, students will have hands on experience on volumetric analysis of some inorganic salts and metal ions. In organic chemistry part students will learn to detect extra element present in the given organic sample through systematic analysis. They will also learn to carry out chromatographic separation of a given organic mixture.

Semester II	
CHE-RC/HG-2014: Chemistry-2	After completion of this course the students will learn periodic properties in main group elements, transition elements. They will also learn the crystal field theory in coordination chemistry unit. In physical chemistry part, the students are expected to learn kinetic theory of gases, ideal gases and real gases, surface tension, viscosity, basic solid state chemistry and chemical kinetics.
CHE-RC/HG-2012-LAB: Chemistry-2	Working through this course, students are expected to develop their skills and knowledge for semi-micro qualitative analysis of at least mixture of four ionic species and quantitative measurement of various ions in a given solution. They will also learn to measure surface tension and viscosity of a liquid, kinetics of certain reactions.
Semester III	
CHE-RC/HG-3014: Chemistry-3	After completion of this course the students will able to understand the chemical system from thermodynamic point of view. They will also learn two very important topics in chemistry-chemical equilibrium and ionic equilibrium. In organic chemistry part, the students are expected to learn various classes of organic molecules-alkyl halides, aryl halides, alcohols, phenols, ethers, aldehydes and ketones.
CHE-RC/HG-3012-LAB: Chemistry-3	In this course, students will have hands on experience on the measurement of P^H of commercially available food drinks, shampoos and soaps. Also gain experience of preparing buffer solution and measurement of its pH. In the organic part, students will learn to purify organic compounds by crystallisation, recrystallisation and distillation. They are also expected to learn organic synthesis and check the purity of the synthesized compounds by measuring their melting point and boiling points.
CHE-SE-3034: Basic Analytical Chemistry	Upon completion of this course, students will be able to explain the basic principles of chemical analysis, design/implement microscale and semimicro experiments, record, interpret and analyze data following scientific methodology.
Semester IV	
CHE-RC/HG-4014: Chemistry-4	After completion of this course the students will learn solutions, phase rule and its application in specific cases, basic of conductance and electrochemistry. Students will also learn some important topics of organic and biochemistry-carboxylic acids, amines, amino acids, peptides, proteins and carbohydrates.

CHE-RC/HG-4012- LAB: Chemistry-4	In this course, students will learn to conduct the study of equilibrium of a given reaction, phase equilibrium, determination of conductance and potentiometric acid-base titration. In the organic part, they will learn the systematic qualitative organic analysis, preparation of derivatives and chromatographic separation of organic mixtures, determination, differentiation and extraction of organic compounds using specified analytical techniques.
Semester V	
PAPER E 501: General Chemistry	On completion of the course, the student should be able to account for the ➢ Bonding in solid: Band theory. ➢ Electronic properties of solids relating electrical conductivity, conductors, insulators semiconductors, Intrinsic and extrinsic semiconductors. ➢ Ferroelectric and Piezoelectric material and preparation of electronic grade pure silicon.
PAPER E 502: Practical	
Semester VI	
PAPER E 601: General Chemistry	After completion of this course, students will ➢ Have in depth knowledge of basic and applied area of Industrial Chemistry. Students will learn what is polymer, their classification, mechanism of polymerisation, manufacture of certain polymers and also learn their structure, properties and applications. ➢ Gain knowledge on how to prepared coal by Fisher-Tropsch process and isolate various chemicals from coal. They will also learn how various hydrocarbons can be obtained industrially from petroleum, industrial reactions involving those hydrocarbons, the synthetic process of methanol from natural gas, synthesis of petrol, LPG, CNG and biodiesel. ➢ Learndetails of the production of soap and detergents industrially from oils and fats, understand the principle of cleansing action of soap and detergents, industrial applications of enzymes in the production of alcohol by fermentation of sugars. ➢ Recognize the different types of air and water pollutant, sources of the pollutions, the toxic effects the pollutants. Students will get aware of the permissible limits of those pollutants in both air and water and measures to control the pollutions.Appreciate the ethical context of

	environmental issues and the links between human and natural systems. ➢ Get insight of the structures and purposes of basic components of prokaryotic and eukaryotic cells, cell membrane andhave good knowledge on concentration gradient, ion and molecule transport across the cell membrane, the structure and functions of amino acids and proteins. ➢ Have learnt to draw the structure of the carbohydrates, to predict the configuration carbohydrate molecules and knowledge on the methods of their synthesis. ➢ Learn the details of the structure of DNA and RNA, have clear understanding on the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins. ➢ Have good knowledge on the catalytic role of enzymes, the hypothesis of Lock-key model of enzyme-receptor interaction, importance of metalloenzyme, coenzymes and vitamins. ➢ Students will conceptualize how various biomolecules are metabolized inside the body in order to produce energy for various functions and how various metabolic pathways regulate growth and development of living beings. Students will know about role of high energy compounds, how carbohydrates serve as energy source to power various functions ➢ Have good knowledge on the extraction, separation, isolation and structure elucidation of the natural products terpenes and alkaloids. Students must also have understanding on the physiological action of alkaloids ➢ Learn details about the structure of hormone, their functions in biological system and the role of neurotransmitter in their action. ➢ Have good understanding of the chemistry of drugs with respect to their pharmacological activity, learn the structure of variousantibiotic, antimalarial, anticancer drugs, their uses and metabolic pathways
PAPER E 602: Practical	In this course students will able to determine the hardness of water by complexometric titration, equivalent mass by titrimetrically, study the kinetics of a reaction, carry acid-base conductometric titration. In the inorganic part, they will learn to prepare double salt and complex salt.

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