Chemistry

[C] = Compulsory [S] = Selective

Semester 1

[C] Mathematical Analysis (A) I

Credits: 5 Class Hours: 112

This course covers: Limits and Continuity，Single Variable Differential Calculus，Single Variable Integral Calculus，Multivariable Differential Calculus，Multivariable Integral Calculus，Theory of Series，Improper Integral Calculus and Parametric Variable Integral Calculus.

Through the course, students not only need to understand the generalized principles, basic concepts, theories and methods, but also to acquire the ability of abstract and logical thinking ability and argument ability, scientific standardized expression ability, thus to master and apply the thought and methods to analyze, transfer and solve problems with mathematical tools.

[C] Introduction to Physics (A) I

Credits: 5 Class Hours: 96

An introductory Physics course usually covers Mechanics, Thermal Physics, Electricity and Magnetism, Optics, and Modern Physics. Typically, it takes two years to go through these subjects. We, on the other hand, will have only one year to cover all this material. A great challenge before us is to master the material in a short period of time, and do it well. Another challenge is that this class consists of students with intention of pursuing rather different majors – mathematics, physics, and life sciences. The preparations and backgrounds are also very different. To address this challenge, we will focus on the most fundamental aspects of physics, emphasizing concepts and general approaches.

[C] Chemical Principles

Credits: 4 Class Hours: 64

Chemical Principles is the foundation course for Zhiyuan Students. The course is about the basic principles of physical chemistry widely applied in the field of Chemistry, and the course is prerequisite of all subsequent chemistry courses (Inorganic Chemistry, Organic Chemistry, Physical Chemistry, and Analytical Chemistry and Chemical Engineering Elective Courses). It includes Atomic Molecular Electronic Structure, Molecular Structure, Molecular Interaction, the Basic Properties of Gas Liquid Solid (Crystal), the Three Laws of Thermodynamics, Thermodynamic Equilibrium and Reaction Kinetics.

[C] Inorganic and Analytic Chemistry Lab. I

Credits: 2 Class Hours: 64

[S] Introduction to Computer Science

Credits: 3 Class Hours: 48

This course has two parts: theory and technology. The first part introduces the content and influence of mathematical foundation applied in computer science. The second part introduces important foundation and technology of computer science with ample evidence. This course emphasizes the most important basic knowledge and technology in the field of computer science to make students have a broader understanding. This course also contains a practical operation.

Semester 2

[C] Mathematical Analysis (A) II

Credits: 5 Class Hours: 119

The basic content of this course contains: Number Entries, Series of Functions, Multivariable Differential Calculus, Multivariable Function Integral Calculus, Integral Depending on a Parameter, Fourier Series.

This course not only enable students to gradually acquire the abstract general conclusion, relevant concept, basic theory and method, but also cultivate students' systematic, rigorous abstract logical thinking and verification ability, scientific and standardized expression ability. In order to make them master the ideology and method of utilizing mathematical tools to analyze problems, transform problem and solve problem.

[C] Introduction to Physics (A) II

Credits: 5 Class Hours: 96

The course is designed for two semesters. Introduction to Physics I covers the core content of classical mechanics, hydrodynamics and thermal physics. Introduction to Physics II covers the core content of electromagnetism, physical optics and modern physics. The course also introduces a considerable number of expansion of the content. In the teaching process, it cover the classical, highlight the characteristics and key points, etc. Each chapter includes the basic content, reading materials, exercises and small paper, etc. In the teaching process, it try to express the content clearly in appropriate difficulty, and attractively, with particular attention to the application of physical principles and physical ideas in practice.

Through the course of study, the students can gradually grasp the ideas and methods of solving problems by physics. They can not only acquire the knowledge, but also their ability to establish physical model, and the capacity of calculation and estimation of quantitative analysis and qualitative analysis, and the ability to obtain knowledge independently, the ability of linking theory to practice can be synchronously improved and developed. Students can open their thinking, inspire their spirit of exploration and innovation, enhance their

adaptability, and enhance their quality of science and technology. Through the course of the study, to enable students to master the scientific learning method and form good learning habits, form the dialectical-materialism-theory-formation world outlook and the methodology.

[C] Frontier of Chemistry I

Credits: 2 Class Hours: 32

This course aims to enhance students' understanding of chemistry, cultivate students' interest in chemistry research, and lay foundation for the future research. By the end of the fresh year, all the students can find their preferred topics and research group to carry out scientific research.

This course is mostly about raising and discussing questions. Types of the questions include: (1) Thinking: invite famous scholars all over the world to give lectures and raise questions; (2) Investigating: enhance the ability of discovering, judging and explaining problems by encouraging the students to speak out; (3) Expanding: Judge on the basis of design scheme and experimental results. Students are required to think over risks, opposite opinions, predict the result or analyze the process of reaching conclusions; (4) Practice: Conduct some theoretical or experimental training to explore and solve problems. Students are needed to search for extra materials, expand their thinking range, and cultivate their interest in scientific research and innovative thinking way. The course lasts one year (2 semesters), and includes Introduction to Chemistry I and II, Seminar of Introduction to Chemistry I and II. The content can be categorized into three parts: 1. Chemistry and material; 2. Chemistry and energy; 3. Chemistry and life.

[C] Inorganic Chemistry

Credits: 4 Class Hours: 64

This course belongs to fundamental chemistry courses. Through classroom teaching to enable students to master the grading regularity of element properties and basic knowledge and theory of coordination chemistry, to know about the preparation methods of elementary substances, the chemical properties of main group and subgroup element and to grasp the researching methods, application and developing trends of Inorganic Chemistry. This course enables the students to have a comprehensive understanding of Inorganic Chemistry, basic chemical principles and their application in chemical analysis and element properties, and the cutting-edge research and current situation of modern Inorganic Chemistry research.

[C] Organic Chemistry I

Credits: 4 Class Hours: 64

The basic concepts and theories of organic chemistry, the structure, properties and changes of the main organic compounds, and the application of the reaction mechanism of typical organic reaction.

[C] Physics Laboratory I

Credits: 1.5 Class Hours: 26

The course is set up to make students hold the ideas, the fundamental principles and the basic methods of the physical experiments, and to teach students how to use the basic experimental instruments and apparatus and how to deal with the data. What's more, the course is set up also to make students have the attitude of working hard and coming down to bedrock and have the hard-bitten style, and lastly to make students basically hold the ability to research.

[C] Inorganic and Analytic Chemistry Lab. II

Credits: 1.5 Class Hours: 48

This course is a basic experiment course for undergraduate students in chemistry class of Zhiyuan College. The course aims to cultivate the habit and ability of autonomous learning and focuses on cultivating the ability to questioning, solving questions and drawing conclusion.

Through the teaching of three levels of experiments: basic experiments, comprehensive experiments, and designing experiments, to cultivate students' ability of independent thinking and problems solving, and establish rigorous studying style, good scientific quality, and the ability to gain and grasp scientific research methods. This course also cultivates scientific researching habits of being accurate, precise and organized, scientific spirit of seeking truth from facts, and forms scientific thinking methods and innovative capacity. With rigorous experimental training, students will be able to analyze and solve complex problems, to collect and deal with chemical analysis results, to express ideas in written forms and to work in a group. The students will understand the basic chemistry principles and the way the chemistry researchers think and do research.

[S] Introduction to Polymer Science

Credits: 2 Class Hours: 32

[S] Integrated Experimental Training I

Credits: 1.5 Class Hours: 48

Semester 3

[C] Linear Algebra

Credits: 5 Class Hours: 80

This course is a basic linear algebra course for students majoring in chemistry and biology, which covers the basic content of linear algebra. The course enables students to master the basic theories, thoughts and methods of linear algebra and polynomial, also systematically trains and enhances the calculation ability and abstract thinking ability. This course lays solid foundation in linear algebra for future study of other majors. The course emphasizes abstract thinking while pays special attention to illustrating the mathematical thoughts and thinking

threads with detailed applicable examples. The course introduce the relations with other subjects and cutting-edge scientific results to broaden the horizon of the students.

[C] Frontier of Chemistry II

Credits: 2 Class Hours: 32

This course aims to enhance students' understanding of chemistry, cultivate students' interest in chemistry research, and lay foundation for the future research. By the end of the fresh year, all the students can find their preferred topics and research group to carry out scientific research.

This course is mostly about raising and discussing questions. Types of the questions include: (1) Thinking: invite famous scholars all over the world to give lectures and raise questions; (2) Investigating: enhance the ability of discovering, judging and explaining problems by encouraging the students to speak out; (3) Expanding: Judge on the basis of design scheme and experimental results. Students are required to think over risks, opposite opinions, predict the result or analyze the process of reaching conclusions; (4) Practice: Conduct some theoretical or experimental training to explore and solve problems. Students are needed to search for extra materials, expand their thinking range, and cultivate their interest in scientific research and innovative thinking way. The course lasts one year (2 semesters), and includes Introduction to Chemistry I and II, Seminar of Introduction to Chemistry I and II. The content can be categorized into three parts: 1. Chemistry and material; 2. Chemistry and energy; 3. Chemistry and life.

[C] Physical Chemistry I

Credits: 5 Class Hours: 80

As a compulsory fundamental course, Physical Chemistry focuses on basic theories and methods. The course is divided into three parts: "balance" introduces the three laws of Thermodynamics and Physical Chemical Equilibrium; "structure" from quantum mechanics to introduce the structure of atoms and molecules, various spectral theories, and the relationship between microstructure and macroscopic properties; the "change" part studies the problem of micro and macro dynamics. As a compulsory fundamental course, Physical Chemistry needs to fulfill the needs of science students on basic knowledge and development of chemistry subject. Compared with the traditional teaching mode, this course is a re-combination of Structural Chemistry and Physical Chemistry (12 credits in total). It emphasizes on basic content of Statistical Mechanics and Microscopic Reaction Kinetics while reduces those more professional parts like Solid Chemistry, Electrochemistry, Colloid and Ectochemistry. The prerequisite course is Chemistry Principle, which introduces the basic principles of Physical Chemistry. Students who want to further their study in Physical Chemistry can select the following courses: Quantum Chemistry, Solid Chemistry, Colloid and Ectochemistry. And the experimental courses accompanying this course are Physical Chemistry Experiment (I & II), and the experiment course will be arranged to the next semester.

[C] Organic Chemistry II

Credits: 4 Class Hours: 64

The basic concepts and theories of organic chemistry, the structure, properties and changes of the main organic compounds, and the application of the reaction mechanism of typical organic reaction.

[C] Physics Laboratory II

Credits: 1.5 Class Hours: 27

Through the learning of this course, students should review and reinforce the understandings about operations of instrument, realization of experiments and analysis of data. They should know about the underlying motivation of designing physical experiments, and be able to briefly design reasonable schemes based on the aim of experiment and instruments, also determine the parameters. They should acquire fundamental methodologies to analyze errors and evaluate results.

Through experiments, students should acquire the ability to observe, analyze and judge. They shall be cultivated to possess manners of scientific research, and acquire elementary research ability.

[C] Organic Chemistry Laboratory I

Credits: 2 Class Hours: 64

This course is a basic experiment course for undergraduate students majoring in Chemistry in Zhiyuan College.

Experimental Chemistry (I) is an integral part of Organic Chemistry teaching, and experiment teaching is to verify, consolidate and enhance theoretical knowledge, cultivate students' ability of choosing, isolating and identifying methods of organic chemical compounds and the ability of operation and thinking on analyzing and solving problems during experiments, enhance the ability to cope with the problems, establish the ability of seeking truth from facts, and a rigorous and precise scientific attitude and working habit. The course trains the student's with basic chemical experiment technics, methods, documents organization and paper writing ability, which will lay a good foundation for future work and research in chemistry.

[C] Undergraduate Research I

Credits: 1 Class Hours: 16

Semester 4

[C] Probability

Credits: 3 Class Hours: 48

Basic probability, basic statistics, models and applications.

[C] Physical Chemistry II

Credits: 5 Class Hours: 80

As a compulsory fundamental course, Physical Chemistry focuses on basic theories and methods. The course is divided into three parts: "balance" introduces the three laws of Thermodynamics and Physical Chemical Equilibrium; "structure" from quantum mechanics to introduce the structure of atoms and molecules, various spectral theories, and the relationship between microstructure and macroscopic properties; the "change" part studies the problem of micro and macro dynamics. As a compulsory fundamental course, Physical Chemistry needs to fulfill the needs of science students on basic knowledge and development of chemistry subject. Compared with the traditional teaching mode, this course is a re-combination of Structural Chemistry and Physical Chemistry (12 credits in total). It emphasizes on basic content of Statistical Mechanics and Microscopic Reaction Kinetics while reduces those more professional parts like Solid Chemistry, Electrochemistry, Colloid and Ectochemistry. The prerequisite course is Chemistry Principle, which introduces the basic principles of Physical Chemistry. Students who want to further their study in Physical Chemistry can select the following courses: Quantum Chemistry, Solid Chemistry, Colloid and Ectochemistry. And the experimental courses accompanying this course are Physical Chemistry Experiment (I & II), and the experiment course will be arranged to the next semester.

[C] Analytical Chemistry

Credits: 3 Class Hours: 48

Instrumental Analysis is an important fundamental course of chemistry. It is an analysis and measurement method of chemical constitution, status and structure based on material physics and chemical properties. This course is mainly about the principles, instrument structures and quantitative and qualitative methods of electrochemical analysis, atomic spectroscopy, molecular spectroscopy, chromatography, capillary electrophoresis and mass spectrometry. Students are required to master the basic principles, characteristics and application scope of the analysis methods of common instruments, understand basic structures and operating principle of common analytical instruments and preliminary be able to apply these methods to solving the corresponding problems and thus to be well-prepared for future scientific research.

[C] Organic Chemistry Laboratory II

Credits: 1.5 Class Hours: 48

This course is a basic experiment course for undergraduate students majoring in Chemistry in Zhiyuan College.

Experimental Chemistry (II) is an integral part of Organic Chemistry teaching, and experiment teaching is to verify, consolidate and enhance theoretical knowledge, cultivate students’ ability of choosing, isolating and identifying methods of organic chemical compounds and the ability of operation and thinking on analyzing and solving problems

during experiments, enhance the ability to cope with the problems, establish the ability of seeking truth from facts, and a rigorous and precise scientific attitude and working habit. The course trains the student's with basic chemical experiment technics, methods, documents organization and paper writing ability, which will lay a good foundation for future work and research in chemistry.

[C] Physical Chemistry Lab. II

Credits: 2 Class Hours: 64

Computational chemistry illustrates the nature of chemical problem on the atomic and molecular level, which plays a major role in creating new material and substances. Calculation and simulation has been infiltrated into all aspects of chemistry and influenced and changed the development of chemistry and has become a third research methods following theoretical chemistry and experimental research.

This course demonstrates the theoretical part of quantum chemistry theory in physical chemistry, atomic and molecular structure and statistical thermodynamic theory. In this course, students can deepen their understanding and recognition of the related content in physical chemistry and grasp the basic theories and methods in computational chemistry through hands-on experiments, study software application, supplemented with theoretical explanation.

[S] NanoMaterials

Credits: 2 Class Hours: 32

At the nanoscale (1-100 nm), materials have unusual properties that derive simply from the size scale alone and that differ from bulk properties in unexpected ways. For example, melting points of nanomaterials may be significantly lower than that of the bulk material, this can be primarily understood as a surface effect. Smaller sized particles increase their surface area substantially. Thus, surface forces take on special significance. Thin films may be fabricated from polymers with thickness of the order of a radius of gyration. Carbon nanotubes have amazing tensile strengths but also highly variable conductivity that makes them candidates for the next generation of molecular electronics. Quantum dots and gold nanoparticles have unusual spectroscopic properties that stem, in part, from their sizes being below the wavelength of visible light.

[S] Inorganic Synthesis

Credits: 2 Class Hours: 32

[S] Chemical Biology and Biological Chemistry

Credits: 2 Class Hours: 32

The first part is called "Introduction to Chemical Biology." Chemical Biology is an interdisciplinary discipline that involves chemistry, physics and biology. Through its application of tools and techniques, new and complex biological questions can be examined. Often this involves the synthesis and development of small molecules and/or biological molecules, and examining the effect that they have within biological systems.

The second part is called “Bio-Organic Chemistry.” Mechanistic organic chemistry is a powerful tool. There is no biological reaction of organic compounds that does not follow the basic rules of organic chemistry. In each of the class sessions, there will be problems that begin with a review of a fundamental area of mechanism in organic chemistry followed by an application of that area to biological molecules. The focus is on organic chemistry, not biochemistry.

[C] Undergraduate Research II

Credits: 1 Class Hours: 32

Semester 5

[C] Instruments Analysis Laboratory

Credits: 2 Class Hours: 64

Instrumental Analysis Experiment is a supporting course of the Instrumental Analysis which plays a great role in cultivating the students’ hands-on ability and independency ability. This course is to help students to master skills for practical analysis, to improve their character and capacity which is demanded as a technology worker.

[C] Undergraduate Research III

Credits: 2 Class Hours: 64

[C] Physical Chemistry Lab. Ⅱ

Credits: 1.5 Class Hours: 48

Computational chemistry illustrates the nature of chemical problem on the atomic and molecular level, which plays a major role in creating new material and substances. Calculation and simulation has been infiltrated into all aspects of chemistry and influenced and changed the development of chemistry and has become a third research methods following theoretical chemistry and experimental research.

This course demonstrates the theoretical part of quantum chemistry theory in physical chemistry, atomic and molecular structure and statistical thermodynamic theory. In this course, students can deepen their understanding and recognition of the related content in physical chemistry and grasp the basic theories and methods in computational chemistry through hands-on experiments, study software application, supplemented with theoretical explanation.

[S] Organic Synthesis Methods

Credits: 2 Class Hours: 32

Organic synthesis is a powerful method to make natural and unnatural functional compounds related to chemical, material, life, environmental, agricultural and pharmaceutical science

and technology. The course Organic Synthesis helps the students to strengthen their understanding and application of organic reactions, to achieve the skills in synthesizing complex functional molecules in their scientific study, and to train their scientific thinking and synthetic designing skills.

[S] Modern Electrochemistry

Credits: 2 Class Hours: 32

This course covers the basic theory, measuring methods and technologies & applications of electrochemistry. The electrochemical technologies and applications focus on energy storage and conversion, design of electrochemical devices, electrochemical environment-engineering and others. The practical problems encountered during R & D and the related improving methods are analyzed and discussed. In addition, the new development in the electrochemical science and technology in the world will be introduced, and the recent research results of electrochemical power sources and the related electroactive materials will be presented.

[S] Polymer Chemistry

Credits: 2 Class Hours: 32

Polymer chemistry course mainly introduces the physical and organic chemistry of the reactions by which polymer molecules are synthesized. At first, the course is to introduce the characteristics which distinguish polymers from their much smaller sized homologs, and then to a detailed consideration of the three types of polymerizations— step, chain, ring- opening polymerization. Polymerization reactions are characterized as to their kinetic and thermodynamic features, their scope and utility for the synthesis of different types of polymer structures, and the process conditions which are used to carry them out. In the last part, there is a discussion of the reactions of polymers that are useful for modifying or synthesizing new polymer structures and the use of polymeric reagents, substrates, and catalyst.

[S] Polymer Physics

Credits: 2 Class Hours: 32

Course character: This course is a fundamental one for undergraduate students of Applied Chemistry (Polymer) major, also for undergraduate students of Materials Science and Engineering related majors. Instructional objectives: Polymer Physics is an important part of polymer science. The instructional objectives of this course are to make students understand the relationship between polymer structure - macromolecular motion - properties and applications, to cultivate their interest in polymer science, to make them realize the relevant research ideas and methods, and thus establish their theoretical knowledge foundation and improve their ability in the research of polymer science and engineering through learning and understanding relative basic knowledge such as polymer chain structures, macromolecular motion, solution properties, aggregative structures, viscoelasticity and mechanical properties of polymeric materials as well as various characterization techniques along with some typically practical applications.

[S] Coordination Chemistry

Credits: 2 Class Hours: 32

Coordination Chemistry is a very important branch in Inorganic Chemistry. This course seeks to provide both broad and in-depth coverage of topics within modern coordination chemistry that will be discussed in several sections listed below. The basic fundamental principle of coordination chemistry including nomenclature, isomerism, bonding, and structure of complexes, the electron spectrum and the magnetism of transitional metal complexes. New trends in modern coordination chemistry will be introduced including metal clusters, bioinorganic chemistry, organometallic chemistry and homogeneous catalysis, and supramolecular chemistry.

Semester 6

[C] Undergraduate Research IV

Credits: 1 Class Hours: 32

[S] Catalyze Application

Credits: 2 Class Hours: 32

[S] Integrative Chemistry Experiments

Credits: 1 Class Hours: 48

[S] Contemporary Analytical Methods in Polymer Science

Credits: 2 Class Hours: 32

[S] Polymer Material

Credits: 2 Class Hours: 32

[S] Polymer Science Experiments

Credits: 2 Class Hours: 68

[S] The Principles of Polymer Molding and Processing

Credits: 2 Class Hours: 32

[S] Functional Polymers

Credits: 2 Class Hours: 32

[S] Integrated Experimental Training III

Credits: 1 Class Hours: 48

Semester 7

[S] Solid Chemistry

Credits: 4 Class Hours: 64

[S] Colloid and Interface Chemistry

Credits: 2 Class Hours: 32

[S] Separation Process

Credits: 2 Class Hours: 32

[S] Ecomaterials

Credits: 2 Class Hours: 32

Semester 8

[C] Undergraduate Thesis

Credits: 6 Class Hours: 96