Module 2: Mathematics, Physics and Chemistry

Contents

Module designation	*Advanced Mathematics C (Part 1)*
Semester(s) in which the module is taught	*1st semester*
Person responsible for the module	*Juan Wang*
Language	*Chinese*
Relation to curriculum	***Compulsory*** *Advanced Mathematics C (Part 1) is a basic theoretical course required for all undergraduate engineering students in the University. Upon completion of this course, students will have a solid theoretical foundation in differential calculus of functions of one variable, integral calculus and ordinary differential equations. They will improve their basic mathematical skills and increase their awareness of how to use the ideas of calculus to analyze and solve problems, so as to lay a good foundation of mathematical knowledge for the subsequent study of related core courses.*
Teaching methods	*Lecture*
Workload (incl. contact hours, self-study hours)	*(Estimated) Total workload: 120 hours* *Contact hours (please specify whether lecture, exercise, laboratory session, etc.): 64 hours (Theoretical teaching)* *Private study including examination preparation, specified in hours: 56 hours*
Credit points	*4.0*
Required and recommended prerequisites for joining the module	*N/A*
Module objectives/intended learning outcomes	***Knowledge:*** *Acquire the basic concepts and fundamental theory of functions, limits, continuities, differential calculus of functions of one variable, integral calculus of functions of one variable, and ordinary differential equations;* ***Skills:*** *Master the basic operations of limits, derivatives, differential, integral and solutions of ordinary differential equations, improve their ability to perform numerical and symbolic calculations, and have strong skills in plane observation, abstract generalization and logical reasoning.* ***Competence:*** *Upon successful completion of this course, students will be able to apply the concepts and techniques of scientific reasoning to analyze and solve problems. They will be able to apply mathematical knowledge and*

	methods to solve practical problems. They will also increase their sense of innovation and increase their creativity.
Content	***Chapter 1 Functions*** *Understand the concept of a function, master the representation of a function, and establish functional relationships for applied problems.* *Understand the function of boundedness, . Monotonicity, periodicity and parity.* *Understand the concept of composite functions and segmented functions, understand the concept of inverse function and implicit function.* *Understand basic elementary functions and their properties and graphs.* *Understand the concepts of demand functions, supply functions, cost, revenue and profit functions.* *Understand the history of mathematics related to functions, and understand the dialectical laws of mathematics and philosophy.* ***Chapter 2 Limits and Continuity*** *Understand the intuitive definitions of limits of series and limits of functions, and understand the strict mathematical definition of a limit.* *Understand the properties of convergent series and limits of functions.* *Understand the concepts of left and right limits of a function and the relationship between the existence of a limit function and the left and right limits.* *Understand the two existence criteria for limits, master the four rules of operation for limits, and master the method of finding limits using two important limits.* *Understand the concepts of infinitesimals and infinitesimal quantities, master the method of comparison of infinitesimals, and know how to use equivalent infinitesimals to find limits.* *Understand the concepts of continuous function (including left continuous and right continuous) and discontinuity point, recognize the type of discontinuity point of function, and understand the removable discontinuity point and jump discontinuity point.* *Understand the properties of continuous functions and the continuity of elementary functions, and understand the properties of continuous functions on closed intervals (boundedness, the most value theorem, the mediator theorem), and be able to apply these properties.* *Understand the history of mathematics related to limits and the related elements of Civics.* ***Chapter 3: Derivatives, Differentials, Margins, and Elasticity*** *Understand the concept of derivative and the relationship between conductivity and continuity, understand the geometric and economic significance of derivatives, and know how to find the tangent and normal equations of plane curves.* *Understand the formula for the derivatives of basic elementary functions, the four rules of the derivative and the rules for the derivatives of composite functions, can find the derivatives of segmented functions, and can find the derivatives of inverse functions.*

	Understand the concept of higher order derivatives and can find higher order derivatives of simple functions. *Will find derivatives of functions determined by implicit functions.* *Understand the concept of differentiation, the relationship between derivatives and differentiation and the invariance of first order differential forms and will find the differentiation of functions.* ***Chapter 4 Median Theorem and Applications of the Derivative*** *Understand and use Rolle's Theorem, Lagrange's Median Theorem, and understand and use Cauchy's Median Theorem.* *Master the use of Lobida's Law to find the undetermined limit.* *Master the method of determining the monotonicity of a function, understand the concept of extreme value of a function, and master the method of finding the extreme value, maximum value and minimum value of a function and its applications.* *Know how to use the derivative to determine the concavity of the graph of a function, know how to find the inflection points of the graph of a function as well as horizontal, lead and oblique asymptotes, and know how to depict the graph of a function.* *Understand Taylor's formula and the idea of approximating functions by polynomials (analytical proofs of theorems and proofs of related problems using Taylor's theorem are not required).* *Understand the median theorem, Lobida's law and Taylor's formula related to the history of mathematics and related elements of the Civics.* ***Chapter 5 Indefinite Integration*** *Understand the concepts of original function and indefinite integral, and master the properties of indefinite integral.* *Master the basic integral formula of indefinite integral.* *Master the commutative method (the first type of commutative method and the second type of commutative method) and the partial integral method of indefinite integral.* *Understand indefinite integration of simple rational functions.* *Understand the history of mathematics related to integrals and the related elements of philosophy.* ***Chapter 6 Definite Integrals and Their Applications*** *Understand the concept of definite integrals.* *Understand the basic properties of definite integrals, understand the median theorem of definite integrals, and use the properties of definite integrals to prove integral equations and inequalities.* *Understand the concept of the upper limit function of an integral and know how to find the derivative of the upper limit function of an integral.* *Master the Newton-Leibniz formula, and master the commutative integral method and partial integral method of definite integral.* *Understand the concept of anomalous integrals, understand the comparative discriminant of convergence of anomalous integrals, and calculate anomalous integrals.*

	Understand the history of mathematics related to integrals related to the elements of Civics.
Examination forms	*Final score includes:* *Basic requirements for class (not late, early retirement, absence of absence without reason, learning performance and paper quality (40%)* *Mid-term exam (20%)* *Final exam (40%)*
Study and examination requirements	*Achieve a score of 60 points or above.*
Reading list	*1.Required books* *[1] Economic Mathematics Calculus, Chuan-Sheng Wu, Higher Education Press, 2021-07* *2.Reference books* *[1] Tongji University, Department of Mathematics. Higher Mathematics (Upper) (Seventh Edition) [M]. Beijing: Higher Education Press. 2014.* *[2] Department of Mathematics, Tongji University. Advanced Mathematics Exercise Problems Guide (Upper Book) (Seventh Edition) [M]. Beijing: Higher Education Press. 2014.* *[3] Wu Ganchang. Calculus (Upper Book - Economics and Management) (Fifth Edition) [M]. Beijing: Renmin University of China Press. 2017.* *[4] Wu Ganchang. Study Guide and Exercise Solutions for Calculus (Upper - Economics and Management) (Fifth Edition) [M]. Beijing: Renmin University of China Press. 2017.* *[5] Weir, Hass, Giordano. Thomas Calculus (Eleventh Edition) [M]. Beijing: Higher Education Press. 2016.* *[6] Katz, translated by Li, Wenlin et al. A General Introduction to the History of Mathematics (Second Edition) [M]. Beijing: Higher Education Press. 2004. [7] Qian Baozhong. History of Chinese Mathematics [M]. Beijing: Commercial Press. 2019.*

Module designation	*Advanced Mathematics C (Part 2)*
Semester(s) in which the module is taught	*2rd semester*
Person responsible for the module	*Juan Wang*
Language	*Chinese*
Relation to curriculum	***Compulsory*** *Advanced Mathematics C (Part 2) is an important basic theoretical course required for all engineering students in the University. Upon completion of this course, students will have a solid theoretical foundation in vector algebra and analytic geometry of space, multivariable calculus, line and surface integrals and infinite series. They will improve their basic mathematical skills and increase their awareness of thinking and solving problems from a mathematical point of view, so as to lay a good foundation of mathematical knowledge for the subsequent study of related core courses.*
Teaching methods	*Lecture*
Workload (incl. contact hours, self-study hours)	*(Estimated) Total workload: 120 hours* *Contact hours (please specify whether lecture, exercise, laboratory session, etc.): 64 hours (Theoretical teaching)* *Private study including examination preparation, specified in hours: 56 hours*
Credit points	*4.0*
Required and recommended prerequisites for joining the module	*Advanced Mathematics C (Part 1)*
Module objectives/intended learning outcomes	***Knowledge:*** *Understand the basic concepts and fundamental theory of vector algebra and analytic geometry of space, multivariable calculus, line and surface integrals and infinite series; master the basic operations of vector algebra, analytic geometry of space, partial derivatives of multi variable functions, differentials and multiple integrals, curvilinear integrals, surface integrals, constant series and power series;* ***Skills:*** *Master the basic operations of vector algebra and analytic geometry of space, multivariable calculus, line and surface integrals and infinite series solutions, improve their ability to perform numerical and symbolic calculations, and have strong skills in plane observation, abstract generalization and logical reasoning.* ***Competence:***

	Upon successful completion of this course, students will be able to apply the concepts and techniques of scientific reasoning to analyze and solve problems. They will be able to apply mathematical knowledge and methods to solve practical problems. They will also increase their sense of innovation and increase their creativity.
Content	***Chapter 6 Definite Integrals and Their Applications*** *1. understand the elemental approach to definite integrals, will use definite integrals to calculate the area of a plane figure, the volume of a rotating body, and the mean of a function, and will use definite integrals to solve simple problems with economic applications;* *2. understand the application of definite integrals in economics.* *3. to understand the integral related history of mathematics related to the elements of the Civics and Politics.* ***Chapter 8 Multivariate Functional Differentiation*** *1. Understand the concept of multivariate functions, understand the limit and continuity of binary functions;* *2. Understand the concept of partial derivatives and full differentials, understand their geometric significance, know the multivariate function of full differential, partial derivatives and the relationship between the continuity of the full differentials;* *3. Understand the multivariate function of the partial derivatives, the higher-order partial derivatives and the calculation of full differentials;* *4. Understand the multivariate composite function differentiation method, will calculate the multivariate composite functions First-order and second-order partial derivatives of multivariate composite functions, and calculate the partial derivatives of implicit functions;* *5. Understand the determination of the extreme value and the maximum value of multivariate functions;* *6. Understand the economic application of multivariate function differentiation, and use the knowledge of partial derivatives to find the cross-elasticity, and use the Lagrange multiplier method to find the extreme value.* ***Chapter 9 Dual Integration*** *1. Understand the concept and properties of dual integration;* *2. Understand the geometric significance of dual integration;* *3. Know how to compute dual integrals (in right-angled coordinates and polar coordinates);* *4. Know the geometric and economic applications of dual integrals;* *5. Know how to compute the simpler anomalous dual integrals on unbounded regions.* ***Chapter 10 Differential Equations and Difference Equations*** *1. Understand some basic concepts of differential equations and difference equations;* *2. Master the solution of some basic first-order differential equations (equations with separable variables, chi-square equations and first-order linear equations);*

	3. Master the solution of chi-square difference equations with constant coefficients of the first order; Master the solution of a simple non-chi-square linear difference equation with constant coefficients of the first order; *4. Use the method of descending order to solve differential equations of the following forms: 5. The second-order linear differential equations and difference equations; they can solve the second-order chi-square linear differential equations and difference equations, and they can solve some simple second-order constant coefficient linear non-chi-square differential equations and difference equations.* *6. They can solve some simple real-world problems through modeling differential equations.* ***Chapter 11 Infinite series*** *1. Understand the concepts of convergence and divergence of infinite series;* *2. Grasp the basic properties of infinite series and the necessary conditions for convergence;* *3. Grasp the convergence results of geometric series and grades, and grasp the comparative convergence method and the ratio convergence method of the positive term series;* *4. Understand the Leibniz Theorem of staggered grades, and understand the concepts of absolute and conditional convergence of infinite series and the relationship between absolute and conditional convergence; 5. Grasp the relationship between simple and converse grades; 6. Understand the concept of absolute and conditional convergence of infinitely variable series; 7. The relationship between absolute convergence and conditional convergence;* *5. Master the simple power series radius of convergence of the method, master the power series in the interval of convergence of the basic properties of the power series, will seek simple power series and function;* *6. Master the function and the McLaughlin expansion, master the function of the power series of the indirect method of expansion;* *7. Understand the application of the infinite series in the economy.*
Examination forms	*1. Final assessment (40%): talce the final exam and answer questions carefully;* *2. Attendance (10%): no late arrivals, no early departures, and no unauthorized absences;* *3. Assigmnents (20%): class notes and reading notes, learning experience;* *4. In-class performance (10%): classroom participation, Discussion and perfonnance in social practice classes (presentations) .* *5. Mid exam (20%): talce the final exam and answer questions carefully;*
Study and examination requirements	*Achieve a score of 60 points or above.*

Reading list	*1.Required books* *[1] Wu, Chuan-Sheng. Economic Mathematics - Calculus (Fourth Edition) [M]. Beijing: Higher Education Press. 2021.* *2.Reference books* *[1] Department of Mathematics, Tongji University. Higher Mathematics (Next) (Seventh Edition) [M]. Beijing: Higher Education Press. 2014.* *[2] Tongji University, Department of Mathematics. Guide to Advanced Mathematics Exercises and Problems (Next Book) (Seventh Edition) [M]. Beijing: Higher Education Press. 2014.* *[3] Wu Ganchang. Calculus (Next Book - Economics and Management) (Fifth Edition) [M]. Beijing: Renmin University of China Press. 2017.* *[4] Wu Ganchang. Study Guide and Exercise Solutions for Calculus (Lower - Economics and Management) (Fifth Edition) [M]. Beijing: Renmin University of China Press. 2017.* *[5] Weir, Hass, Giordano. Thomas Calculus (Eleventh Edition) [M]. Beijing: Higher Education Press. 2016.* *[6] Katz, translated by Li, Wenlin et al. A General Introduction to the History of Mathematics (Second Edition) [M]. Beijing: Higher Education Press. 2004.[7] Qian Baozhong. History of Chinese Mathematics [M]. Beijing: Commercial Press. 2019.*

Module designation	*Linear algebra*
Semester(s) in which the module is taught	*2rd semester*
Person responsible for the module	*Dejun Zhao*
Language	*Chinese*
Relation to curriculum	***Compulsory*** *As a common introductory course designed for students majoring in science and engineering in institutions of higher learning, Linear Algebra is a discipline of mathematics that explains the classic theories in linear operations in algebra. Given the fact that linear problems have been observed extensively in various science and technology contexts and some nonlinear problems can be translated into linear problems, the Linear Algebra course is playing a bigger role with increasingly greater influence in the present world with the increasing popularity of computers. Therefore the theories and methods covered in this course will find profound applications in various science and technology contexts. This course will also provide a thorough grounding in mathematics and help students to lay a foundation for further studies in subsequent engineering courses.*
Teaching methods	*Lecture*
Workload (incl. contact hours, self-study hours)	*(Estimated) Total workload: 60 hours* *Contact hours (please specify whether lecture, exercise, laboratory session, etc.): 32 hours (Theoretical teaching)* *Private study including examination preparation, specified in hours: 28 hours*
Credit points	*2.0*
Required and recommended prerequisites for joining the module	*N/A*
Module objectives/intended learning outcomes	***Knowledge:*** *1. Demonstrate understanding of the fundamental knowledge in linear algebra, (with an emphasis on determinants, matrices and their operations);* *2. Demonstrate understanding of the linear correlation of vector groups and linear equations;* ***Skills:*** *Demonstrate understanding of the similar diagonalization of matrices and quadratic forms, among others Skills:* *Demonstrate understanding of the key concepts, basic operations and applications of determinants and matrices, Demonstrate skills in solving*

	linear equations and applying them in appropriate problems; *Demonstrate understanding of the concept of quadratic form and skills in transforming quadratic form into standard form* ***Competence:*** *This course aims to lay down basic concepts, theories and techniques of linear algebra, providing a thorough grounding in Linear algebra and laying a foundation for further studies in subsequent courses with an aim to enable them to use their linear algebra knowledge and skills to solve problems in real contexts.*
Content	***Part A. Theoretical teaching (32 contact hours; 28 self-study hours)*** ***Linear Algebra*** ***Chapter 1.Determinant (5 contact hours, 5 self-study hours)*** *The definition of the second- and third-order determinants;** *The properties and calculations of the second- and third order determinants.*** *The definition and properties of n-order determinant;* *Solutions to some simple n order determinants;* *Cramer's rule *** ***Chapter 2. Matrix and Its Operation (8 contact hours; 6 self study hours)*** *The concept of matrix, and the definitions and properties of some special matrices;** *Linear operations on matrices, matrix multiplication and its algorithm;*** *The power of square matrix, matrix polynomial, and the determinant of the product of two square matrices;** *The concept and properties of inverse matrix, the necessary and sufficient conditions for a matrix to be invertible, methods of finding the inverse of a matrix;*** *Partitioned matrix and its algorithm;* Elementary transformations of matrices; *** *The properties of elementary matrices, the concept of matrix equivalence, and methods of finding the rank and inverse matrix of a matrix by using elementary transformations.*** ***Chapter 3. Linear Correlation of Vector Groups (4 contact hours; 4 self-study hours)*** • *n-Dimensional vectors and their linear operations;** • *The concepts of linear combination and linear representation of vector groups;** • *The definition and determination of linear dependence/independence of vector groups;***

	*• The maximal linearly independent array and the rank of vector groups; *** *• The rank of matrices and the rank of vector groups and methods of finding them. ** ***Chapter 4. Linear Equations (5 contact hours; 5 self-study hours)*** *• The concept of linear equations and Gauss elimination;** *• Determination of the existence of a non-zero solution to homogeneous linear equations;***** *• Determination of the existence of a solution to inhomogeneous linear equations;***** *• The properties of solutions to two types of linear equations and the structure of the solutions;** *• The methods of finding the general solution to two types of linear equations by using elementary row transformations.* ***Chapter 5. Similar Diagonalization of Matrices (8 contact hours; 6 self-study hours)*** *• The concepts and properties of the eigenvalues and eigenvectors of a matrix;***** *• The methods of finding the eigenvalues and eigenvectors of a matrix;***** *• The concept and properties of similar matrices, as well as the necessary and sufficient conditions for a matrix to be diagonalizable and the methods;***** *• The inner product of vectors and standard orthogonalization methods for vector groups;** *• The concepts and properties of orthogonal matrices and orthogonal transformations;** *• The properties of real symmetric matrices and methods of orthogonal diagonalization.***** ***Chapter 6. Quadratics and Standard Form (2 contact hours; 2 self-study hours)*** *• The concepts of quadratic form and standard form. Quadratics and symmetric matrices;** *• Make use of orthogonal transformation to convert a quadratic form into standard form; *** *• Methods of converting a quadratic form into standard form.*
Examination forms	*After-class assignments shall be done independently by students after each class.* *Daily performance accounts for 30%, including attendance, inclass performance and assignments;* *Final exam (closed-book written exam): 60%.*
Study and examination requirements	*Achieve a score of 60 points or above.*

Reading list	*1.Required books* *[1] WU Suichao, SHEN Jun, YU Weiqin. Linear Algebra (1st Edition), Beijing: Qinghua University of Science and Technology Press, 2014.4.* *[2] TIAN Yuan, SHEN Yiyi. Linear Algebra (1st Edition), Shanghai: Donghua University Press, 2013.7.* *2.Reference books* *[1] Department of Mathematics of Tongji University. Linear Algebra (1st Edition), Shanghai: Tongji University of Science and Technology Press, 2011.* *[2] LI Jiongsheng, CHA Jianguo, WANG Xinmao. Linear Algebra (2nd Edition), AnHui: University of Science and Technology Press, 2010.* *[3] XU Zhixiao, LIANG Haiming, CHEN Fan. Linear Algebra.Beijing: Beijing Institute of Technology Press, 2016.1*

Module designation	*Probability and Statistics*
Semester(s) in which the module is taught	*3rd semester*
Person responsible for the module	*Suichao Wu*
Language	*Chinese*
Relation to curriculum	***Compulsory*** *As a basic mathematics discipline that studies the statistical regularity of random phenomena from a quantitative perspective, Probability Theory and Mathematical Statistics is a science of reasoning by deduction and induction of the statistical regularity of random phenomena. Probability Theory and Mathematical Statistics can be divided into two interrelated branches, i.e., probability theory and mathematical statistics. Probability is a quantitative measure of the possibility that a random event occurs. Topics covered in the Probability Theory include, but not limited to, calculating probabilities by using the classical probability model, the distribution of random variables and numerical characteristics, and limit theorems. Mathematical Statistics is one of the mathematical sciences that have the most direct and extensive interactions with the real world. It investigates a number of fundamental knowledge and principles, including point estimation (estimation by method of moment, maximum likelihood estimation), parameter hypothesis testing, nonparametric hypothesis testing, variance analysis, multiple regression analysis, and reliability analysis, providing students with an in-depth knowledge of various statistical concepts and principles. After successfully completing this course, students will be able to describe and use the statistical concepts and principles of the Probability Theory and Mathematical Statistics, apply mathematical knowledge and methods to perform numerical or analytical calculation, and translate real-world problems in economics and management into probability and statistics models.*
Teaching methods	*Lecture*
Workload (incl. contact hours, self-study hours)	*(Estimated) Total workload: 90 hours* *Contact hours (please specify whether lecture, exercise, laboratory session, etc.): 48 hours (Theoretical teaching)* *Private study including examination preparation, specified in hours: 42 hours*
Credit points	*3.0*
Required and recommended prerequisites for joining the module	*N/A*
Module objectives/intended learning outcomes	***Knowledge:***

	Demonstrate understanding of the concepts of point estimation (estimation by method of moment, maximum likelihood estimation), parameter hypothesis testing, nonparametric hypothesis testing; *Demonstrate understanding of the concepts and principles of variance analysis, multiple regression analysis, and reliability analysis, among others;* *Demonstrate understanding of fundamental knowledge of random mathematics.* ***Skills:*** *1. Apply commonly used analysis and calculation rules and methods to solve problems, e.g., calculating probabilities by using the classical probability model;* *2. Make use of probability formula and Bayes 'Theorem to find the conditional probability of events, the mathematical expectation and variance of random variables;* *3. Demonstrate understanding of how to find a confidence interval for the mean of a normal population.* ***Competence:*** *After successfully completing this course, students will be able to translate real-world problems in economics and management into probability and statistics models, and apply statistical concepts and principles to solve problems in real contexts.*
Content	***Part A. Theoretical teaching (48 contact hours; 42 self-study hours)*** ***Chapter 1. Random Events and Their Probabilities (10 contact hours; 10 self-study hours)*** *. The concept of random events and sample space;** *. The relationship between events and basic operations;*** *. The concept of event frequency; the statistical regularity of random phenomena;** *. The concept of classical probability;** *. The basic properties of probability (additive theorem in particular); use these properties to perform probability calculation;*** *. The concept of conditional probability;** *. The Multiplication Theorem, Law of Total Probability and Bayes 'Theorem. Apply these theorems to perform probability calculation.*** ***Chapter 2. Random Variables and Their Distribution (10 contact hours; 10 self-study hours)*** • *The concept and properties of the distribution function;**

	• *Discrete random variables and continuous random variable, and methods of describing them;***
	• *The concepts and properties of distribution law and distribution density;**
	• *Binomial distribution, Passion distribution, uniform distribution, exponential distribution and normal distribution. Malce use of probability distribution to find the probability of related events;***
	• *The concepts of random variables and distribution functions;**
	• *Distribution function of a random variable (strictly monotonic) and methods of finding the probability distribution. ***
	Chapter 3. Multidimensional Random Vector and its Distribution (6 contact hours; 6 self-study hours)
	• *The concepts and properties of joint distribution function, joint distribution law, joint distribution density of bivariate random variables;**
	• *Methods of calculating the probability of an event;** The relationship between the marginal distribution and joint distribution of bivariate random variables;***
	• *The concept of independence of random variables;**
	• *Methods of calculating the probability of the independence of a random variable;***
	• *The distribution function of a bivariate random variable. **
	Chapter 4. Numerical Characteristics of Random Variables (6 contact hours; 6 self-study hours)
	• *The concepts, properties and calculation of mathematical expectation and variance;***
	• *Methods of calculating the mathematical expectation of the function of a random variable;***
	• *Mathematical expectation and variance of binomial distribution, Poisson distribution, uniform distribution, exponential distribution and normal distribution;***
	• *The concept, properties and calculation of correlation coefficient;***
	• *Chebyshev's inequality. **
	Chapter 5. Law of Large Numbers and Central Limit Theorem(4 contact hours; 2 self-study hours)
	• *Law of Large Numbers by Jacob Bernoulli. ***
	Chapter 6. Key Concepts in Mathematical Statistics (4 contact hours; 4 self-study hours)
	• *The concepts of population, individual, sample and statistics;**
	• *Methods of finding the sample mean and sample variance;***
	• *The definitions of chi-square distribution, t-distribution, and F-distribution and methods of reading relevant tables;***
	• *The distribution of some commonly used statistics for a normal population.**
	Chapter 7. Parameter Estimation 包 contact hours; 2 self- study hours)

	*Point estimation;*** *Estimation by method of moment (first-order, secondorder) and maximum likelihood estimation. Estimator selection criteria;* The concept of interval estimation;* Methods of calculating the confidence interval for the mean and variance of the nom 叫 population. * ** ***Chapter 8. Hypothesis Testing (4 contact hours; 2 self-study hours)*** *. The key concepts and steps in hypothesis testing;*** *. Two types of errors that may occur in hypothesis testing;** *. Hypothesis testing of the mean and variance of one or two normal population(s).*** ***Part B. Experiment/practice teaching: 0 hour***
Examination forms	*After-class assignment shall be done independently by students after each class.* *Daily perforn 诅 nee accounts for 40%, including attendance, inclass performance, assignments and stage assessments;* *Final exam (closed-book written exam): 60%.*
Study and examination requirements	*Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.* *Achieve a score of 60 points or above.*
Reading list	*1.Required books* *[1] GE Yuba. Probability Theory and Mathematical Statistics (2nd Edition). Beijing: Tsinghua University Press, 2017* *2.Reference books* *[1] SHENG Xu,X 正 Shiqian, PAN Chengyi. Probability Theory and Mathematical Statistics. Beijing: Higher Education Press, 2001.3.* *[2] XU Bosheng, ZHANG Ying. Study Guide for Probability Theory and Mathematical Statistics. Shanghai: Donghua University Press, 2013.6* *[3] MAO Shisong, CHENG Yiming, PU Xiaolong. A Textbook for Probability Theory and Mathematical Statistics. Beijing: Higher Education Press. 2011.*

Module designation	*College Physics B*
Semester(s) in which the module is taught	*2rd semester*
Person responsible for the module	*Yunxia Ping*
Language	*Chinese*
Relation to curriculum	***Compulsory*** *University Physics B is a general basic course for students of various majors in science and engineering in higher education, and is an important course for cultivating and improving students' scientific quality, scientific thinking method and scientific research ability. Through the study of this course, students can master the basic concepts, basic theories and basic methods of physics such as mechanics, thermology, electromagnetism, mechanical vibration and mechanical waves, optics, and the foundations of modern physics, etc., enhance the ability of students to analyze and solve problems, cultivate the spirit of exploration and innovation, and lay a good foundation of physical knowledge for the study of the subsequent related professional courses. Through the study of this course, students can be cultivated to have the basic scientific literacy needed to become scientists and engineering talents, which plays an important role in the cultivation of talents for the reform of "new engineering" focusing on the strengthening of scientific thinking, engineering ability and innovation ability. At the same time, this course contains rich history of physics and history of science and technology and other elements of ideology and politics, which play an important role in guiding students to establish a correct world view, outlook on life and values, strengthen the education of scientific ethics, and cultivate patriotic feelings that cannot be replaced by other courses.*
Teaching methods	*Lecture*
Workload (incl. contact hours, self-study hours)	*(Estimated) Total workload: 120 hours* *Contact hours (please specify whether lecture, exercise, laboratory session, etc.): 64 hours (Theoretical teaching)* *Private study including examination preparation, specified in hours: 56 hours*
Credit points	*4.0*
Required and recommended prerequisites for joining the module	*Advanced Mathematics C (Part 1)* *Advanced Mathematics C (Part 2)*
Module objectives/intended learning outcomes	*Knowledge:* *Demonstrate understanding of the concepts of point estimation (estimation by method of moment, maximum likelihood estimation), parameter hypothesis testing, nonparametric hypothesis testing;*

	Demonstrate understanding of the concepts and principles of variance analysis, multiple regression analysis, and reliability analysis, among others; *Demonstrate understanding of fundamental knowledge of* *random mathematics.* *Skills:* *Apply commonly used analysis and calculation rules and methods to solve problems, e.g., calculating probabilities by using the classical probability model;* *2. Make use of probability formula and Bayes'Theorem to find the conditional probability of events, the mathematical expectation and variance of random variables;* *3. Demonstrate understanding of how to find a confidence interval for the mean of a normal population.* *Competence:* *After successfully completing this course, students will be able to translate real-world problems in economics and management into probability and statistics models, and apply statistical concepts and principles to solve problems in real contexts.*
Content	***Chapter 1 Kinematics of Masses*** *Reference System Coordinate System Physical Models;* *Position Vector Displacement Velocity Acceleration;* *Description of Curvilinear Motion;* *Two Types of Problems in Kinematics.* ***Chapter 2: Dynamics of Masses*** *Newton's Laws of Motion; Momentum Laws of Conservation of Momentum; Work Kinetic Energy Potential Energy Law of Conservation of Mechanical Energy; Angular Momentum and Conservation of Angular Momentum of Masses.* ***Chapter 3 Fundamentals of Rigid Body Mechanics*** *Rigid Bodies Description of fixed-axis rotation of a rigid body; Laws of rotation for fixed-axis rotation of a rigid body; Kinetic energy theorem for fixed-axis rotation of a rigid body; Angular momentum theorem and law of conservation of angular momentum for fixed-axis rotation of a rigid body.* ***Chapter 4 Mechanical Vibrations and Mechanical Waves*** *Dynamical characteristics of simple harmonic vibrations; kinematics of simple harmonic vibrations; energy of simple harmonic vibrations and their synthesis; formation and propagation of mechanical waves; wave functions of plane simple harmonic waves; energy of waves; Huygens' Principle; superposition and interference of waves.* ***Chapter 5 Kinetic Theory of Gases***

	Equilibrium Temperature Equation of state for an ideal gas; pressure and temperature of an ideal gas; Energy Equalization Theorem Internal energy of an ideal gas. *Chapter 6 Fundamentals of Thermodynamics* *First Law of Thermodynamics; Ideal Gas Equivalent and Adiabatic Processes; Cyclic Processes; Second Law of Thermodynamics.* ***Chapter 7 Electrostatic Fields*** *Electric Fields Electric Field Strength; Electric Flux Gauss's Theorem; Work of the Electric Field Force; Electric Potential; Conductors in Electrostatic Fields; Capacitance; Capacitors; Energy of Electric Fields.* ***CHAPTER 8 INVENTORY MAGNETIC FIELDS*** *Electric current Electric potential; Magnetic fields Magnetic induction; Ampere's loop theorem; The effect of magnetic fields on current carrying wires; The effect of magnetic fields on moving charges.* ***Chapter 9 Changing Electromagnetic Fields*** *Laws of Electromagnetic Induction; kinetic and induced electromotive forces; self- and mutual inductance.* *Chapter 10 Fluctuating Optics (Supports Course Objectives 1, 2, 3, 4)* *Young's double-slit interference; thin-film interference; diffraction of light; grating diffraction; polarization of light.* ***Chapter 11 Special Relativity*** *Fundamental principles of special relativity; Lorentz transformations; special relativity view of space-time; basic conclusions about special relativity dynamics.* ***Chapter 12 Fundamentals of Quantum Physics*** *Blackbody Radiation Planck's Quantum Hypothesis; Quantum Nature of Light; Bohr's Theory of the Hydrogen Atom; Fluctuation of Particles; Measurement Relation; Wave Function Schrödinger's Equation.*
Examination forms	*1. Final assessment (50%): talce the final exam and answer questions carefully;* *2. Attendance (10%): no late arrivals, no early departures, and no unauthorized absences;* *3. Assigmnents (20%): class notes and reading notes, learning experience;* *4. In-class performance (20%): classroom participation, Discussion and perfonnance in social practice classes (presentations) .*
Study and examination requirements	*Achieve a score of 60 points or above.*
Reading list	*1.Required books* *Zhao Jinfang,Wang Denglong. A Concise Course of University Physics[M]. Beijing: Beijing University of Posts and Telecommunications Press,2021.* *2.Reference books*

	Department of Physics Teaching, Shanghai University of Engineering and Technology. University Physics Study Guide [M], Beijing: Tsinghua University Press, 2011. *Department of Physics Teaching, Shanghai University of Engineering and Technology. University Physics (Upper) [M], Beijing: Tsinghua University Press, 2013.* *Mao Junjian Gu Mu. University Physics (Second Edition) [M], Beijing: Higher Education Press, 2013. 4. Halliday Zhang Hui Li Chun Translated by Teng Xiaoying Ma Tingjun. Teng Xiaoying Ma Tingjun adapted, Halliday University Physics [M], Beijing: Mechanical Industry Press, 2009.* *Guo Yiling, Shen Huijun, History of Physics (Second Edition) [M], Beijing: Tsinghua University Press, 2005.* *Ma Wenwei Su Huihui et al. Application of Principles of Physics in Engineering and Technology (Fourth Edition), [M], Beijing: Higher Education Press, 2015.* *Shi, D. N.. Cultural Physics [M], Beijing: Higher Education Press, 2018.* *Ma, Wenwei, Zhou, Yuqing, et al. Adapted. Physics (Upper and Lower) (Seventh Edition) [M], Beijing: Higher Education Press, 2020.*

Module designation	*Theoretical Mechanics*
Semester(s) in which the module is taught	*3rd semester*
Person responsible for the module	*Peochao Li*
Language	*Chinese*
Relation to curriculum	***Compulsory*** *Theoretical Mechanics is an important and fundamental course that enables students to master methods of force analysis of objects, simplify force systems, use the theory of equilibrium of force systems and equilibrium conditions to solve the binding force; understand methods of describing motion of objects and their geometric properties in motion, develop equations of motion of objects, calculate velocity (angular velocity) of objects in motion; use synthetic motion to analyze velocity of a moving point on an instantaneous mechanism; master the momentum theorem, kinetic energy theorem, momentum moment theorem; understand the concept of inertial force; master the simplified results of inertial force in tl1e case of rigid body translation, fixed axis and plane motion; master the application of D'Alembert's principle; develop the ability to correctly establish mechanical models of simple engineering objects, and be able to conduct static, kinematic, kinetic (including) (instantaneous and process) analytical and computational skills.*
Teaching methods	*Lecture*
Workload (incl. contact hours, self-study hours)	*(Estimated) Total workload: 120 hours* *Contact hours (please specify whether lecture, exercise, laboratory session, etc.): 64 hours (Theoretical teaching)* *Private study including examination preparation, specified in hours: 56 hours*
Credit points	*4.0*
Required and recommended prerequisites for joining the module	*Advanced Mathematics, College Physics*
Module objectives/intended learning outcomes	***Knowledge:*** *1. Statics: The axioms of statics, analysis of forces on objects, point-to-point moment of force, plane couples, moment of spatial force on axes, the concept of friction, planar concurrent force system, analysis and equilibrium of coplanar forces system, equilibrium of three-dimensional forces;* *2. Kinematics: Calculation of velocity and acceleration of the synthetic motion of points and rigid plane motion;*

	3. Dynamics: Calculation of momentum, kinetic energy, moment of momentum and inertial forces; application of the universal theorems of dynamics (momentum theorem, moment of momentum theorem, kinetic energy theorem, D'Alembert's principle). ***Skills:*** *1. Ability to analyze forces on objects and calculate binding force by force balance;* *2. Ability to calculate velocity and acceleration of the synthetic motion of points and rigid plane motion;* *3. Ability to apply the universal theorem of dynamics in a comprehensive way to solve problems of mass and mass point system* ***Competence:*** *Having the ability to apply principles and methods of engineering mechanics to solving engineering problems, and to build corresponding mechanical models for analysis and problem solving. Through the study of engineering mechanics, students will be able to improve their logical and abstract thinking skills.*
Content	***Part A. Theoretical teaching*** ***Chapter 1 Introduction*** • *The study object and content of Engineering Mechanics (1);* • *Research methods for Engineering Mechanics (1);* • *Learning objectives, methods and notes of Engineering Mechanics (1).* ***Chapter 2 Axioms of Statics and Analysis of Forces on Objects*** • *The concept of rigid body and force;*** • *The axioms of statics;*** • *Constraint and constraining forces;*** • *Analysis of foces on object* ***Chapter 3 Plane Force Systems*** • *Resultant and equilibrium condition of planar concurrent force system: geometrical and analytical methods;*** • *Concepts of force couples, planar force-couple system synthesis and equilibrium;*** • *Simplification of coplanar forces system to a point in the plane of action and discussion of the results of the simplification; ** • *Equations of equilibrium for coplanar forces system and their applications; **

	• *Truss force analysis and solution; *** • *Friction angle and self-locking concepts and their engineering applications. *** ***Chapter 4 Spatial Force System*** • *Spatial force on the axis projection and moment to the axis;* • *Equations of equilibrium for spatial force system and its applications;* • *The center of gravity method. ** ***Chapter 5 Kinematics of A Point Particle*** • *Method of describing the motion of a point;*** • *Using sagittal, Cartesian, and natural coordinate methods to establish the equations of motion of points.*** ***Chapter 6 Basic Motion of Rigid Bodies*** • *The concept of parallel movement of rigid bodies; *** • *Equations of fixed-axis rotation of rigid bodies, velocity and acceleration analysis; *** ***Chapter 7 Synthetic Motion of a Point Particle*** • *Concepts of relative, implicated, and absolute motion;*** • *The velocity synthesis theorem for points; *** • *The synthesis theorem for the acceleration of a point when the implicated motion is a flat motion; *** • *The synthesis theorem for the acceleration of a point when the implicated motion is a fixed-axis rotation.** ***Chapter 8 Planar Kinematics of Rigid Bodies*** • *Concept of planar kinematics of rigid bodies; *** • *Using the base point method and velocity projection method to calculate velocity of a point on a plane graph;*** • *Applying the concept of instantaneous center of velocity to calculate velocity of a point on a plane graph;*** • *Using the base point method to calculate the acceleration of a point on a plane graph.** ***Chapter 9 Fundamental Theorems of Dynamics*** • *Differential equations of particle motion; *** • *Moment theorem; *** • *Momentum theorem, kinetic energy theorem.*** ***Chapter 10 D'Alembert's Principle*** • *The concept of inertial forces and the simplified results of inertia[forces in the case of a rigid body in translational, fixed-axis, and planar motion. The application of D'Alembert's principle. **
Examination forms	*After-class assignment shall be done independently by students after each class.* *Usual performance accounts for 30%, including assigrunents (20%), in-class performance and attendance (10%): no late arrivals, no early departures, and no unauthorized absences; final assessment (closed-book written exam) accounts for 70%.*

Study and examination requirements	*Achieve a score of 60 points or above.*
Reading list	*1.Required books* *LI Peichao, FAN Zhiyi, LIU Xiaomei. Concise Engineering Mechanics (2nd Edition). Beijing: Tsinghua University Press, 2016.* *2.Reference books* *[1] Teaching Research Center of Basic Mechanics, School of Aerospace Engineering and Applied Mechanics, Tongji University. Theoretical Mechanics. Shanghai: Tongji University Press, 2005.* *[2] Lin Yanzhu, ZHU Benhua, YANG Haixing. Theoretical Mechanics (3rd Edition). Higher Education Press, 2009.* *[3] MEI Fengxiang, ZHOU Jiping, SHUI Xiaoping. Engineering Mechanics. Beijing: Higher Education Press, 2003.* *[4] LI Junfeng. Theoretical Mechanics (2nd Edition). Beijing: Tsinghua University Press, 2007.*