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Module 1 Mathematics and Physics

1.1 Advanced Mathematics A1

Competence field	Mathematics and Physics
Module designation	Advanced Mathematics A1
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Prof. XU Yongqing, Assistant Professor
Language	Chinese
Relation to curriculum	This course is a compulsory foundational course for all first-year students and serves as a core requirement in the undergraduate curriculum of Transportation Engineering. It provides essential mathematical knowledge and skills required for advanced courses in the program, aligning with the goal of cultivating high-quality professionals in transportation engineering with strong analytical and problem-solving abilities. The course is structured around six key aspects: 1) Functions and Limits, 2) Derivatives and Differentiation Rules, 3) Applications of Derivatives, 4) Indefinite Integrals, 5) Definite Integrals, and 6) Definite Integrals Applications. It emphasizes the theoretical framework and practical applications of mathematical concepts in engineering contexts.
Teaching methods	lecture-based teaching; blended learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: Theoretical teaching Contact hours: 72 hours Size of class: No more than 60 students for theoretical teaching
Workload	Workload = 120 hours Contact Hours = 72 hours Self-Study Hours = 48 hours
Credit points	4.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	This foundational course is designed for first-year Transportation students, providing essential mathematical knowledge for advanced studies. The course aims to cultivate high-quality professionals with strong analytical and problem-solving abilities. It covers key topics such as functions and limits, derivatives, integrals, and their applications in engineering contexts, emphasizing both theoretical understanding and practical applications in transportation engineering. Specific objectives include: **Knowledge:** 1) Understand the foundational concepts of functions, limits, continuity, derivatives, integrals, and infinite series. 2) Learn mathematical theories, such as differential mean value theorem, Taylor series, and L'Hôpital's rule. **Skills:**

	Students will be able to 1) Master the techniques for solving differentiation and integration problems. 2) Develop the ability to analyze functions, determine extrema, and solve problems involving optimization. 3) Apply mathematical methods to solve real-world engineering problems. **Competences:** Upon completion of this course, students will have developed: 1) Demonstrate critical thinking and the ability to solve mathematical problems systematically. 2) Relate mathematical concepts to practical applications in engineering and technology. 3) Foster innovative thinking by using mathematics to analyze and interpret complex scenarios.
Contents	**Part A: Theoretical Teaching** (72 contact hours; 48 self-study hours) **Chapter 1: Functions and Limits** (14 contact hours; 8 self-study hours) • Concepts of functions, sequences, and limits • Properties of continuity and important limits • Learning outcomes: Master the computation of limits and understand the properties of continuous functions. **Chapter 2: Derivatives and Differentiation** (10 contact hours; 8 self-study hours) • Concepts of derivatives and differentiation rules • Learning outcomes: Proficiency in applying differentiation techniques to various types of functions. **Chapter 3: Applications of Derivatives** (12 contact hours; 8 self-study hours) • Differential mean value theorem, optimization, curve sketching • Learning outcomes: Analyze functions and solve problems related to optimization and curvature. **Chapter 4: Indefinite Integrals** (12 contact hours; 8 self-study hours) • Techniques of integration: substitution and by parts • Learning outcomes: Understand and compute indefinite integrals using various techniques. **Chapter 5: Definite Integrals and Applications** (14 contact hours; 8 self-study hours) • Fundamental theorem of calculus, applications in geometry and physics • Learning outcomes: Apply definite integrals to calculate areas, volumes, and arc lengths. **Chapter 6: Infinite Series** (10 contact hours; 8 self-study hours) • Convergence of series and Taylor expansions • Learning outcomes: Learn to evaluate series and approximate functions.
Examination forms	Final Exam

Study and examination requirements	1) Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. 2)The composition of the overall grade (minimum passing score: 60) is as follows: • Regular Grades 30% (including attendance, assignments, and in-class participation); • Final Exam 70%.
Reading list	**Required Textbook:** Department of Mathematics, Tongji University, *Advanced Mathematics* (7th Edition), Higher Education Press, 2014. **Reference Books:** Gong Sheng, *Concise Calculus* (4th Edition), Higher Education Press, 2006.

1.2 Advanced Mathematics A2

Competence field	Mathematics and Physics
Module designation	Advanced Mathematics A2
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Prof. XU Yongqing, Assistant Professor
Language	Chinese
Relation to curriculum	This course is a compulsory foundational course designed for students majoring in Automation, Robotics, Vehicles, and related fields. It is a continuation of Advanced Mathematics A1 and provides essential mathematical knowledge, such as multivariable calculus, differential equations, infinite series, and vector algebra. These topics are integral for advanced engineering mathematics and professional courses, equipping students with the analytical and problem-solving skills necessary for their future studies and careers. The course focuses on six main aspects: 1) Differential Equations: Introduction to first-order and higher-order differential equations, their solutions, and applications. 2) Vector Algebra and Analytic Geometry: Exploration of vector operations and their geometric applications. 3) Multivariable Calculus: Study of partial derivatives, gradient, multiple integrals, and their applications. 4) Line and Surface Integrals: Examination of Green's theorem, divergence theorem, and Stokes' theorem with practical examples. 5) Infinite Series: Understanding of convergence, Taylor series, and Fourier series. 6) Practical Problem-Solving: Application of advanced calculus in engineering and scientific contexts.
Teaching methods	lecture-based teaching; blended learning
Type of teaching, contact hours	Targeted Students: students of Transportation Program Type of teaching: Theoretical teaching Contact hours: 108 hours Size of class: No more than 60 students for theoretical teaching
Workload	Workload = 180 hours Contact Hours = 108 hours Self-Study Hours = 72 hours
Credit points	6.0
Recommended prerequisites	Advanced Mathematics A1
Module objectives/intended learning outcomes	This foundational course is designed for first-year Transportation students, providing essential mathematical knowledge for advanced mathematical knowledge necessary for solving complex engineering problems. It builds upon the foundation of Advanced Mathematics A1, covering differential equations, vector algebra, multivariable calculus, infinite series, and practical problem-solving. The course helps students develop essential analytical and problem-solving skills, preparing them for advanced studies and professional careers in engineering. Specific objectives include: **Knowledge:** 1) Understand the foundational concepts of multivariable calculus, differential equations, vector algebra, and series. 2) Grasp mathematical theories such as Green's theorem, Stokes'

	theorem, and Fourier series. **Skills:** Students will be able to 1) Solve complex engineering problems using advanced calculus techniques. 2) Analyze and model systems mathematically with multiple variables. 3) Apply mathematical principles to real-world scenarios in engineering and science. **Competences:** Upon completion of this course, students will have developed: 1) Develop critical thinking and problem-solving abilities in mathematical contexts. 2) Integrate calculus knowledge into professional practice and advanced studies.
Contents	**Part A: Theoretical Teaching** (108 contact hours; 72 self-study hours) **Chapter 1: Differential Equations** (15 contact hours, 10 self-study hours) • Concepts, methods of solution, and practical applications. **Chapter 2: Vector Algebra and Analytic Geometry** (12 contact hours, 8 self-study hours) • Vector operations, geometry of planes, lines, and curves. **Chapter 3: Multivariable Calculus** (20 contact hours, 14 self-study hours) • Partial derivatives, multiple integrals, gradient, and applications. **Chapter 4: Line and Surface Integrals** (15 contact hours, 10 self-study hours) • Green's theorem, divergence theorem, and Stokes' theorem. **Chapter 5: Infinite Series** (18 contact hours, 12 self-study hours) • Convergence, Taylor expansions, and Fourier series. **Chapter 6: Practical Applications** (28 contact hours, 18 self-study hours) • Solving engineering and scientific problems using advanced calculus.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. 2)The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 10% • In-class test 5%; • Mid-term test 15%; • Final Exam 60%.
Reading list	**Required Textbook:** Department of Mathematics, Tongji University, *Advanced Mathematics* (7th Edition), Higher Education Press, 2014. **Reference Books:**

	Gong Sheng, *Concise Calculus* (4th Edition), Higher Education Press, 2006.

1.3 College Physics B1

Competence field	Mathematics and Physics
Module designation	College Physics B1
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Prof. TANG Yongbo, Associate Professor Prof. WU Hainan, Associate Professor
Language	Chinese
Relation to curriculum	This course is a fundamental general education course for engineering students, designed to systematically build a foundation in physics, enhance students' abilities to analyze and solve problems, and cultivate an exploratory spirit and innovative consciousness. It plays an irreplaceable role in establishing a scientific worldview for students. The course focuses on basic concepts, theories, and methods of physics, providing a solid foundation for further studies. It also integrates the development of scientific literacy and the cultivation of scientific quality in applied technical talents.
Teaching methods	lecture-based teaching; blended learning
Type of teaching, contact hours	Targeted students: Students of Transportation Program Type of teaching: Theoretical Teaching, Practical Teaching Contact hours: 54 hours Size of class: No more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Advanced Mathematics
Module objectives/intended learning outcomes	The course aligns with the curriculum's goal of cultivating students' foundational knowledge and skills in science and engineering while fostering critical thinking and innovation. The course aims to enable students to systematically understand and master the basic knowledge of physics, develop their abilities to analyze and solve problems, and foster an exploratory spirit and innovative consciousness. Specific objectives include: Specific objectives include: **Knowledge:** 1) Students will gain a comprehensive understanding of the basic concepts, theories, and methods of physics, including mechanics, special relativity, kinetic theory of gases, and thermodynamics. **Skills:** Students will be able to 1) develop practical skills in physical experiments and the ability to apply physical knowledge to solve real-world problems. **Competences:** Upon completion of this course, students will have developed: 1) the ability to apply scientific knowledge to practical scenarios, demonstrating competence in the practical aspects of physics.

Contents	**Part A Theoretical Teaching** (49 contact hours; 32 self-study hours**)** **Chapter 1 Introduction and Mathematical Prerequisites** (7 contact hours; 4 self-study hours) • Introduction to the relationship between calculus and mechanics • Functions, derivatives, and differentials • Definite and indefinite integrals • Vectors **Chapter 2 Motion and Force** (7 contact hours; 5 self-study hours) • Description of particle motion, position vectors, kinematic equations, velocity, acceleration • Projectile motion, circular motion, and general curves • Relative motion • Newton's laws of motion, common forces in mechanics, and fundamental forces • Galilean relativity principle, non-inertial systems, and inertial forces **Chapter 3 Conservation Quantities and Laws of Motion** **(7** contact hours; 5 self-study hours) • Internal and external forces of a particle system, center of mass, and center of mass motion theorem • Momentum theorem and conservation of momentum • Work, kinetic energy, and kinetic energy theorem • Conservative forces, work of pairwise forces, and potential energy • Functional principle of a particle system, mechanical energy conservation law • Collisions • Symmetry and conservation laws **Chapter 4 Rigid Body Rotation** **(7** contact hours; 5 self-study hours) • Rigid body model and its motion • Torque, moment of inertia, and rotational motion laws • Functional relationships in rotational motion • Angular momentum theorem and conservation of angular momentum for a particle system • Angular momentum theorem and conservation of angular momentum for a rigid body in rotational motion • Precession • Ideal fluid model and Bernoulli's equation for steady flow **Chapter 5 Special Relativity** (7 contact hours; 4 self-study hours) • Galilean relativity principle and Galilean transformation • Basic principles of special relativity and Lorentz transformation • Velocity transformation formulas in special relativity • Spacetime view of special relativity • Basic dynamics of special relativity • Introduction to general relativity **Chapter 6 Kinetic Theory of Gases** (7 contact hours; 4 self-study hours) • Equilibrium state, ideal gas state equation • Microscopic model of an ideal gas • Ideal gas pressure formula and temperature formula • Equipartition theorem, internal energy of an ideal gas

	• Maxwell's velocity distribution law • Average collision frequency and mean free path of gas molecules • Transport phenomena in gases • Van der Waals equation for real gases **Chapter 7 Thermodynamics Basics** (7 contact hours; 5 self-study hours) • Zeroth law and first law of thermodynamics • Application of the first law of thermodynamics to ideal gas quasi-static processes • Cyclic processes and Carnot cycle • Second law of thermodynamics • Reversible and irreversible processes, Carnot's theorem • Boltzmann distribution • Entropy increase principle and statistical significance of the second law of thermodynamics • Dissipative structures and information entropy **Part B Practical Teaching** (5 contact hours; 4 self-study hours) **Project 1 Physical Experiments** (5 contact hours; 4 self-study hours) • Conducting basic physical experiments to reinforce theoretical knowledge
Examination forms	Final Exam
Study and examination requirements	1) Students must attend at least 2/3 of the classes, complete 2/3 of the assignments, and perform the required experiments to be eligible to take the final exam. 2)The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Homework 10% • Classroom test 10% • Middle exam 15% • Final exam 60%
Reading list	**Required Books** [1] Cheng, S., Jiang, Z., Gao, J., & Hu, Q. General Physics (8th Edition, Volumes I & II) [M]. Higher Education Press, 2022. [2] Shu, H. History of Physics in China [M]. Hunan University Press, 2013. **Reference Books** [1] Ma, W. Physics Tutorial (7th Edition, Volumes 1 & 2) [M]. Higher Education Press, 2020. [2] Xi, G. University Basic Physics [M]. Higher Education Press, 2008. [3] Wu, H. Physics Overview [M]. Tsinghua University Press, 2018.

1.4 College Physics B2

Competence field	Mathematics and Physics
Module designation	College Physics B2
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Prof. TANG Yongbo, Associate Professor Prof. WU Hainan, Associate Professor
Language	Chinese
Relation to curriculum	This module, University Physics B2, is a fundamental general education course for engineering students, which is an integral part of the 2024 undergraduate training program. The course is designed to build a systematic foundation in physics, enhance the students' abilities to analyze and solve problems, and cultivate an exploratory spirit and innovative consciousness. It includes seven chapters: Electrostatics (Chapter 7), Steady Current and Magnetic Field (Chapter 8), Electromagnetic Induction and Electromagnetic Field Theory (Chapter 9), Mechanical Vibration (Chapter 10), Mechanical Waves and Electromagnetic Waves (Chapter 11), Optics (Chapter 12), and Quantum Mechanics Fundamentals (Chapter 13). This course plays a significant role in the scientific literacy education of applied technical talents.
Teaching methods	lecture-based teaching; blended learning
Type of teaching, contact hours	Targeted students: Students of Transportation Programs Type of teaching: Theoretical Teaching, Practical Teaching Contact hours: 54 hours Size of class: No more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Advanced Mathematics, University Physics B1
Module objectives/intended learning outcomes	The course aims to enable students to systematically understand and master the basic knowledge of physics, develop their abilities to analyze and solve problems, and foster an exploratory spirit and innovative consciousness. Specific objectives include: Specific objectives include: **Knowledge:** 1) Students will gain a comprehensive understanding of the basic concepts, theories, and methods of physics, including electromagnetism, optics, quantum physics, and more. **Skills:** Students will be able to 1) develop practical skills in physical experiments and the ability to apply physical knowledge to solve real-world problems. **Competences:** Upon completion of this course, students will have developed: 1) the ability to apply scientific knowledge to practical scenarios,

	demonstrating competence in the practical aspects of physics.
Contents	**Part A Theoretical Teaching** (54 contact hours; 36 self-study hours) **Chapter 1 Electrostatics** (8 contact hours; 6 self-study hours) • Coulomb's Law, Electric Field Strength, and Calculations • Electric Flux, Gauss's Law, and Applications • Loop Theorem, Electric Potential • Relationship between Electric Field Strength and Electric Potential • Conditions for Electrostatic Equilibrium of Conductors and Charge Distribution • Mechanisms of Dielectric Polarization • Dielectrics in Gauss's Law and Loop Theorem • Capacitance, Electric Field Energy **Chapter 2 Steady Current and Magnetic Field** (8 contact hours; 5 self-study hours) • Concept of Electromotive Force (EMF) • Magnetic Induction, Magnetic Field Gauss's Theorem • Biot-Savart Law • Ampere's Circuital Law • Ampere's Law, Work of Magnetic Field • Lorentz Force • Magnetic Media **Chapter 3 Electromagnetic Induction and Electromagnetic Field Theory** (8 contact hours; 5 self-study hours) • Faraday's Law of Electromagnetic Induction • Motional Electromotive Force (EMF) • Eddy Currents, Induced EMF • Self- and Mutual Induction, Magnetic Field Energy, Displacement Current, Maxwell's Equations **Chapter 4 Mechanical Vibration** (7 contact hours; 5 self-study hours) • Characteristics and Simple Harmonic Motion (SHM), SHM Expression • Rotating Vector, SHM Energy • SHM Superposition **Chapter 5 Mechanical Waves** (8 contact hours; 5 self-study hours) • Generation and Propagation of Mechanical Waves, Plane Simple Harmonic Wave Function • Wave Energy • Huygens' Principle, Diffraction, Reflection, and Refraction of Waves • Superposition Principle, Interference, and Standing Waves • Doppler Effect **Chapter 6 Optics** (7 contact hours; 5 self-study hours) • Coherent Light, Young's Double-Slit Interference • Thin-Film and Wedge Interference • Michelson Interferometer • Huygens-Fresnel Principle, Single-Slit Diffraction

	• Diffraction Grating • Optical Instrument Resolution • Natural and Polarized Light, Brewster's Law, Malus's Law • Double Refraction Phenomenon **Chapter 7 Quantum Physics** (8 contact hours; 5 self-study hours) • Blackbody Radiation, Photoelectric Effect, Compton Effect • Hydrogen Spectrum, Bohr's Theory of the Hydrogen Atom • de Broglie Hypothesis, Wave-Particle Duality • Heisenberg Uncertainty Principle, Wave Function
Examination forms	Final Exam
Study and examination requirements	1) Students must attend at least 2/3 of the classes, complete 2/3 of the assignments, and perform the required experiments to be eligible to take the final exam. 2)The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Homework 10% • Classroom test 10% • Middle exam 15% • Final exam 60%
Reading list	**Required Books** [1] Cheng, S., Jiang, Z., Gao, J., & Hu, Q. General Physics (8th Edition, Volumes I & II) [M]. Higher Education Press, 2022. [2] Shu, H. History of Physics in China [M]. Hunan University Press, 2013. **Reference Books** [1] Ma, W. Physics Tutorial (7th Edition, Volumes 1 & 2) [M]. Higher Education Press, 2020. [2] Xi, G. University Basic Physics [M]. Higher Education Press, 2008. [3] Wu, H. Physics Overview [M]. Tsinghua University Press, 2018.

1.5 College Physics Experiments B1

Competence field	Mathematics and Physics
Module designation	College Physics Experiments B1
Semester(s) in which the module is taught	1th semester
Person responsible for the module	Dr. SONG Jiaqi, Associate Professor
Language	Chinese
Relation to curriculum	College Physics Experiments is the beginning of students' training in systematic experimental methods and experimental skills, which focuses on cultivating students' scientific literacy and initial mastery of the ability to conduct scientific experimental research, and is the important foundation for a series of scientific experimental training. College Physics Experiments B1 consists of 8 basic projects including Introduction, Basic Measurement, Young's Modulus, Single Pendulum, Triple Pendulum, Unbalanced Bridge Method, RLC Series Circuit Characterization, and Standing Wave on a String, as well as an optional project in the last week.
Teaching methods	blended learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: practical teaching Contact hours: 36 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 60 hours Contact hours = 36 hours Self-study hours = 24 hours
Credit points	2.0
Recommended prerequisites	none
Module objectives/intended learning outcomes	This course is aims to enable students to receive more systematic training in the basic knowledge, basic methods, and basic skills of physics experiments, to deepen their understanding and mastery of the basic concepts and basic laws of physics, and to cultivate and improve their hands-on abilities. Specific objectives include: **Knowledge:** This course systematically introduces the principles and performance of common basic physical instruments, measurement methods for various physical quantities, and common experimental methods such as graphing, difference method, extrapolation, compensation, and calibration. It covers the theoretical aspects of error analysis, uncertainty evaluation, and the proper use of significant figures. The course also includes understanding the physical laws through experimental methods, the significance of physical phenomena, and the application of theoretical knowledge to guide experiments and analyze experimental issues. **Skills:** Students will be able to: 1) Students can understand and apply the principles and performance of common basic measurement instruments such as vernier calipers and

	micrometers. 2) Students can master data processing software like Excel and graphing software like Origin. 3) Students can conduct uncertainty analysis of measurement results and correctly express the results. 4) Students can operate and analyze data using equipment such as the Young's modulus tester, digital force gauge, telescope, ruler, micrometers, and calipers. 5) Students can measure gravitational acceleration using a pendulum and understand the use of timing instruments. 6) Students can measure the moment of inertia of rigid bodies using the three-wire pendulum method and verify the parallel axis theorem. 7) Students can adjust instruments to determine the linear density of a string and verify the relationship between wavelength and tension. 8) Students can operate oscilloscopes and study the resonance characteristics of RLC circuits. 9) Students can understand the working principle of the unbalanced bridge and measure thermistors and temperature using it. **Competences:** Upon completion of this course, students will have developed: 1) Students acquire practical abilities in conducting scientific experiments, including hands-on skills, analytical judgment, independent thinking, innovation, summarization, and oral presentation skills. 2) Students develop a rigorous scientific approach, especially in the serious treatment of experimental data, to eliminate fraud and establish a factual scientific attitude. 3) Students enhance their comprehensive abilities to work in scientific experiments, including the ability to analyze and solve problems encountered during experiments. 4) Students learn to apply theoretical knowledge to practical experiments and to innovate in experimental design and methodology. 5) Students gain the ability to critically assess experimental results and develop a deep understanding of physical laws through experimental investigation.
Contents	**Part A Practical teaching** (36 contact hours; 24 self-study hours) **Project 1 Introduction to University Physics Laboratory** (2 contact hours; 1 self-study hour) • The status and role of university physics laboratory courses • Basic teaching requirements of university physics laboratory courses • Procedures for university physics laboratory courses • Measurement and error • Uncertainty of measurement and representation of results • Rules for significant figures and their operations • Basic methods for data processing **Project 2 Basic Measurements** (4 contact hours; 2 self-study hours) • Principle and performance of vernier calipers • Principle and performance of micrometers • Use of Excel and Origin software **Project 3 Determination of Young's Modulus of Metal Wire by Tension Method** (5contact hours; 3 self-study hours)

	• Definition of Young's modulus • Digital display Young's modulus measuring instrument • Principle of the lever magnification method • Method of successive differences **Project 4 Measurement of Gravitational Acceleration by Pendulum Method** (6 contact hours; 4 self-study hours) • Simple harmonic motion and pendulum • Principle of measuring gravitational acceleration with a pendulum • Pendulum experiment apparatus • Universal counter **Project 5 Measurement of Rigid Body Moment of Inertia by Three-String Pendulum Method** (4 contact hours; 3 self-study hours) • Definition of moment of inertia • Parallel axis theorem of moment of inertia • Principle and performance of DH4601 moment of inertia tester (three-string pendulum) **Project 6 Standing Wave Experiment on a String** (4 contact hours; 3 self-study hours) • Observation of standing wave phenomena on a string fixed at both ends, understanding the conditions for resonance and stable standing wave formation, and determination of the string's linear density • Experimental determination of the relationship between the wavelength of string vibration and tension • Experimental determination of the relationship between standing wave wavelength and vibration frequency with constant string tension • Correct plotting with graphing software and linear fitting for data processing, and drawing conclusions **Project 7 Study of RLC Circuit Resonance Characteristics** (6 contact hours; 4 self-study hours) • Principle and use of oscilloscopes • RLC series circuits • Resonance characteristics of RLC circuits **Project 8 Unbalanced Bridge Experiment** (5 contact hours; 4 self-study hours) • Construction of unbalanced bridges • Working principle of unbalanced bridges and its similarities and differences with balanced bridges • Principle and method of measuring thermistors with unbalanced bridges
Examination forms	Practical Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, lab report completion rate over 2/3, and performing required experiments are allowed to take the exam. 2)The composition of the overall grade (minimum passing score: 60) is as follows: • Review 16% • Operation 32%

	• Classroom test 24% • Middle exam 8% • Final exam 20%.
Reading list	**Required books** [1] Su, Y., & Song, J. University Physics Experiment [M]. Higher Education Press, 2024. **Reference books** [1] Zhou, H., & Zhang, Z. University Physics Experiment (I) [M]. Xidian University Press. [2] Zhao, G., & Huang, J. University Physics Experiment (II) [M]. Xidian University Press. **Other materials** [1] PPT courseware (self-compiled)

1.6 College Physics Experiments B2

Competence field	Mathematics and Physics
Module designation	College Physics Experiments B2
Semester(s) in which the module is taught	2th semester
Person responsible for the module	Dr. SONG Jiaqi, Associate Professor
Language	Chinese
Relation to curriculum	College Physics Experiments is the beginning of students' training in systematic experimental methods and skills. It emphasizes the cultivation of students' scientific literacy and the initial mastery of the ability to carry out scientific experimental research, and is the important foundation for a series of scientific experimental training. College Physics Experiments B2 experiments include 11 of the 12 basic projects in optics, thermology and acoustics, as well as an optional project in the last week.
Teaching methods	blended learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: practical teaching Contact hours: 36 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 60 hours Contact hours = 36 hours Self-study hours = 24 hours
Credit points	2.0
Recommended prerequisites	College Physics Experiments B1
Module objectives/intended learning outcomes	This course is aims to enable students to receive more systematic training in the basic knowledge, basic methods, and basic skills of physics experiments, to deepen their understanding and mastery of the basic concepts and basic laws of physics, and to cultivate and improve their hands-on abilities. Specific objectives include: **Knowledge:** This course systematically introduces the principles and operations of common basic physical instruments, measurement techniques for various physical quantities, and experimental methods such as graphing, difference method, extrapolation, compensation, and calibration. Students will learn about error analysis theory, basic data processing methods, and the significance of significant figures. The course also covers the exploration of physical laws through experiments, observation and analysis of physical phenomena, and the application of theoretical knowledge to guide experiments and analyze experimental issues. **Skills:** Students will be able to: 1) Understand the development and frontier of various measurement techniques in physics and master the theoretical cycle knowledge of physical experiments. 2) Master the working principles and the advantages and disadvantages

	of various physical measurement systems, and understand the design methods and principles of these systems. 3) Use common basic measurement instruments such as vernier calipers and micrometers correctly, and perform data processing using software like Excel and Origin. 4) Conduct uncertainty analysis of measurement results and correctly express the results. 5) Operate equipment such as Young's modulus testers, digital force gauges, telescopes, rulers, micrometers, and calipers, and analyze the data obtained from these instruments. 6) Measure gravitational acceleration using a pendulum and understand the use of timing instruments. 7) Measure the moment of inertia of rigid bodies using the three-wire pendulum method and verify the parallel axis theorem. 8) Adjust instruments to determine the linear density of a string and verify the relationship between wavelength and tension. 9) Operate oscilloscopes and study the resonance characteristics of RLC circuits. 10) Understand the working principle of the unbalanced bridge and measure thermistors and temperature using it. **Competences:** Upon completion of this course, students will have developed: 1) Practical abilities and innovative thinking in various physical measurement systems and engineering technology knowledge. 2) A rigorous scientific approach, especially in the serious treatment of experimental data, to eliminate fraud and establish a factual scientific attitude. 3) Comprehensive abilities to work in scientific experiments, including hands-on skills, analytical judgment, independent thinking, innovation, summarization, and oral presentation skills. 4) The ability to apply theoretical knowledge to practical experiments and to innovate in experimental design and methodology. 5) The ability to critically assess experimental results and develop a deep understanding of physical laws through experimental investigation.
Contents	**Part A Practical teaching** (36 contact hours; 24 self-study hours) **Project 1 Light Intensity Distribution of Single and Multiple Slit Diffraction** (2 contact hours; 1 self-study hour) • Adjustment of instruments and optical path • Measurement of the relationship between light intensity distribution and peak width in single-slit diffraction • Measurement of the relationship between light intensity distribution and the number of slits in multiple-slit interference • Measurement of the diameter of a fine wire • Data analysis and experimental results using Origin for graphing **Project2 Grating Diffraction and Atomic Grating Spectral Measurement** (3 contact hours; 2 self-study hours) • Adjustment of optical path and grating to the required state • Measurement of grating constant, unknown light wavelength, and dispersion rate • Measurement of helium's atomic spectrum and representation of the relationship between light intensity and wavelength **Project 3 Adjustment of Spectrometer and Measurement of**

	Refractive Index of Glass Triangular Prism (3 contact hours; 2 self-study hours) • Adjustment of the spectrometer and determination of the triangular prism's apex angle (self-collimation method and reflection method) • Measurement of the refractive index of prism glass using the minimum deviation angle method (dispersion curve as an optional experiment) • Familiarization with the use of spectrometers, parallel plane reflectors, glass triangular prisms, and mercury lamps **Project 4 Measurement of the Radius of Curvature of a Concave Lens Using Newton's Rings** (4 contact hours; 3 self-study hours) • Familiarization with the principle, adjustment, and use of a reading microscope • Measurement of the radius of curvature of a lens using Newton's rings; measurement of the diameter of a microwire using a wedge • Data processing and error analysis **Project 5 Hall Effect Experiment** (2 contact hours; 1 self-study hour) • Negative effects in the experiment and methods for elimination • Measurement of electrical conductivity σ • Mapping the VH~Is curve while keeping Im constant • Mapping the VH~Im curve while keeping Is constant • Measurement of VAC at zero magnetic field with Is=0.1mA • Determination of the sample's conduction type and calculation of RH, n, σ , and μ **Project 6 Measurement of Sonic Velocity Using Doppler Effect** (3 contact hours; 2 self-study hours) • Doppler effect • Principle of measuring sonic velocity using the phase method • Principle of measuring sonic velocity using the standing wave method • Data processing using the method of successive differences **Project 7 Observation of Dynamic Hysteresis Loop** (4 contact hours; 3 self-study hours) • Familiarization with experimental instruments and circuit connection • Observation and mapping of the sample's hysteresis loop • Determination of the sample's magnetization curve • Graphing with Origin and reading out the values of Bm, Br, and Hc **Project 8 Measurement of Thermal Expansion Coefficient by Interference Method** (3 contact hours; 2 self-study hours) • Optical path adjustment • Observation of Michelson interference patterns under different conditions • Heating and temperature control, observation of interference fringe changes, and data recording • Graphing and calculation of the thermal expansion coefficient **Project 9 Measurement of Thermal Conductivity** Coefficient (3 contact hours; 2 self-study hours)

	• Measurement of the diameter D, thickness δ, mass m, and thickness L of the copper disk and the sample • Determination of temperature values T_1 and T_2 in a stable thermal conduction state • Calculation of the cooling rate using the object's heat dissipation rate • Calculation of the thermal conductivity coefficient • Familiarization with the thermal conductivity measurement experimental setup, voltage regulator, and digital voltmeter **Project 10 Measurement of Lens Focal Length, Polarized Light, and Basic Characteristics of Photoresistors** (3 contact hours; 2 self-study hours) • Alignment adjustment of various elements on the optical bench • Measurement of the focal length of a convex lens using object distance to image distance method, Bessel's method, and self-collimation method • Measurement of the focal length of a concave lens using object distance to image distance method **Project 11 Measurement of Liquid Viscosity Coefficient by the Falling Ball Method** (4 contact hours; 3 self-study hours) • Adjustment of the viscosity measurement setup • Measurement of the falling speed of a ball in a liquid • Calculation of viscosity based on the falling speed • Calculation of the viscosity coefficient of castor oil **Project 12 Determination of Elementary Charge - Millikan Oil Drop Experiment** (2 contact hours; 1 self-study hour) • Adjustment of the instrument to meet experimental conditions • Selection of appropriate oil drops and practice controlling the oil drops • Measurement of the charge carried by oil drops using the static balance method • Measurement of the charge carried by oil drops using the dynamic non-equilibrium method
Examination forms	Practical Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, lab report completion rate over 2/3, and performing required experiments are allowed to take the exam. 2)The composition of the overall grade (minimum passing score: 60) is as follows: • Review 16% • Operation 32% • Classroom test 24% • Middle exam 8% • Final exam 20%.
Reading list	**Required books** [1] He, J., & Huo, J. University Physics Fundamentals and Comprehensive Experiments [M]. Higher Education Press, 2018. **Reference books** [1] Zhou, H., & Zhang, Z. University Physics Experiments (Part I) [M]. Xidian University Press.

	[2] Zhao, G., & Huang, J. University Physics Experiments (Part II) [M]. Xidian University Press. **Other materials** [1] PPT courseware (self-compiled)

1.7 Linear Algebra A

Competence field	Mathematics and Physics
Module designation	Linear Algebra A
Semester(s) in which the module is taught	3rd semester
Person responsible for the module	Prof. YANG Liusha, Assistant Professor
Language	Chinese
Relation to curriculum	Linear Algebra is a fundamental course within the mathematics curriculum, serving as a cornerstone for students pursuing studies in engineering and other related fields. The course introduces essential concepts and techniques that underpin advanced mathematics, offering tools to model, analyze, and solve complex problems in both theoretical and practical contexts. This course not only develops students' logical reasoning and abstract thinking skills but also equips them with the ability to apply mathematical methods to interdisciplinary challenges. The course is structured into four main chapters: 1) Systems of Linear Equations and Matrices 2) Determinants of Square Matrices 3) Vector Spaces and the Solution Structure of Linear Equations 4) Similar Matrices and Quadratic Forms.
Teaching methods	lecture-based teaching; blended learning
Type of teaching, contact hours	Targeted students: Students of Transportation Programs Type of teaching: Theoretical Teaching Contact hours: 54 hours Size of class: No more than 60 students for theoretical teaching
Workload	Total Workload = 90 hours Contact Hours = 54 hours Self-study Hours = 36 hours
Credit points	3.0
Recommended prerequisites	Advanced Mathematics
Module objectives/intended learning outcomes	The course aims to provide students with a solid foundation in linear algebra, emphasizing its application to complex problem-solving in engineering and related fields. By exploring core concepts such as systems of linear equations, matrices, determinants, and vector spaces, students will develop their logical reasoning and abstract thinking skills. Additionally, the course prepares students to apply mathematical methods to interdisciplinary challenges, enabling them to model and solve real-world problems using the principles of linear algebra. Specific objectives include: **Knowledge** 1) Comprehend the fundamental principles and operations of matrices, determinants, and their properties. 2) Understand the theoretical framework of vector spaces, including concepts such as vector groups, linear combinations, and solution structures of linear equations. 3) Analyze the relationships among similar matrices, eigenvalues, eigenvectors, and quadratic forms, including their standard and positive-definite forms.

	Skills 1) Perform matrix operations, including elementary transformations, block matrix manipulations, and matrix inversion using determinant methods. 2) Solve systems of linear equations using analytical techniques such as Cramer's rule and rank analysis. 3) Diagonalize symmetric matrices and standardize quadratic forms through transformations. **Competences** 1) Develop the ability to apply linear algebra concepts and methods to solve practical problems in various scientific and engineering fields. 2) Cultivate analytical and logical reasoning skills essential for understanding advanced mathematical models and theories. 3) Integrate knowledge of vector spaces and quadratic forms into interdisciplinary research and applications.
Contents	**Part A Theoretical Teaching** (54 contact hours; 36 self-study hours) **Chapter 1 Systems of Linear Equations and Matrices** (14 contact hours; 9 self-study hours) • Introduction to matrix concepts and operations • Block matrices • Linear equations and matrix elementary transformations • Elementary matrices and inverse transformations **Chapter 2 Determinants of Square Matrices** (13 contact hours; 9 self-study hours) • Definition of determinants • Properties of determinants • Expansion of determinants by rows (columns) • Matrix inversion formulas and Cramer's rule **Chapter 3 Vector Spaces and the Solution Structure of Linear Equations** (14 contact hours; 9 self-study hours) • Vector groups and linear combinations • Correlation of vector groups • Rank of vector groups and matrices • Solution structure of linear equations • Vector spaces **Chapter 4 Similar Matrices and Quadratic Forms** (13 contact hours; 9 self-study hours) • Inner product, length, and orthogonality of vectors • Eigenvalues and eigenvectors of square matrices • Similar matrices • Similar diagonalization of real symmetric matrices • Quadratic forms and standard forms • Positive definite quadratic forms and matrices
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. 2)The composition of the overall grade (minimum passing score: 60) is as follows:

	• Attendance 10% • Homework 15% • In-class test 5% • Study report 10% • Final exam 60%.
Reading list	**Required Book** [1] Department of Mathematics, Tongji University. *Linear Algebra* [M]. People's Posts and Telecommunications Press, 2016. **Reference Books** [1] Zhao, S. *Linear Algebra* (5th Edition) [M]. Renmin University of China Press, 2017. [2] Department of Mathematics, Tongji University. *Linear Algebra* (6th Edition) [M]. Higher Education Press, 2014.

1.8 Probability and Statistics A

Competence field	Mathematics and Physics
Module designation	Probability and Statistics A
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Dr. HE Fang, Lecturer
Language	Chinese
Relation to curriculum	Aligned with the objectives of the transportation engineering curriculum, Probability Theory and Mathematical Statistics is a core course within the mathematics curriculum, essential for students majoring in fields such as engineering, science, and data analysis. It equips students with the theoretical foundation needed to understand and apply probabilistic and statistical methods to analyze and solve real-world problems. The course is structured into eight main chapters: 1) Random Events and Probability 2) Random Variables and Their Distributions 3) Two-Dimensional Random Variables and Their Distributions 4) Numerical Characteristics of Random Variables 5) The Law of Large Numbers and the Central Limit Theorem 6) Samples and Sampling Distributions 7) Parameter Estimation 8) Hypothesis Testing.
Teaching methods	lecture-based teaching; blended learning
Type of teaching, contact hours	Targeted Students: Students of Transportation programs Type of teaching: theoretical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Total Workload = 90 hours Contact Hours = 54 hours Self-study Hours = 36 hours
Credit points	3.0
Recommended prerequisites	Advanced Mathematics, Linear Algebra
Module objectives/intended learning outcomes	This course aims to provide students with a comprehensive understanding of probability theory and mathematical statistics. It equips students with the essential tools to apply probabilistic and statistical methods in analyzing and solving real-world problems, particularly in engineering, science, and data analysis. Emphasizing practical applications, the course covers key concepts such as random variables, distributions, estimation, and hypothesis testing, enabling students to use these techniques to make informed decisions and optimize solutions in their future careers. Specific objectives include: **Knowledge:** 1) Understand the basic concepts, theories, and methods of probability theory and mathematical statistics. 2) Learn about random events, random variables, and their distributions. 3) Grasp the concepts of expectation, variance, covariance, and correlation coefficients. 4) Comprehend the Law of Large Numbers and the Central Limit Theorem.

	Skills: Students will be able to 1) Develop the ability to calculate probabilities for various events and random variables. 2) Apply statistical methods to analyze data and draw conclusions. 3) Use sampling distributions to perform parameter estimations and hypothesis testing. **Competences:** Upon completion of this course, students will have developed: 1) Critically evaluate and apply probabilistic and statistical concepts to solve complex problems. 2) Demonstrate the ability to interpret and communicate statistical results effectively. 3) Integrate knowledge of probability and statistics into real-world applications, showing creativity and innovation in problem-solving.
Contents	**Part A Theoretical Teaching** (54 contact hours; 36 self-study hours) **Chapter 1 Random Events and Probability** (6 contact hours; 4 self-study hours) • Random events and their operations • Definition and properties of probability • Equally likely probability models • Conditional probability and independence of events • Total probability formula and Bayes' theorem **Chapter 2 Random Variables and Their Distributions** (7 contact hours; 5 self-study hours) • Random variables and their distributions • Common discrete random variables • Common continuous random variables • Distribution of random variable functions **Chapter 3 Two-Dimensional Random Variables and Their Distributions** (7 contact hours; 4 self-study hours) • Two-dimensional random variables and joint distributions • Common two-dimensional random variables • Marginal distributions • Conditional distributions • Distributions of functions of two-dimensional random variables **Chapter 4 Numerical Characteristics of Random Variables** (7 contact hours; 5 self-study hours) • Mathematical expectation • Variance and standard deviation • Covariance and correlation coefficient • Other numerical characteristics **Chapter 5 The Law of Large Numbers and the Central Limit Theorem** (7 contact hours; 4 self-study hours) • The Law of Large Numbers • The Central Limit Theorem **Chapter 6 Samples and Sampling Distributions**

	(7 contact hours; 5 self-study hours) • Population and sample • Statistical measures • Three major distributions • Sampling distributions of normal populations **Chapter 7 Parameter Estimation** (7 contact hours; 4 self-study hours) • Point estimation • Criteria for evaluating point estimates **Chapter 8 Hypothesis Testing** (6 contact hours; 5 self-study hours) • Basic principles of testing • Hypothesis testing for parameters of normal populations
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3and and assignment completion rate over 2/3 are allowed to take the exam. 2)The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 10% • In-class test 5% • Study report 15% • Final exam 60%
Reading list	**Required Book** [1] Yang, J., & Wang, Y. *Probability Theory and Mathematical Statistics* [M]. People's Posts and Telecommunications Press, 2022. **Reference Books** [1] Sheng, Z., Xie, S., & Pan, C. *Probability Theory and Mathematical Statistics* (5th Edition) [M]. Higher Education Press, 2020. [2] Jie, S., Cheng, Y., & Pu, X. *Probability Theory and Mathematical Statistics Tutorial* [M]. Higher Education Press, 2019.

1.9 Operations Research

Competence field	Electives
Module designation	Operations Research
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Dr. HE Yuxin, Associate Professor
Language	Chinese
Relation to curriculum	Operations Research, a core compulsory course for undergraduate students majoring in Transportation Engineering, is an interdisciplinary field combining mathematics, management, and economics. This course aims to systematically educate students about the fundamental concepts, principles, and applications of operations research in solving practical problems. The curriculum covers the main mathematical models of operations research, methods of solution, applications of models, and modeling techniques. Students will learn how to efficiently allocate resources (such as human, financial, and material resources) in economic management systems and provide data- and model-based optimal solutions for decision-makers, thereby achieving effective management. Additionally, the course teaches basic modeling skills and computer-based methods for solving operations research problems, enabling students to apply their knowledge to solve complex issues in their professional work.
Teaching methods	lecture-based teaching; hands-on labs; case-based learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 72 hours Size of class: no more than 80 students for theoretical teaching
Workload	Workload =120 hours Contact hours = 72 hours Self-study hours = 48 hours
Credit points	4.0
Recommended prerequisites	Advanced Mathematics, Linear Algebra
Module objectives/intended learning outcomes	This course aims to enable students to gradually and progressively understand and master the fundamental concepts and methods in operations research, specifically applied to transportation systems. The course will provide students with the ability to model and solve real-world problems in transportation planning and management using operations research techniques. Specific objectives include: **Knowledge:** This course will provide a comprehensive understanding of operations research methodologies, including linear programming, the simplex method, sensitivity analysis, integer programming, dynamic programming, and network optimization. Students will learn to apply these methods to transportation-related problems, such as route planning, assignment problems, and network flow optimization. They will also gain an understanding of the principles behind transportation modeling and optimization, including transportation and assignment

	problems and their real-world applications. **Skills:** Students will be able to 1) Apply operations research techniques to solve complex transportation planning problems, improving decision-making in transportation systems. 2) Develop mathematical models for transportation problems and solve them using appropriate optimization methods, such as linear programming and dynamic programming. 3) Use sensitivity analysis to evaluate the stability and robustness of transportation models in dynamic environments. 4) Analyze and interpret optimization results to recommend improvements in transportation system design and management. **Competences:** Upon completion of this course, students will have developed: 1) Practical abilities to formulate and solve transportation problems using operations research tools. 2) The ability to apply theoretical knowledge to real-world transportation scenarios, enhancing their capacity for critical thinking and problem-solving. 3) Competence in evaluating transportation system performance and identifying optimization opportunities. 4) The ability to contribute to the development and improvement of transportation systems using quantitative methods.
Contents	**Part A Theoretical teaching** (54 contact hours; 36 self-study hours) **Chapter 1 The Overview of Operations Research and Modeling Methods** (2 contact hours; 1 self-study hour) • The origin, essence, and impact of operations research • General methods and steps for problem modeling, solution, model validation, and result implementation **Chapter 2 Linear Programming and the Simplex Method** (10 contact hours; 10 self-study hours) • The mathematical models of linear programming problems (standard and non-standard models) and modeling methods • The mathematical models of linear programming problems (standard and non-standard models) and modeling methods • Various application examples of linear programming • The Simplex Method **Chapter 3 Dual Problems and Sensitivity Analysis of Linear Programming** (8 contact hours; 6 self-study hours) • The dual problem in linear programming; • The basic properties of dual problems; • Shadow prices; • Sensitivity analysis of changes in a single objective function coefficient; • Sensitivity analysis of changes in multiple objective function coefficients; • Sensitivity analysis of changes in the right-hand side value of a single constraint; • Sensitivity analysis of simultaneous changes in the right-hand side

	values of multiple constraints; • Sensitivity analysis of changes in constraint coefficients; • Application examples of sensitivity analysis **Chapter 4 Modeling and Applications of Linear Programming** (4 contact hours; 2 self-study hours) • The four main types of linear programming problems; • Modeling and application of multi-resource allocation problems; • Modeling and application of cost-benefit balance problems; • Modeling and application of network distribution problems; • Modeling and application of mixed problems **Chapter 5 Transportation Problems and Assignment Problems** (8 contact hours; 5 self-study hours) • Description of transportation problems; • Characteristics of transportation problems; • Modeling methods and application examples of transportation problems; • Solution methods for transportation problems; • Basic concepts and variations of assignment problems; • Modeling and application examples of assignment problems. • **Chapter 6 Network Optimization Problems** (10 contact hours; 6 self-study hours) • Basic concepts of networks and graph theory; • Shortest path problem; • Minimum spanning tree problem; • Maximum flow problem; • Minimum cost flow problem; • Modeling and application of network optimization problems. • **Chapter 7 Integer Programming** (6 contact hours; 4 self-study hours) • Basic concepts of integer programming; • Some basic techniques for modeling; • Modeling examples; • Characteristics of solving integer programming problems; • Branch and bound method; • Cutting plane method; • 0-1 integer programming. • **Chapter 8 Dynamic Programming** (6 contact hours; 2 self-study hours) • Characteristics of dynamic programming; • Deterministic dynamic programming; • Stochastic dynamic programming. **Part B Practical teaching** (18 contact hours; 12 self-study hours) **Project 1 Linear Programming Problem Modeling and Solving Experiment** (4 contact hours; 2 self-study hours) • Graphical method principles and steps; • Loading the "Solver" tool in Excel software; • Creating a new problem in Excel, inputting the model, solving the model, and performing a basic analysis of the results. **Project 2 Linear Programming Sensitivity Analysis Experiment**

	(4 contact hours; 2 self-study hours) • Using Excel software to solve sensitivity analysis problems in exercises and case studies. **Project 3 Modeling and Solving Transportation Problems Experiment** (2 contact hours; 2 self-study hours) • Using Excel software and other methods to solve related transportation problem exercises and case studies. **Project 4 Assignment Problem Modeling Experiment** (1 contact hour; 1 self-study hour) • Using Excel software and other methods to solve related assignment problem exercises and case studies. **Project 5 Shortest Path Problem Solving Experiment** (2 contact hours; 1 self-study hour) • Using Excel software and other methods to solve related shortest path problem exercises and case studies. **Project 6 Minimum Spanning Tree Problem Solving Experiment** (2 contact hours; 1 self-study hour) • Using Excel software and other methods to solve related minimum spanning tree problem exercises and case studies. **Project 7 Maximum Flow Problem Solving Experiment** (1 contact hour; 1 self-study hour) • Using Excel software and other methods to solve related maximum flow problem exercises and case studies. • **Project 8 Dynamic Programming Problem Modeling and Solving Experiment** (2 contact hours; 2 self-study hours) • Using Excel software and other methods to model and solve related dynamic programming problem exercises and case studies.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2)The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 15% • In-class test 7% • Experiment 8% • Final exam 60%.
Reading list	**Required books** [1] Textbook Compilation Group of Operations Research. Operations Research (5th Edition) [M]. Tsinghua University Press, 2021. **Reference books** [2] Li, Z. (Ed.). Operations Research ABC: Achievements, Beliefs, and Abilities [M]. Economic Management Press, 2000. [3] Jiang, B., et al. Wu Wenjun and Chinese Mathematics [M]. Shanghai Jiao Tong University Press, 2016.

	[4] Hu, Y., Guo, Y. Introduction to Operations Research (5th Edition) [M]. Tsinghua University Press, 2018. [5] Ye, X.. Practical Operations Research: Modeling and Solving with Excel 2010 (2nd Edition) [M]. Renmin University of China Press. **Other materials** [1] PPT courseware (self-compiled)

Module 2 Informatics

2.1 College Computer A

Competence field	Informatics
Module designation	College Computer A
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Prof. CHEN Fan, Assistant Professor
Language	Chinese
Relation to curriculum	University Computer A is a core course in the computer science curriculum, essential for students across various engineering and science disciplines. It forms an integral part of the general education program, aiming to equip students with fundamental knowledge and skills in computer science, computational thinking, and information technology. The course is structured into eight aspects: 1) Computer Overview, 2) Programming Language Knowledge, 3) Information Encoding and Data Representation, 4) Algorithmic Foundations, 5) Computer Systems, 6) Computer Networks and Their Applications, 7) Database Application Basics, 8) Emerging IT Technologies IT.
Teaching methods	lecture-based teaching; blended learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching contact hours: 72 hours Size of class: no more than 60 students for theoretical teaching
Workload	Total Workload = 120 hours contact hours = 72 hours self-study hours = 48 hours
Credit points	4.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	The course aims to develop students' foundational understanding of computing, focusing on computational thinking, problem-solving, information representation, and computer systems. Students will gain essential skills in applying computing methods, enhancing problem-solving abilities, and fostering information literacy and computational thinking. Specific objectives include: **Knowledge:** 1) Understand the basic concepts and principles of computer systems, networks, and information technology. 2) Grasp the fundamentals of programming, data structures, and algorithms. 3) Learn the basics of database management and the application of IT in various fields. **Skills:** Students will be able to

	1) Develop programming skills using Python to solve computational problems. 2) Apply computational thinking to analyze and solve complex problems. 3) Utilize database systems and network technologies for data management and communication. **Competences:** Upon completion of this course, students will have developed: 1) Enhance the ability to critically evaluate and apply computer science concepts to real-world scenarios. 2) Demonstrate proficiency in using computer technology for information processing and communication. 3) Adapt to new technological developments and continue learning in the rapidly evolving field of IT.
Contents	**Part A Theoretical Teaching** (36 contact hours; 24 self-study hours) **Chapter 1 Computer Overview** (3 contact hours; 2 self-study hours) • Introduction to computer systems and computing concepts • Overview of computational thinking **Chapter 2 Programming Language Knowledge** (4 contact hours; 3 self-study hours) • Introduction to Python programming and basic syntax • Control structures and functions in Python • Object-oriented programming concepts **Chapter 3 Information Encoding and Data Representation** (5 contact hours; 3 self-study hours) • Digitalization of information and encoding concepts • Data representation in computers **Chapter 4 Algorithmic Foundations** (5 contact hours; 4 self-study hours) • Algorithm concepts and mathematical modeling • Description methods and design strategies • Data structures and problem-solving **Chapter 5 Computer Systems** (4 contact hours; 4 self-study hours) • Overview of hardware components • Introduction to operating systems • Using Python with operating systems **Chapter 6 Computer Networks and Their Applications** (6 contact hours; 3 self-study hours) • Fundamentals of computer networks and Internet basics • Overview of TCP/IP protocols and network applications **Chapter 7 Database Application Basics** (5 contact hours; 2 self-study hours) • Database concepts and data models • Introduction to database management systems • Python database programming **Chapter 8 Emerging IT Technologies & Comprehensive Review**

	(4 contact hours; 3 self-study hours) • High-performance computing and cloud computing • Overview of big data and artificial intelligence • New computing technologies and review session **Part B Practical Teaching (36 contact hours; 24 self-study hours)** **Project 1: Python Development Environment Configuration** (2 contact hours; 1 self-study hour) • Familiarize with several commonly used Python IDEs and the Headgeek online training platform, mastering the methods of installation and deployment, as well as the basic operations of the Headgeek training platform. **Project 2: Python Programming Introduction** (2 contact hours; 1self-study hours) • Write and compile Python code, and submit code through the Headgeek system. **Project 3: Python Program Design (1)** (3 contact hours; 2 self-study hours) • Utilize the basic program design content learned to design and write Python language programs to solve the problems assigned in the Headgeek system. **Project 4: Python Program Design (2)** (3 contact hours; 2 self-study hours) • Utilize the basic program design content learned to design and write Python language programs to solve the problems assigned in the Headgeek system. **Project 5: Python Program Design (3)** (3 contact hours; 2 self-study hours) • Utilize the basic program design content learned to design and write Python language programs to solve the problems assigned in the Headgeek system. **Project 6: Python Information Encoding (1)** (2 contact hours; 2 self-study hours) • Utilize the basic program design content learned to design and write Python language programs to solve the problems related to base conversion in the Headgeek system. **Project 7: Python Information Encoding (2)** (2 contact hours; 1self-study hours) • Utilize the basic program design content learned to design and write Python language programs to solve the problems related to image and sound information encoding in the Headgeek system. **Project 8: Python Problem Solving (1)** (2 contact hours; 1 self-study hour) • Utilize the basic program design content learned to design and write Python language programs to solve the problems assigned in the Headgeek system. **Project 9: Python Problem Solving (2)** (2 contact hours; 1 self-study hour) • Utilize the basic program design content learned to design and

	write Python language programs to solve the problems assigned in the Headgeek system. **Project 10: Python Problem Solving (3)** (3 contact hours; 2 self-study hours) • Utilize the basic program design content learned to design and write Python language programs to solve the problems assigned in the Headgeek system. **Project 11: Python Problem Solving (4)** (3 contact hours; 2 self-study hours) • Utilize the basic program design content learned to design and write Python language programs to solve the problems assigned in the Headgeek system. **Project 12: Python Operating System (1)** (2 contact hours; 2 self-study hours) • Utilize the content learned to understand the working principles of computer hardware systems and complete the simulation experiment questions in the Headgeek system. **Project 13: Python Operating System (2)** (2 contact hours; 1 self-study hour) • Utilize the basic program design content learned to design and write Python language programs to solve the problems assigned in the Headgeek system. **Project 14: Network Data Acquisition and Analysis** (3 contact hours; 2 self-study hours) • Utilize the basic program design content learned to design and write Python language programs to solve the problems assigned in the Headgeek system. **Project 15: Python Database Program Design** (2 contact hours; 2 self-study hours) • Utilize the basic program design content learned to design and write Python language programs to solve the problems assigned in the Headgeek system. **Project 16: Comprehensive Experiment** (2 contact hours; 1 self-study hour) • Utilize the basic program design content learned to design and write Python language programs to solve the problems assigned in the Headgeek system.
Examination forms	Open-book Exam
Study and examination requirements	1) Students must attend at least 2/3 of the classes, complete 2/3 of the assignments, and perform the required experiments to be eligible to take the final exam. 2)The composition of the overall grade (minimum passing score: 60) is as follows: • Classroom Exercises 10% • Experiments 30% • Curriculum Design 10% • Final Exam 50%
Reading list	**Required Books** [1] Shen, X., & Kong, J. *Fundamentals of University Computer Science*

	[M]. Tsinghua University Press, 2024.07. [2] Zhou, H., & Zhou, W. *University Computer Science Basic Experiment Tutorial (2nd Edition)* [M]. Tsinghua University Press, 2018.09. **Reference Books** [1] Zhan, L. *University Computer Science—Elements of Computational Thinking and Information Literacy (3rd Edition)* [M]. Higher Education Press, 2019.08. [2] Sha, W. *Introduction to Computer Science—Python Approach (3rd Edition)* [M]. Tsinghua University Press, 2020.11.

2.2 Python Programming B

Competence field	Informatics
Module designation	Python Programming B
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Dr. HU Jinping, Assistant professor
Language	Chinese
Relation to curriculum	Fundamentals of Programming B is a foundational course for non-computer science majors, designed to equip students with practical programming skills and cultivate computational thinking. As part of the general education curriculum, the course emphasizes mastering Python programming to solve real-world problems. It introduces key programming concepts and techniques to build a solid foundation for further learning. The course covers ten aspects of Python programming: 1) Introduction to Python and Basic Syntax – Understanding Python's core elements and writing basic programs. 2) Simple Data Types and Built-in Functions – Using basic data types and exploring Python's built-in functions. 3) Sequences: Lists and Tuples – Organizing and manipulating data using lists and tuples. 4) List Operations – Performing common operations and modifications on lists. 5) If Statements – Implementing decision-making processes using conditional statements. 6) Dictionaries and Sets – Managing data relationships through dictionaries and sets. 7) While Statements – Controlling program flow with loops. 8) Functions – Defining and using functions for modular and reusable code. 9) Classes – Learning object-oriented programming by creating and managing classes. 10) Comprehensive Python Application – Integrating all learned concepts through practical projects.
Teaching methods	lecture-based teaching; blended learning; hands-on labs
Type of teaching, contact hours	Targeted students: all students Type of teaching: theoretical teaching, practical teaching contact hours: 72 hours Size of class: no more than 60 students for theoretical teaching
Workload	Total Workload = 120 hours contact hours = 72 hours (Including 36 hours for practical sessions) self-study hours = 48 hours
Credit points	4.0
Recommended prerequisites	College Computer A
Module objectives/intended learning outcomes	The objective of Fundamentals of Programming B is to introduce non-computer science students to Python programming. Students will learn to write clean, efficient code, set up programming environments, and use basic and advanced Python features, including variables, data types, functions, loops, and object-oriented programming. They will also gain proficiency in utilizing Python libraries, such as Pandas, for data analysis. By the end of the course, students will be able to develop practical, real-world applications and enhance their independent

	learning and problem-solving abilities in programming. Specific objectives include: **Knowledge:** 1) Understand the Python programming language, its features, and differences from other languages like C. 2) Grasp basic Python syntax, data types, control structures, and functions. 3) Learn to use Python standard libraries and extensions like Pandas for data analysis. **Skills:** Students will be able to 1) Develop programming skills in Python to solve computational problems. 2) Apply Python for data manipulation and analysis using libraries such as Pandas. 3) Write clean, efficient, and maintainable Python code following best practices. **Competences:** Upon completion of this course, students will have developed: 1) Enhance the ability to think computationally and solve problems using programming. 2) Demonstrate proficiency in using Python for practical applications in various fields. 3) Develop self-learning skills and the ability to read and understand existing code.
Contents	**Part A Theoretical teaching** (48 contact hours; 20 self-study hours) **Chapter 1 Introduction to Python** (4 contact hours; 14 self-study hours) • Scenarios of Python usage • What is Python (Python language features, differences from C language) • History of Python (Python 2.0 and Python 3.0) • Setting up the Python programming environment (downloading Python, text editors, Anaconda, pip tool) • Basic Python syntax (print function, variables and assignment statements, variable naming, variable types) **Chapter 2 Simple Data Types and Common Built-in Functions** (4 contact hours; 2 self-study hours) • Simple data types (numbers, strings) • String formatting (concept of methods, differences between methods and functions, string formatting) • Operators and expressions (common operators, logical operators, relational operators) • Common built-in functions (input/output functions, formatting functions) • Introduction to common standard libraries (importing modules, math module, random module) • Python code conventions (indentation, line length, blank lines, comments) **Chapter 3 Sequences: Lists and Tuples** (5 contact hours; 2 self-study hours)

	• Common sequence structures in Python (lists, tuples, sets, strings, etc.) • Definition of lists (creating and deleting lists, accessing list elements, adding, modifying, and deleting list elements) • Organizing lists (sorting lists using functions and methods, confirming list length) • Definition of tuples (creating and deleting tuples, differences between tuples and lists) **Chapter 4 List Operations** (6 contact hours; 3 self-study hours) • Common list methods (append, insert, remove, count, etc.) • Common built-in list functions (len(), sum(), enumerate(), etc.) • For statement (traversing lists, for loop statements, indentation) • Number lists (creating number lists, simple statistical analysis of number lists, list slicing) • List comprehensions (list comprehensions, generator expressions) • map(), reduce(), filter() functions **Chapter 5 If Statements** (5 contact hours; 2 self-study hours) • Simple if statements (basic structure of if statements, application of if statements in for loops) • Conditional tests (testing equality, testing inequality, comparing numbers, checking multiple conditions) • If-else statements and if-elif-else statements (logical structure of branching statements) • Application examples of if statements (application in program design, application in data analysis) **Chapter 6 Dictionaries and Sets** (6 contact hours; 2 self-study hours) • Definition of dictionaries (creating and deleting dictionaries, accessing dictionaries, accessing and modifying dictionary values) • Traversing dictionaries (traversing keys of dictionaries, traversing values of dictionaries, traversing key-value pairs of dictionaries) • Dictionary lists (storing lists in dictionaries) • Dictionary comprehensions (dictionary comprehension expressions) • Definition of sets (creating and deleting sets, comparing sets, set operations) **Chapter 7 While Statements** (6 contact hours; 3 self-study hours) • Loop statements (while loops, for loops, differences between the two) • Exiting loops (conditional tests, break keyword, continue keyword) • Using while to process lists (traversing lists) • Application cases of while loops (application in program writing, application in data analysis) **Chapter 8 Functions** (4 contact hours; 2 self-study hours) • Defining functions (defining functions, calling functions) • Arguments (positional arguments, keyword arguments, default value parameters) • Return values (return statement) • Anonymous functions (lambda functions) • Application cases of functions (application in program writing,

	application in data analysis) • Understanding practical application cases of functions **Chapter 9 Classes** (4 contact hours; 2 self-study hours) • Concepts of object-oriented programming (classes and instances, creating and using classes) • Attributes and methods of classes (accessing and modifying attributes of classes, calling methods in classes) • Inheritance (parent classes and child classes, defining attributes and methods of child classes) • Application cases of classes (application in program writing, application in data analysis) **Chapter 10 Comprehensive Application of Python** (4 contact hours; 1 self-study hour) • Comprehensive practice of Python basic syntax • Practical cases of Python program design **Part B Practical teaching** (24 contact hours; 28 self-study hours) **Project 1 Python Basic Syntax Experiment** (2 contact hours; 2 self-study hours) • Setting up the Python runtime environment, registering and using the Head Song platform • Variables and assignment statements • Common built-in functions and basic input/output functions • String formatting **Project 2 Python List Operations Experiment** (2 contact hours; 4 self-study hours) • Usage methods of lists and tuples in Python • Creating and organizing lists • Common list methods and built-in functions • Traversing lists with for loop statements • Creating number lists and simple statistical analysis of number lists • map(), reduce(), filter() functions **Project 3 If Statements and Conditional Testing Experiment** (2 contact hours; 2 self-study hours) • If statements, if-else structure, if-elif-else structure • Conditional tests **Project 4 Python Dictionaries and Sets** (2 contact hours; 4 self-study hours) • Creating dictionaries • Traversing dictionaries • Application of sets **Project 5 Python Loop Statements Experiment** (2 contact hours; 3 self-study hours) • Practice of for loops and while loops • Use of break, continue, return keywords **Project 6 Function Design and Usage Experiment** (2 contact hours; 5 self-study hours) • Definition and calling of functions • Use of anonymous function lambda

	Project 7 Class Design and Usage Experiment (2 contact hours; 5 self-study hours) • Definition and calling of classes • Defining attributes and methods of classes • Inheritance of classes **Project 8 Comprehensive Application of Python** (2 contact hours; 3 self-study hours) • Comprehensive practice of Python basic syntax • Practice and application of Python program design
Examination forms	Final Exam
Study and examination requirements	1) Students must attend at least 2/3 of the classes, complete 2/3 of the assignments, and perform the required experiments to be eligible to take the final exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Experiment 30% • Quiz 5% • Curriculum Design 10% • Final Exam 50%
Reading list	**Required Book** [1] Matthes, E. *Python Crash Course: A Hands-On, Project-Based Introduction to Programming* (2nd ed.). People's Posts and Telecommunications Press, 2021.5. **Reference Books** [1] Jiang, H., & Yu, Q. *Python Programming and Algorithm Foundation Course* (2nd ed.). Tsinghua University Press, 2019.6. [2] Li, Q. *Pandas in Depth: Data Processing and Analysis with Python*. Mechanical Industry Press, 2021.12.

2.3 Information System and Database

Competence field	Informatics
Module designation	Information System and Database
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Prof. CHENG Tao, Professor
Language	Chinese
Relation to curriculum	This course is designed to provide students with a comprehensive understanding of information systems and databases, focusing on their development, management, and security in the context of modern technological advancements. The course aims to equip students with essential knowledge in information system design, database principles, and emerging trends in AI and Big Data. It covers the following key topics: 1) Overview of information systems and their importance, 2) Technical foundations: hardware, software, networks, 3) Development strategies for information systems: agile, waterfall, 4) Introduction to databases and DBMS, 5) Data models and database design concepts, 6) Database normalization and integrity, 7) Querying and advanced SQL techniques, 8) Transaction management and security in databases, 9) Distributed databases and cloud solutions, 10) Big Data and NoSQL databases, 11) Database administration and performance tuning, 12) Data mining and machine learning in databases, 13) System planning, analysis, and design methods, 14) Database protection technologies, 15) Emerging trends in information systems: IoT, AI, Big Data, digital twins, and the metaverse. This course will combine theoretical teaching with hands-on practice, including class discussions, system analysis, and database design projects.
Teaching methods	lecture-based teaching; blended learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Total Workload = 90 hours contact hours = 54 hours self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Fundamentals of Programming, Higher Mathematics, Introduction to Intelligent Transportation Systems, Introduction to Rail Transit Systems
Module objectives/intended learning outcomes	This course aims to provide students with a comprehensive understanding of information systems (e.g., MIS), including their applications, structures, and technological foundations (such as computer science, networking, AI, and Big Data). Students will master key concepts, theories, and methods in information systems analysis, design, development, and evaluation. The course focuses on data management, particularly database technologies, equipping students with the skills to design, build, manage, and maintain databases.

	Ultimately, students will develop the ability to apply these concepts to solve practical problems in various domains, including transportation, urban planning, and business operations. Specific objectives include: **Knowledge:** 1) Understand the application, role, architecture, and latest developments of information systems (MIS). 2) Grasp the main concepts, basic theories, and principles of information systems and database management. 3) Learn the basic methods and related technologies for information system analysis, planning, design, development, implementation, and evaluation and maintenance. **Skills:** Students will be able to 1) Develop practical skills in information system analysis and database management. 2) Enhance the ability to apply information systems and database technologies to solve practical problems in enterprise operations, control, decision-making, and other areas. **Competences:** Upon completion of this course, students will have developed: 1) Cultivate the ability to use information systems and databases as methodological tools to address real-world problems in various contexts, including transportation, logistics, and other social activities. 2) Develop a comprehensive capability to analyze, design, develop, integrate, test, manage, and apply information systems in engineering practices.
Contents	**Part A: Theoretical Teaching (36 contact hours; 20 self-study hours)** **Chapter 1 Course Introduction and Overview of Information Systems** (1 contact hour; 1 self-study hour) • Course introduction, schedule, and requirements • Overview of information systems and basic knowledge **Chapter 2 Information System Technology Foundation and Development Strategies and Methods (1)** (2 contact hours; 1 self-study hour) • Introduction to modern computer hardware and software technologies and their development • Introduction to network and communication technologies • Introduction to typical intelligent terminals **Chapter 3 Information System Technology Foundation and Development Strategies and Methods (2)** (2 contact hours; 1 self-study hour) • Sensors and information processing, industrial internet of things, and their applications in urban transportation (with a focus on the use state monitoring technology and system of new energy intelligent connected vehicles, system architecture, operation and processing flow, principles and selection of typical sensors, principles and structure of the internet of things, and key core technologies)

	• Deep learning and big data mining and their applications in urban rail transit (with a focus on the intelligent maintenance system of urban rail transit, related principles, core technologies, and application models) **Chapter 4 Information System Technology Foundation and Development Strategies and Methods (3)** (3 contact hours; 2 self-study hours) • Development strategies and tactics • Thinking models and development methods (theories) (such as systemic thinking models, anti-entropy thinking models, V-type thinking models, non-linear thinking, etc., structured modular methods, object-oriented methodology, agent-based methodology and swarm intelligence, etc.) • Introduction to commonly used development environments and tools **Chapter 5 Information System Design and Development: System Planning, Analysis, and Design Methods Overview** (1 contact hour; 1 self-study hour) • System planning methods, system analysis methods • Information system project management (with a focus on how to be a product manager/project manager, introducing and discussing the concepts, methods, and skills of information system project management through application cases) • System design methods **Chapter 6 Information System Design and Development: Database Principles 1** (2 contact hours; 1 self-study hour) • Development and comparative analysis of data management technologies • Introduction to database systems - composition, typical architecture, layout modes, operation mechanisms and processes, main roles, and cognitive models and methodologies • Basic knowledge of databases - definition and connotation analysis, basic structure and sharing and independence mechanisms, data structures and data models, typical database types (products) and their roles, advantages, and disadvantages **Chapter 7 Information System Design and Development: Database Principles 2** (2 contact hours; 1 self-study hour) • Database design methods and main processes - combining 1-2 typical business processing process guidance cases, analyzing and explaining the database design ideas, main steps, and their interrelationships and related requirements • Basic knowledge of database design - data flow diagrams and data dictionaries • Basic knowledge of database design - conceptual models and E-R models (1) **Chapter 8 Information System Design and Development: Database Principles 3** (2 contact hours; 1 self-study hour) • Basic knowledge of database design - conceptual models and E-R models (2) • Basic knowledge of database design - logical models and the conversion of conceptual models to logical models • Basic knowledge of database design - logical models and

	relational data models (relational data structures) and their roles, properties, and construction methods **Chapter 9 Information System Design and Development: Database Principles 4** (3 contact hours; 2 self-study hours) • Basic operations (traditional set operations) and examples • Specialized relational operations 1 and examples **Chapter 10 Information System Design and Development: Database Principles 5** (2 contact hours; 2 self-study hours) • Specialized relational operations 2 and examples • Relational optimization and normalization theory of relational data models • Classroom exercises and discussions on relational algebra **Chapter 11 Information System Design and Development: Database Principles 6** (1 contact hour; 1 self-study hour) • Basic syntax and statements • The relationship and conversion between database queries based on SQL statements and relational algebra queries **Chapter 12 Information System Design and Development: Database Principles 7** (1 contact hour; 1 self-study hour) • Simple queries and examples • Join queries and examples **Chapter 13 Information System Design and Development: Database Principles 8** (2 contact hours; 1 self-study hour) • nested queries and set queries and other complex queries and examples 1 **Chapter 14 Information System Design and Development: Database Principles 9** (2 contact hours; 1 self-study hour) • Complex queries such as nested queries and examples 2 • Query optimization **Chapter 15 Information System Design and Development: Database Principles 10** (3 contact hours; 2 self-study hours) • Comprehensive exercise class on database principles • For homework 2, around databases (systems), data models and database design, relational algebra operations, SQL statement query operations, relational normalization and optimization, and other related knowledge points, problem-solving methods and skills, etc., for explanation, Q&A, and discussion **Chapter 16 Information System Design and Development: Database Principles 11** (2 contact hours; 1 self-study hour) • Relational database query language SQL (4) - Introduction to database application development based on high-level programming languages and SQL **Chapter 17 Information System Design and Development: Database Protection and SQL Server Database Protection Technology** (3 contact hours; 2 self-study hours) • Database security and SQL Server's security mechanisms and management • Database integrity and SQL Server's integrity control

	• Database concurrency control and SQL Server's concurrency mechanisms (with a focus) • Database recovery technology and SQL Server's data recovery mechanisms • Common data security protection and recovery techniques (with a focus) **Chapter 18 Classroom Discussion: Sensors and Intelligent Perception+, Internet of Things and Internet+, Big Data and AI+, Digital Twins and Metaverse+, and Applications of Large AI Models** (2 contact hours; 1 self-study hour) • Group exchange and discussion on topics including sensors and intelligent perception+, internet of things and industrial internet+, big data and AI+, digital twins and metaverse+, and applications of large AI models **Part B Practical teaching (18 contact hours; 16 self-study hours)** **Project 1 Database and Basic Table Operations Experiment, Data Operations Experiment** (4 contact hours; 2 self-study hours) • This project includes two experiments on database and basic table operations and data operations, covering the composition, role, and usage methods of database management systems. A database is a "warehouse for organizing, storing, and managing data according to data structures," which is a collection of a large amount of data that is stored in a computer for a long time, organized, shareable, and managed uniformly. The experiment on database and basic table operations requires mastering the methods of creating databases and basic tables using object resource managers and SQL statements, as well as modifying and deleting basic tables using object resource managers and SQL statements. On the basis of creating databases and basic tables, use SQL statements to perform operations such as adding, deleting, and modifying data in the database. **Project 2 Single Table Query Experiment and Multi-Table Join Query Experiment** (5 contact hours; 2 self-study hours) • This project mainly introduces the principles and methods of database queries, covering the methods of single table queries and multi-table join queries. Single table queries include unconditional queries, conditional queries, and the use of aggregate functions in single table queries. Multi-table join queries include the conditions for connecting tables and the differences between inner joins and outer joins. The focus is on mastering the general format of query statements and the use of conditions. **Project 3 Nested Queries and Set Queries, Indexes and Views** (5 contact hours; 2 self-study hours) • This project includes nested queries and set queries, as well as indexes and views. Nested queries include subqueries with IN predicates, subqueries with comparison operators, subqueries with ANY or ALL, and set queries. The experiment on indexes and views mainly involves understanding the differences between views and basic tables, and mastering the methods of creating, modifying, and deleting indexes and views. **Project 4 Information System Design and Development (Course Design/Paper)** (4 contact hours; 10 self-study hours)

	• This course design is one of the main practical teaching links of "Information Systems and Databases." Its purpose is to consolidate and deepen the understanding of the basic theories and knowledge of information systems and databases. Students are required to use the basic theories and methods they have mastered in the analysis, design, development, maintenance, and management of information systems and databases to practice the development of information systems for actual problems, including but not limited to urban road traffic and urban rail transit, in order to promote the application of advanced management concepts, methods, and information technology in transportation.
Examination forms	Final Exam
Study and examination requirements	1) Students must attend at least 2/3 of the classes, complete 2/3 of the assignments, and perform the required experiments to be eligible to take the final exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 3% • Homework 8% • Experimental Report 9%; • Presentation 6% • Curriculum Design 24% • Final Exam 50%
Reading list	**Required Book** [1] Huang, T., & Li, Y. *Management Information Systems* (7th ed.). Higher Education Press, 2019.8. **Reference Books** [2] Xue, H. *Management Information Systems* (7th ed.). Tsinghua University Press, 2022.1. [3] Wan, C., Liao, G., Wu, J., & Liu, X. *Database Principles* (3rd ed.). Tsinghua University Press, 2017.8.

Module 3 Informatics

3.1 College Computer A

Competence field	Engineering Fundamentals
Module designation	Engineering Drawing and CAD
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Dr. YIN Xiaohong, Associate Professor
Language	Chinese
Relation to curriculum	This course is a professional foundation course, which is an applied discipline that studies the drawing, expression, and reading of engineering drawings. On the basis of projection theory, this course organically combines typical concepts and expression methods such as two-dimensional views, axonometric sketches, and three-dimensional solid models. It combines hand drawn drawings, ruler drawings, and computer graphics, with graphic expression as the core and visual thinking as the main line, to cultivate students' basic abilities and qualities in engineering design expression.
Teaching methods	lecture-based teaching; blended learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours:72 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 120 hours Contact hours = 72 hours Self-study hours = 48 hours
Credit points	4.0
Recommended prerequisites	none
Module objectives/intended learning outcomes	This course aims to develop the engineering design expression skills and engineering literacy of students majoring in Transportation Engineering. By studying the orthographic projection method and its applications, combined with freehand sketching, ruler-and-compass drawing, and computer-aided drafting, students will master the basic methods of engineering drawing and expression, while cultivating fundamental engineering design capabilities and spatial thinking skills. The course also emphasizes fostering a meticulous work ethic and an innovative spirit in students, laying a solid foundation for advanced professional courses and engineering practice. Specific objectives include: **Knowledge:** Students will master the core theories and methods of engineering drawing, including the fundamental principles of the orthographic projection method, as well as the construction and representation of engineering forms. They will learn to integrate 2D views, isometric sketches, and 3D models to effectively express engineering designs. Through this course, students will understand the basic rules and

	technical requirements for creating and interpreting engineering drawings, providing theoretical support for future engineering applications. **Skills:** Through practical exercises, students will become proficient in using freehand sketching, ruler-and-compass drawing, and computer-aided design software (such as AutoCAD) to create detailed engineering drawings of components. They will also develop the ability to accurately interpret engineering drawings. Additionally, students will master techniques for observing and analyzing shapes using projection methods, enabling them to express and comprehend engineering design intentions from multiple perspectives. **Competences:** This course aims to cultivate students' spatial thinking, visual thinking, and logical reasoning abilities, enabling them to conceptualize and express engineering designs. It also emphasizes fostering students' innovative spirit and rigorous, pragmatic engineering literacy, equipping them with the comprehensive skills to solve real-world engineering problems. This foundation prepares students for advanced professional studies and future career development.
Contents	**Part A Theoretical teaching** (36 contact hours; 24 self-study hours) **Chapter 1: Basic Knowledge of Technical Drawing** (3 contact hours; 2 self-study hours) • Introduction to the relevant *Technical Drawing* standards for engineering drawing; • Overview of drawing tools and instruments, including their usage methods; • Introduction to AutoCAD software, including installation and drawing environment setup. **Chapter 2: Fundamentals of Orthographic Projection** (6 contact hours; 4 self-study hours) • Formation, classification, and applications of projections, as well as the characteristics of orthographic projection; • Formation and projection rules of three-view drawings of solid objects; • Projection analysis of points, lines, and surfaces on solid object surfaces; • Principles and basic operations of drawing in AutoCAD, including layer settings. **Chapter 3: Solids and Their Intersection Lines** (9 contact hours; 7 self-study hours) • Projections of basic solids; • Sectioned solids (intersection of planes and solids); • Intersecting solids (intersection of two revolving solids); • Drawing and editing 2D mechanical graphics in AutoCAD. **Chapter 4: Composite Solids**

	(5 contact hours; 3 self-study hours) • Analysis of composite solid shapes; • Methods for drawing three-view diagrams of composite solids; • Interpretation of three-view diagrams of composite solids; • Dimensioning of composite solids. **Chapter 5: Methods of Drawing Graphics** (7 contact hours; 5 self-study hours) • Views; • Sectional views (including full sections, half sections, and partial sections); • Cross-sections and detail enlargement drawings; • Common simplified and standardized drawing methods. **Chapter 6: Road Engineering Drawings** (6 contact hours; 3 self-study hours) • Drawing methods for highway route engineering plans and urban road route engineering plans; • Drawing methods for road intersections. **Part B Practical teaching** (36 contact hours; 24 self-study hours) **Project 1: Introduction to AutoCAD Software and Training on Drawing Principles and Basic Operations** **(5 contact hours; 3 self-study hours)** • Installation of AutoCAD software, interface environment, and functional layout; • Methods and steps for setting up the drawing environment; • Drawing workflow in AutoCAD; • Functions, setup, and use of layers in AutoCAD; • Methods for drawing common elements such as points, lines, circles, and polygons. **Project 2: Application of AutoCAD Blocks, Dimensions, Text, and Tables** **(7 contact hours; 5 self-study hours)** • Configuration and use of object snapping; • Mastery of general editing methods for drawings; • Techniques for mirroring, offsetting, and arraying drawings; • Methods for setting text styles and dimension styles; • Application of commonly used dimensioning methods. **Project 3: Comprehensive Practice in Drawing Floor Plans with AutoCAD** **(6 contact hours; 4 self-study hours)** • Mastery of creating drawing templates; • Methods for printing and outputting drawings; • Comprehensive practice in floor plan creation to assess students'

	proficiency in AutoCAD drawing, template file creation, and drawing output techniques. **Project 4: Introduction to SolidWorks Software, Drawing Principles, and Sketch Creation** **(5 contact hours; 3 self-study hours)** • Overview of SolidWorks' basic features and functional modules, including the software interface, basic configurations, and settings; • Common methods for creating sketches; • Editing sketches and applying constraints to enhance sketch accuracy; • Methods for expressing designs and dimensioning assembly drawings. **Project 5: SolidWorks Feature Command Training and Part Drawing** **(7 contact hours; 5 self-study hours)** • Training on common feature commands: Modeling and editing using extrude and extrude cut; Modeling methods for chamfer and shell features; Modeling and editing using revolve and revolve cut; Modeling methods for chamfers and fillets; Modeling and editing methods for sweeps. • Creating 2D engineering drawings from completed 3D part and assembly models, including standard three-view drawings, isometric views, sectional views, and detail views; • Adding dimensions and modifying engineering drawings; • Customizing and editing engineering drawing templates. **Project 6: Practical Training in Drawing Assembly Diagrams with SolidWorks** **(6 contact hours; 4 self-study hours)** • Understanding the significance of assembly and introduction to the assembly interface; • Step-by-step guide for bottom-up assembly using existing parts; • Comprehensive 3D drawing exercises to assess students' proficiency in SolidWorks modeling techniques.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Performance in the class 3% • Homework 12% • Software20% • Final Exam 60%

Reading list	**Required books** [1] Engineering Drawing [M].Bilingual Edition: English-Chinese, 3rd Edition, edited by Hu Lin et al., China Machine Press, 2019. [2] Engineering Drawing Exercise Book [M]. Bilingual Edition: English-Chinese, 3rd Edition, edited by Hu Lin and Cheng Rong, China Machine Press, 2019. **Reference books** [1] Basic Tutorial on Mechanical Drawing with AutoCAD 2016 compiled by Phoenix Hi-Tech Education, Peking University Press, 2016. [2] SolidWorks Software Teaching Notes, self-compiled by Professor Wang Hongzhi, 2022. **Other materials** [1] PPT courseware (self-compiled)

3.2 Fundamentals of Transportation Electrotechnics Technology

Competence field	Engineering Fundamentals
Module designation	Fundamentals of Transportation Electrotechnics Technology
Semester(s) in which the module is taught	3th semester
Person responsible for the module	Ms. TANG Ruixue, Senior Experimentalist
Language	Chinese
Relation to curriculum	This course is a technical foundation course that lays a solid theoretical foundation for students to learn subsequent specialized courses and to engage in practical work related to the major. Through the study of this course, students are expected to master the basic theories, knowledge, and skills of circuits and electrical and electronic technology. This will enable them to analyze and solve simple electronic circuit problems and to further understand and grasp some typical applications of electrical and electronic technology in their major. The teaching emphasizes the cultivation of students' abilities to analyze and solve problems, laying the groundwork for their future study of specialized courses and professional work.
Teaching methods	lecture-based teaching; blended learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 72 hours Size of class: no more than 50 students for theoretical teaching
Workload	Workload =120 hours Contact hours = 72 hours Self-study hours = 48 hours
Credit points	4.0
Recommended prerequisites	Advanced Mathematics, University Physics
Module objectives/intended learning outcomes	This course aims to enable students to master the necessary basic theories, basic knowledge, and basic analytical methods of electrical and electronic technology, understand the development overview of electrical and electronic technology, have the ability to analyze and solve simple electronic circuit problems, and further understand and master some typical applications of electrical and electronic technology in their major, laying a certain foundation for studying subsequent courses and engaging in engineering technology related to their major. Specific objectives include: **Knowledge objectives:** This course will comprehensively introduce circuit theory knowledge, including the basic concepts and basic laws of circuits, circuit analysis methods, transient analysis of circuits, sinusoidal AC circuits, three-phase circuits; knowledge of electrical machinery and control, including the basics of transformers, AC motors; analog electronic technology, including semiconductor devices, basic amplification circuits, integrated operational amplifiers; digital electronic technology, including gate circuits, combinational logic circuits. In addition, the

	course also covers an introduction to urban rail transit power supply systems. **Skill objectives:** ➢ Combine practical production and life to understand the cognitive methods of electrical and electronic technology, cultivate interest in learning, form correct learning methods, and have a certain level of independent learning ability. ➢ Be able to skillfully use common electrical instruments, and be able to read and analyze simple circuit schematics and block diagrams of equipment. **Competency objectives:** Upon completion of this course, students are expected to possess: ➢ The ability to apply knowledge of electrical and electronic technology and engineering application methods to solve practical electrical and electronic problems in production, life, and professional-related engineering; ➢ Strengthen awareness of safe production, energy conservation and environmental protection, and product quality, and develop good working methods, work styles, and a scientific attitude towards work; ➢ Stimulate and cultivate students' innovative consciousness and spirit in conjunction with teaching content. Guide students to gradually develop good study habits, practical awareness, and a pragmatic scientific attitude, and improve students' employability and entrepreneurial capabilities.
Contents	**Part A Theoretical Teaching (54 class hours, 30 self-study hours)** **Chapter 1 Basic Concepts and Laws of Circuits** (5 contact hours; 3 self-study hours) ● The role and components of circuits ● Circuit models ● Ohm's Law ● Powered circuits, open circuits, and short circuits ● Kirchhoff's Laws ● The concept and calculation of electric potential in circuits **Chapter 2 Basic Analysis Methods of Circuits** (5 contact hours; 3 self-study hours) ● Equivalent transformations of series and parallel resistance connections ● Two models of power sources and their equivalent transformations ● Branch current method ● Node voltage method ● Superposition theorem ● Thevenin's theorem and Norton's theorem ● Analysis of circuits with controlled sources **Chapter 3 Transient Analysis of Circuits** (6 contact hours; 3 self-study hours) ● Resistive, inductive, and capacitive elements ● Energy storage elements and switching rules ● Three-element method for transient analysis of first-order linear circuits ● Differential and integral circuits ● Response of RL circuits

	Chapter 4 Sinusoidal AC Circuits (6 contact hours; 3 self-study hours) ● Sinusoidal voltage and current ● Phasor representation of sinusoidal quantities ● Single-parameter AC circuits ● Series AC circuits with resistive, inductive, and capacitive elements ● Series and parallel impedances ● Series resonance ● Improvement of power factor **Chapter 5 Three-Phase Circuits** (4 contact hours; 2 self-study hours) ● Three-phase voltage ● Star-connected three-phase circuits with loads ● Delta-connected three-phase circuits with loads ● Three-phase power ● Safe electricity use **Chapter 6 Basic Transformer Theory** (4 contact hours; 2 self-study hours) ● Working principle of transformers ● External characteristics of transformers ● Special transformers ● Polarity of transformer windings **Chapter 7 AC Electric Motors** (4 contact hours; 2 self-study hours) ● Construction of three-phase asynchronous motors ● Rotation principle of three-phase asynchronous motors ● Circuit analysis of three-phase asynchronous motors ● Torque and mechanical characteristics of single-phase asynchronous motors ● Starting of three-phase asynchronous motors ● Speed control of three-phase asynchronous motors ● Braking of three-phase asynchronous motors ● Nameplate data of three-phase asynchronous motors **Chapter 8 Urban Rail Transit Power Supply Systems** (2 contact hours; 2 self-study hours) ● Composition of power supply systems ● Functional division of power supply systems ● Electric traction systems ● Power supply systems ● Power and lighting supply systems ● Stray current **Chapter 9 Semiconductor Devices** (3 contact hours; 2 self-study hours) ● Conductivity characteristics of semiconductors ● PN junction and its unidirectional conductivity ● Diodes ● Zener diodes ● Bipolar junction transistors ● Photoelectric devices **Chapter 10 Basic Amplification Circuits**

	(4 contact hours; 2 self-study hours) ● Composition of common emitter amplification circuits ● Static analysis of amplification circuits ● Dynamic analysis of amplification circuits ● Determination of static operating points ● Emitter followers ● Differential amplification circuits ● Complementary symmetric power amplification circuits **Chapter 11 Operational Amplifiers** (4 contact hours; 2 self-study hours) ● Brief introduction to operational amplifiers ● Applications of operational amplifiers in signal operations ● Several issues to be aware of when using operational amplifiers **Chapter 12 Feedback in Electronic Circuits** (4 contact hours; 2 self-study hours) ● Basic concepts of feedback ● Feedback in amplification circuits **Chapter 13 Logic Gates** (3 contact hours; 2 self-study hours) ● Number systems and pulse signals ● Basic logic gates and their combinations ● TTL logic gates ● CMOS logic gates ● Boolean algebra ● Analysis and design of combinational logic circuits **Part B Practical Teaching (18 class hours; 21 self-study hours)** **Experiment 1 Measurement and Error Analysis of Common Electrical Instruments** (2 contact hours; 2 self-study hours) ● Master the use of oscilloscopes, multimeters, signal generators, and basic signal and simple circuit measurements. **Experiment 2 Verification of Kirchhoff's Laws** (2 contact hours; 2 self-study hours) ● Verify the basic laws of lumped circuits - Kirchhoff's current law and voltage law. **Experiment 3 Verification of Thevenin's Theorem** (2 contact hours; 2 self-study hours) ● Master the measurement methods for open-circuit voltage and input equivalent resistance of active two-port networks, and understand the characteristics of various measurement methods. **Experiment 4 Response and Study of RC First-Order Circuits** (2 contact hours; 2 self-study hours) ● Study the transition process of RC series circuits. Analyze the impact of the values of R and C components on circuit response and transition processes. **Experiment 5 Testing of Transistor Input and Output Characteristics** (2 contact hours; 3 self-study hours) ● Test the input and output characteristics of transistors. Learn to use

	multimeters to test the static working points of transistors and determine the working state of transistors. **Experiment 6 Operational Amplifier Circuits** (2 contact hours; 2 self-study hours) ● Build an operational amplifier using the UA741 chip. **Experiment 7 Testing of Integrated NAND, NOT, OR, and NOR Gates** (2 contact hours; 3 self-study hours) ● Familiarize and test the logical functions of gate circuits, understand the shape and pin arrangement of integrated logic gate circuit chips. Deepen the understanding of the principles of logic gate circuits and master common methods for testing logic circuit functions. **Experiment 8 Design of Combinational Logic Circuits** (2 contact hours; 2 self-study hours) ● Master the method of designing combinational logic circuits with small-scale integrated circuits. Verify the logical functions of the designed circuits with experiments. **Experiment 9 Open Design Experiment** (2 contact hours; 2 self-study hours) Design of circuits such as buzzers and timers.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Homework 15% • In-class test 5% • Experiment 25% • Final Exam 50%.
Reading list	**Required books** [2] 2019. Electrical Engineering (Volume 1 and 2) [M]. Higher Education Press, 2019 **Reference books** [6] Electrical Engineering and Electronic Technology [M].Tsinghua University Press,2022. [7] Basic Circuit Theory[M]. Huelsman L.P. ,2017. [8] Circuit experiment and Multisim simulation design[M]. Mechanical Industry Press,2017. **Other materials** [1] PPT courseware (self-compiled)

3.3 Engineering Mechanics

Competence field	Engineering Fundamentals
Module designation	Engineering Mechanics
Semester(s) in which the module is taught	3th semester
Person responsible for the module	Dr. FENG Ping, Professor
Language	Chinese
Relation to curriculum	This course is an engineering fundamentals course, enabling students to have a solid understanding of the basic concepts, theories, and methods of engineering mechanics. While cultivating rigorous deductive thinking, it particularly emphasizes inspiring and developing students' comprehensive and divergent thinking, as well as their ability to identify similarities and differences through the study of mechanics. In addition to learning theoretical knowledge, the course focuses on developing students' practical skills and their understanding that experiments are one of the important means of scientific research through experimental teaching.
Teaching methods	lecture-based teaching; blended learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 72 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 120 hours Contact hours = 72 hours Self-study hours = 48 hours
Credit points	4.0
Recommended prerequisites	Advanced Mathematics、Engineering Drawing and CAD
Module objectives/intended learning outcomes	**Knowledge:** This course systematically introduces the fundamental concepts and theories of engineering mechanics, including the principles of statics and dynamics. It covers the basic concepts of force, moment, and equilibrium, as well as the application of these principles to rigid bodies and deformable bodies. The course also explores the mechanical properties of materials, the behavior of structures under various loads, and the principles of fluid mechanics. Additionally, it delves into the analysis of stress and strain, the design considerations for strength and stability, and the understanding of fatigue and fracture in engineering applications. **Skills:** Students will be able to: 1) Students can understand and apply the principles of statics to analyze the equilibrium of rigid bodies and deformable bodies. 2) Students can calculate the forces, moments, and reactions in structures using methods such as the method of sections and equilibrium equations. 3) Students can analyze the mechanical properties of materials and understand the behavior of materials under different loading conditions. 4) Students can apply the principles of fluid mechanics to calculate

	pressures and forces exerted by fluids on structures. 5) Students can perform stress and strain analysis for various structural elements, such as beams, shafts, and columns. 6) Students can use the principles of strength and stability to design and analyze structural components for safety and performance. **Competences:** Upon completion of this course, students will have developed: 1) Students acquire practical abilities to solve engineering problems using the principles of mechanics, including the ability to model real-world problems and apply appropriate mechanical theories. 2) Students develop critical thinking and problem-solving skills, enabling them to analyze complex engineering systems and make informed design decisions. 3) Students gain the ability to innovate in engineering design, considering factors such as material properties, structural integrity, and environmental impacts. 4) Students cultivate a rigorous approach to engineering analysis, emphasizing accuracy and precision in calculations and the interpretation of results. 5) Students are equipped with the skills to communicate effectively in an engineering context, both in written and oral forms, to explain their analyses and designs.
Contents	**Part A Theoretical teaching (54 contact hours; 32 self-study hours)** **Chapter 1 Introduction** (4 contact hours; 2 self-study hours) • What is mechanics; what is engineering mechanics; mechanics and engineering; • Research objects, methods, and basic assumptions of engineering mechanics; • Basic concepts and notation of body force, surface force, stress, strain, and displacement, and their positive and negative conventions. **Chapter 2 Basic Concepts and Theories of Rigid Body Statics** (5 contact hours; 3 self-study hours) • Concept of force, projection of force, analytical method of force composition • Concept of couple, composition of couples • Concept of constraints and constraint forces, types of constraints • Force diagrams; moment of force about a point, translation theorem of force, simplification of planar force systems, balance conditions and equilibrium equations; • Two-force equilibrium and three-force intersection theorem. **Chapter 3 Static Balance Problems** (4 contact hours; 3 self-study hours) • Analysis methods for planar force system balance problems, concept of statically indeterminate problems • Node method and section method for internal force analysis of planar trusses • Projection of force on spatial coordinate axes, moment of force about an axis, equilibrium equations of spatial force systems and their solutions. **Chapter 4 Foundation of Deformable Body Statics** (4 contact hours; 2 self-study hours)

	• Research mainline of engineering statics, basic assumptions of deformable solids • Section method for internal forces • Basic deformations of bars; axial tension and compression of bars • Stress and strain at a point • Analysis of statically indeterminate problems in tension and compression of bars • Concept of stress concentration. • **Chapter 5 Mechanical Properties of Materials** (6 contact hours; 3 self-study hours) • Tensile stress-strain curve of low carbon steel, several important performance indicators of materials • Mechanical properties of different materials under tension and compression • Strength indicators for failure of ductile and brittle materials, Poisson's ratio. • **Chapter 6 Strength and Design of Connectors** (4 contact hours; 3 self-study hours) • Strength conditions and safety factors • Strength design of tension and compression members • Shear and its practical calculation • Compression and its practical calculation • Strength design of connectors. **Chapter 7 Fluid Force and Containers** (5 contact hours; 3 self-study hours) • Calculation of fluid force using principles of statics, analysis of strength problems of thin-walled containers. **Chapter 8 Torsion of Cylindrical Shafts** (6 contact hours; 4 self-study hours) • Concept of torsion, torque and torque diagram, stress and deformation of torsion in cylindrical shafts • Polar moment of inertia and torsional section modulus • Stress state at a point in torsion of cylindrical shafts, strength and rigidity conditions, statically indeterminate problems. **Chapter 9 Plane Bending of Beams** (4 contact hours; 2 self-study hours) • Concept of beams • Section method for internal force diagrams of beam • Equilibrium differential equations of beams • Simplified drawing methods for internal force diagrams of beams • Stress and strength conditions of beams • Moment of inertia and bending section modulus • Shear stress in rectangular section beams • Introduction to deformation and rigidity conditions of beams. **Chapter 10 Stress State, Strength Theories, and Combined Deformation** (4 contact hours; 2 self-study hours) • General analysis of plane stress state • Ultimate stress and principal stress • Generalized Hooke's law and strain energy • Introduction to strength theories • Combined deformation of tension (compression) and bending,

	combined deformation of bending and torsion. **Chapter 11 Stability of Columns** (4 contact hours; 3 self-study hours) • Concept of stability • Critical load of slender columns with hinged ends • Critical load of columns under different support conditions • Critical stress of columns with medium and low slenderness • Stability calculation of columns. **Chapter 12 Fatigue and Fracture** (4 contact hours; 2 self-study hours) • Fatigue failure and its fracture characteristics • S-N curve and fatigue crack initiation life • Fracture failure and fracture control design • Fatigue crack propagation life. **Part B Practical teaching (18 contact hours; 16 self-study hours)** • MOOC-Online Study • Material tensile test • Material torsion test • Three-point bending test of a beam
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Homework 28% • Notes 22% • Exp. Report 10% • Final Exam 40%
Reading list	**Required books** [1] Chen Chuanyao, Wang Yuanxun. Engineering Mechanics (2nd Edition) [M]. Higher Education Press, 2018-03-01. **Reference books** [1] Wang Yuanxun, Wu Ying, Yang Xinhua. Exercises of Engineering Mechanics [M]. Higher Education Press, 2021-03-01. [2] Jun Li, Feihong Xu, et al. Experiments of Engineering Mechanics [M]. Southwest Jiaotong University Press, 2018-10-01. **Other materials** [1] PPT courseware (self-compiled)

Module 4 Engineering Applications

4.1 Introduction to Rail Transit

Competence field	Engineering Applications
Module designation	Introduction to Rail Transit
Semester(s) in which the module is taught	3th semester
Person responsible for the module	Dr. LUO Qin, Professor
Language	Chinese
Relation to curriculum	This course is a compulsory for transportation major. It provides students with an overall conceptual understanding of urban rail transit systems, helping them build a foundational knowledge framework for theoretical research and practical applications. This prepares them for a more targeted approach to subsequent specialized courses. Through this course, students are expected to master the overall concept of urban rail transit systems and understand their structural characteristics, the features of each component, and how they interconnect and coordinate. Students will also gain a preliminary understanding of aspects such as urban rail transit line engineering, track structure, vehicles, communication, signaling systems, electric drive, and operational organization, as well as the relationships and functions between these components.
Teaching methods	lecture-based teaching; blended learning; case-based learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching Contact hours: 36 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 60 hours Contact hours = 36 hours Self-study hours = 24 hours
Credit points	2.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	This course aims to provide students with a systematic understanding of the overall urban rail transit system, equipping them with relevant professional theories and practical skills. It seeks to develop students' comprehensive abilities in planning, construction, and operations management while enhancing their professional recognition, social service awareness, and innovative capabilities. Specific objectives include: **Knowledge:** This course comprehensively introduces the fundamental concepts of urban rail transit systems, including the characteristics of core components such as network structure, track types, vehicles, power supply, and communication signals. Students will also learn about safety assurance mechanisms, line planning principles, and track structure knowledge, while gaining insight into the historical background, technological advancements, and future trends of rail transit

	development. Additionally, students will become familiar with key operational elements of rail transit systems, such as transportation planning, passenger management, vehicle scheduling, and the impact of line design on operational efficiency. The course also emphasizes the close relationship between rail transit and urban development, highlighting China's technological breakthroughs, economic contributions, and global leadership in the field. **Skills:** Students will be able to: 1) Analyze urban rail transit network planning and passenger flow forecasting, reasonably assess transportation capacity and line scale, and propose optimization plans. 2) Master the basic design principles and maintenance management methods of systems such as track structure, vehicles, and power supply, with the ability to solve practical operational issues. 3) Become proficient in using transportation modeling tools and data analysis methods to evaluate the safety, efficiency, and service quality of rail transit operations. 4) Learn to develop transportation plans and timetables, scientifically schedule vehicles and personnel, optimize passenger flow organization, and ensure a balance between operational safety and efficiency. **Competences:** Upon completion of this course, students will have developed: 1) Systematic thinking skills to closely integrate rail transit with urban development, comprehensively understanding the full process of rail transit planning, construction, and operations management. 2) Problem analysis and practical engineering problem-solving skills, especially in the interdisciplinary fields of rail transit. 3) Professional ethics and a sense of responsibility, guided by course-based ideological and political education to cultivate a people-centered transportation service philosophy. 4) Innovation practice, independent research, and technical problem-solving capabilities, contributing to the technological advancement of the rail transit industry and serving society effectively.
Contents	**Part A Theoretical teaching** (30 contact hours; 15 self-study hours) **Chapter 1 Knowledge of the Emergence and Development of Rail Transit** (6 contact hours; 2 self-study hours) • Characteristics of rail transit • Mechanisms for ensuring the safe operation of rail transit and analysis of typical operational incidents • Early forms of rail transit • Development history of rail transit • Overview of rail transit development in major cities in the world and China **Chapter 2 Knowledge of Rail Transit Forms** (4 contact hours; 2 self-study hours) • Classification methods for urban rail transit types • Concepts, characteristics, and development of various rail transit types based on technical and economic features **Chapter 3 Knowledge of Rail Transit Network Planning**

	(4 contact hours; 2 self-study hours) • Key principles and content of network planning • Passenger flow forecasting for urban rail transit • Research on network schemes and scale • Evaluation of network schemes **Chapter 4 Urban Rail Transit Line Engineering** (4 contact hours; 3 self-study hours) • Route selection • Horizontal and vertical alignment design • Clearance standards **Chapter 5 Knowledge of Urban Rail Transit Track Structure** (2 contact hours; 1 self-study hour) • Rails • Sleepers • Fastenings • Ballast bed • Turnouts • Track stops **Chapter 6 Knowledge of Urban Rail Transit Power Supply Systems** (2 contact hours; 1 self-study hour) • Electric traction power supply systems • Power and lighting supply systems • Power monitoring systems • Stray current **Chapter 7 Knowledge of Urban Rail Transit Communication and Signaling** (2 contact hours; 1 self-study hour) • Basic concepts and composition of communication systems • Concepts of signaling, block systems, and interlocking • Basic principles of block systems and interlocking • Fully automated driving modes **Chapter 8 Knowledge of Urban Rail Transit Operations Management** (6 contact hours; 3 self-study hours) • Construction modes of urban rail transit • Urban rail transit transportation plans • Basic knowledge of train operation scheduling and command • Passenger transportation management • Key operational indicators **Part B Practical teaching** (6 contact hours; 9 self-study hours) **Project 1 Subway Visit and Practice: Understanding Station Facilities and Equipment** (2 contact hours; 3 self-study hours) • Classification of urban rail transit stations • Layout and structure of urban rail transit stations • Construction of transfer stations • Station electromechanical equipment and management **Project 2 Subway Visit and Practice: Understanding Vehicles and Depot Equipment** (2 contact hours; 3 self-study hours)

	• Basic composition of vehicles • Technical parameters of vehicles • Key elements of depots (vehicle bases) **Project 3 Subway Visit and Practice: Understanding OCC Train Operation and Dispatching** (2 contact hours; 3 self-study hours) • Construction modes of urban rail transit • Urban rail transit transportation plans • Basic knowledge of train operation scheduling and command
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Online learning 20% • Class discussion20% • Exercise report 10% • Final Exam 40%.
Reading list	**Required books** [3] Luo, Q., & Chen J. Introduction to Rail Transit (2nd Edition) [M]. Southwest Jiaotong University Press, 2021. **Reference books** [9] Sun, Z., & Pu, Q. Introduction to Urban Rail Transit [M]. People's Traffic Publishing House, 2010. [10] Luo, Q. Organization and Management of Urban Rail Transit Operations [M]. Southwest Jiaotong University Press, 2017. **Other materials** [1] PPT courseware (self-compiled)

4.2 Transportation Organization

Competence field	Engineering Applications
Module designation	Transportation Organization
Semester(s) in which the module is taught	3th semester
Person responsible for the module	Dr. CHEN Jingjing, Professor
Language	Chinese
Relation to curriculum	This course is a compulsory for transportation major. It aims to provide students with a comprehensive understanding of the fundamental knowledge of transportation organization while cultivating their ability to analyze and solve practical problems in transportation system operations. Focusing on transportation organization, the course introduces rail vehicles from the following perspectives: basic concepts of transportation, transportation markets and regulations, transportation demand and supply, planning and design of transportation products, passenger transportation organization, freight transportation organization, transportation hubs and station operations, transportation production planning and scheduling, multimodal transportation organization, and the development of transportation organization.
Teaching methods	lecture-based teaching; problem-based learning; case-based learning; seminar-based teaching
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 36 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 60 hours Contact hours = 36 hours Self-study hours = 24 hours
Credit points	2.0
Recommended prerequisites	Introduction to Transportation Systems, Introduction to Rail Transit
Module objectives/intended learning outcomes	This course aims to help students comprehensively master the foundational knowledge and practical skills of transportation organization, cultivating their comprehensive abilities in planning, implementing, and optimizing transportation organization to contribute to the development of modern transportation systems. Specific objectives include: **Knowledge:** Students will systematically study the basic concepts of transportation, classification of transportation systems, and organizational forms. They will understand the composition of the transportation market, regulatory policies, and the equilibrium analysis of transportation demand and supply. Through the course, students will master the key aspects of transportation product planning, passenger and freight transportation organization, hub transportation, and combined transportation. Additionally, they will learn the framework of transportation production planning and scheduling management, as well as the fundamental characteristics of modern transportation organization. Students will gain a profound understanding of China's achievements in transportation technology, economic development, and global influence, enhancing their comprehension of the "Transportation Power" strategy through

	specific case studies and establishing a systematic professional knowledge framework. **Skills:** Students will be able to: 1) Proficiently master methods for transportation product planning, conduct balanced analyses of transportation demand and supply, plan passenger and freight transportation organizations, and develop operational schemes for integrated transportation hubs. 2) Design enterprise transportation production plans, optimize transportation scheduling, utilize resources efficiently, and improve system effectiveness. 3) Analyze the forms and trends of combined transportation organizations, assess transportation system performance through statistical data and case studies. 4) Conduct comprehensive analyses of transportation system planning and scheduling processes, laying a solid foundation for innovation and efficiency improvement in transportation services. **Competences:** Upon completion of this course, students will have developed: 1) Comprehensive abilities to solve practical problems in transportation organization, including transportation planning, scheduling optimization, and resource allocation. 2) The ability to integrate transportation organization with regional economies and national development strategies, gaining a deep understanding of the core values of initiatives such as the "Belt and Road." 3) The capacity to apply sustainable development concepts in planning and operations, implementing specific measures for green transportation. 4) Innovation capabilities, enabling them to explore modern transportation organization models, actively participate in industry transformations, and contribute to the development of a "Transportation Power" and societal advancement
Contents	**Theoretical teaching** (36 contact hours; 24 self-study hours) **Chapter 1 Basic Concepts of Transportation** (3 contact hours; 1 self-study hour) • Basic concepts of transportation • Classification of transportation systems • Basic concepts and forms of transportation organization **Chapter 2 Transportation Market and Regulation Knowledge** (4 contact hours; 2 self-study hours) • Basic concepts of the transportation market • Marketing methods in the transportation market • Formulation of transportation policies • Methods of transportation regulation **Chapter 3 Transportation Demand and Supply Knowledge** (4 contact hours; 2 self-study hours) • Basic concepts of transportation demand • Transportation demand curve • Basic concepts of transportation supply • Transportation supply curve

	• Analysis methods for transportation demand and supply equilibrium **Chapter 4 Transportation Product Planning and Design Knowledge** (6 contact hours; 3 self-study hours) • Basic concepts of transportation product planning • Content of transportation product planning • Methods of transportation product planning • Main content and formulation methods of the transportation schedule **Chapter 5 Passenger Transportation Knowledge** (3 contact hours; 2 self-study hours) • Basic concepts and classification of passenger transportation organization • Main content and methods of intercity passenger transportation organization • Main content and methods of urban public transport passenger transportation organization **Chapter 6 Freight Transportation Knowledge** (6 contact hours; 2 self-study hours) • Requirements for freight transportation organization • Rationalization of freight transportation • Organization of freight loading and distribution **Chapter 7 Hub Transportation Knowledge** (5 contact hours; 2 self-study hours) • Concepts of stations and hubs • Principles and methods for the planning and layout of stations and hubs • Operation and transportation organization of port hubs • Operation and transportation organization of railway hubs • Operation and transportation organization of urban public transport hubs **Chapter 8 Production Planning and Scheduling Knowledge** (5 contact hours; 1 self-study hour) • Transportation production planning • Basic concepts, main content, and methods of transportation scheduling • Enterprise transportation production planning • Main content and calculation methods of statistical analysis **Chapter 9 Freight Transportation Knowledge** (5 contact hours; 1 self-study hour) • Basic concepts of combined transportation organization • Concepts and forms of passenger combined transportation • Concepts and forms of freight combined transportation • Concepts and forms of container combined transportation **Chapter 10 Production Planning and Scheduling Knowledge** (5 contact hours; 1 self-study hour) • Basic concepts and main content of modern transportation organization • Relationship and content between transportation and sustainable development

Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 10% • Investigation report 10% • Essay 10% • Final Exam 60%
Reading list	**Required books** [1] Hu, Z.A. Organization of Transportation [M]. Southwest Jiaotong University Press, 2014. **Reference books** [1] Yang, H. Organization of Transportation [M]. China Railway Publishing House, 2004. [2] Shen, Z.Y., et al., editors. Transportation Engineering [M]. People's Traffic Publishing House, 2003. [3] Yang, H., et al., editors. Organization of Railway Transportation [M]. China Railway Publishing House, 2001. [4] Zhang, C., et al., editors. Transportation Hubs and Ports [M]. China Railway Publishing House, 2006. [5] Chen, Z.H., et al., editors. Transportation Organization Technology [M]. People's Traffic Publishing House, 2003. [6] Hu, S.J. Transportation Science [M]. People's Traffic Publishing House, 2001. **Other materials** [1] PPT courseware (self-compiled)

4.3 Principles of Urban Planning

Competence field	Engineering Applications
Module designation	Principles of Urban Planning
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Dr. CHEN Jingjing, Professor Dr. LI Baicheng, Associate Professor
Language	Chinese
Relation to curriculum	This course aligns with the undergraduate program's goal of cultivating students with a comprehensive understanding of urban and regional planning principles, methodologies, and practices. It serves as a core course, integrating theoretical knowledge and practical applications to equip students for advanced studies and professional roles in urban planning. Key content areas directly correspond to program requirements: • **Urbanization and Planning Systems**: Provides essential insights into urbanization processes, planning systems, and the societal value of planning (Chapters 1–4). • **Analytical Methods and Influencing Factors**: Develops students' ability to assess key urban planning factors such as ecology, economy, society, culture, and technology, aligning with interdisciplinary program goals (Chapters 5–9). • **Spatial and Specialized Planning**: Offers foundational knowledge on spatial planning frameworks, including master planning, detailed planning, and specialized planning in transportation, environment, and housing, which are critical for urban planning professionals (Chapters 10–20). • **Planning Implementation**: Covers urban development strategies and management approaches, emphasizing the practical implementation of planning concepts (Chapters 21–22). This course not only builds essential knowledge but also fosters critical thinking, analytical skills, and practical competencies, preparing students for real-world urban planning challenges and advanced coursework in the curriculum.
Teaching methods	lecture-based teaching; case-based learning; blended learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours

	Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	**Knowledge**: 5) Understand the core concepts of urbanization, urban planning systems, and their societal value. 6) Learn the factors influencing urban planning, including ecological, economic, social, cultural, and technological elements. 7) Familiarize with various types of urban spatial and specialized plans and their technical frameworks. **Skills**: 1) Analyze and evaluate the influence of key factors (e.g., environment, economy, population) on urban planning. 2) Develop preliminary frameworks for master plans, detailed plans, and specialized plans. 3) Apply urban planning principles to solve real-world problems effectively. **Competences**: 1) Enhance critical thinking and spatial analysis skills for urban and regional planning. 2) Develop sustainable planning strategies to address urban development challenges. 3) Communicate and collaborate effectively in group discussions, case studies, and presentations.
Contents	**Part A Theoretical teaching** (54 contact hours; 36 self-study hours) **Chapter 1: Urbanization and Urban Development** (2 contact hours; 1 self-study hour) • Concepts of urbanization and urban development • Stages of urbanization and their characteristics **Chapter 2: Evolution of Urban Planning Ideas** (2 contact hours; 1 self-study hour) • Key historical milestones in urban planning • Modern urban planning theories **Chapter 3: Urban and Regional Planning Systems** (2 contact hours; 1 self-study hour) • Planning laws, regulations, and administrative structures in China • Comparative international planning systems **Chapter 4: The Value of Urban Planning** (2 contact hours; 1 self-study hour) • Social, economic, and environmental benefits of urban planning **Chapter 5: Ecology and Environment** (2 contact hours; 1 self-study hour) • Urban ecosystems and environmental challenges • Environmental impact assessments in planning

	Chapter 6: Economy and Industry (2 contact hours; 1 self-study hour) • Economic development and industrial structure analysis • Economic indicators in urban planning **Chapter 7: Population and Society** (2 contact hours; 1 self-study hour) • Demographic trends and social needs in urban planning • Public services and spatial distribution **Chapter 8: History and Culture** (2 contact hours; 1 self-study hour) • Historical and cultural resource preservation • Integrating cultural identity into urban planning **Chapter 9: Technology and Information** (2 contact hours; 2 self-study hours) • Use of GIS, big data, and smart technologies in urban planning • Technological impacts on urban development **Chapter 10: Types and Content of Urban Planning** (2 contact hours; 2 self-study hours) • Functions and categories of urban planning • Content and technical requirements of planning documents **Chapter 11: Land Use Classification and Evaluation** (2 contact hours; 2 self-study hours) • Standards for land use classification • Evaluation of land use suitability **Chapter 12: Regional and Rural Planning** (2 contact hours; 2 self-study hours) • Regional coordination and rural development strategies **Chapter 13: Master Planning** (3 contact hours; 2 self-study hours) Key elements of master plans • Case studies and practical applications **Chapter 14: Regulatory Detailed Planning** (3 contact hours; 2 self-study hours) • Land use control and planning indicators • Spatial layout and functional design **Chapter 15: Urban Transportation and Road Systems** (3 contact hours; 2 self-study hours) • Traffic planning principles and road network design **Chapter 16: Urban Ecology and Environmental Planning** (3 contact hours; 2 self-study hours)

	• Green space systems and sustainable urban development **Chapter 17: Urban Infrastructure Planning** (3 contact hours; 2 self-study hours) • Planning of urban utilities and infrastructure systems **Chapter 18: Housing Area Planning** (3 contact hours; 2 self-study hours) • Residential area classifications and planning strategies **Chapter 19: Urban Design** (3 contact hours; 2 self-study hours) • Public space and urban form design principles **Chapter 20: Urban Heritage Conservation and Revitalization** (3 contact hours; 2 self-study hours) • Strategies for urban heritage protection and renewal **Chapter 21: Urban Development Planning** (3 contact hours; 2 self-study hours) • Urban development models and spatial patterns **Chapter 22: Urban Planning Management** (3 contact hours; 2 self-study hours) • Planning approval, implementation, and monitoring
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3 are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 10%; • Investigation report 10% • Essay 10% • Final Exam 60%.
Reading list	**Primary Textbook:** [1] Principles of Urban Planning, by Wu Zhiqiang and Li Dehua, China Architecture & Building Press, 2010. **Supplementary Resources:** [1] The Death and Life of American Cities, Jane Jacobs, 1961. [2] The Image of the City, Kevin Lynch, 1960.

4.4 Transport Economics

Competence field	Engineering Applications
Module designation	Transport Economics
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Dr. LI Baicheng, Associate Professor
Language	Chinese
Relation to curriculum	This course is compulsory for transportation major, designed to teach students in the field who are interested in transportation planning and management about the basic knowledge of transport economics. The course focuses on demand-supply analysis, equilibrium analysis, firm behaviours, and externality analysis of transport systems from the perspectives of economics. The course covers six aspects of transport economics: 1) demand-supply and market equilibrium of transportation markets, 2) firms and profit-maximization for transport cooperatives, 3) externality, 4) labor economics in transport sectors, 5) theory and practice of road pricing, 6) pricing of road transport serivces.
Teaching methods	lecture-based teaching; problem-based learning; case-based learning; seminar-based teaching
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching Contact hours: 36 hours Size of class: no more than 80 students for theoretical teaching
Workload	Workload = 60 hours Contact hours = 36 hours Self-study hours = 24 hours
Credit points	2.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam.
Recommended prerequisites	Transportation Organization Theory
Module objectives/intended learning outcomes	This course aims to enable students to gradually and progressively understand and master the principles of microeconomics and its application in transportation markets, as well as to become acquainted with common analytical methods for dealing with problems in transport economics. Specific objectives include: **Knowledge:** Students will gain a comprehensive understanding of the fundamentals related to the theory of microeconomics and the development and practice of transportation economics theory, including the theory of road pricing, the analysis of transportation costs and pricing of different modes of transportation, and the theory and practice of the online car market. **Skills:** Students will be able to: 1) have the basic ability to analyze and evaluate transportation policies from an economic perspective. 2) master policy evaluation methods for different decision-making

	objectives. 3) develop the ability to analyze and think about practical problems in urban transportation governance from an economic perspective and develop solutions. **Competences:** Upon completion of this course, students will have developed: 1) to analyze and evaluate transportation policies from an economic perspective. 2) the ability to further study and practice research and topics related to transportation economics.
Contents	**Part A Theoretical teaching** (36 contact hours; 24 self-study hours) **Chapter 1 Introduction to Transport Economics** (1 contact hour; 1 self-study hour) • History of Economics in Transportation • Transport Economics in Reality **Chapter 2 Ten Principles in Microeconomics** (2 contact hours; 1 self-study hour) • Ten important principles and assumptions of microeconomics • The concept of rationality, opportunity cost, and comparative advantage **Chapter 3 Demand, supply, and elasticity** (3 contact hours; 2 self-study hours) • Concept of demand and supply • Supply demand equilibrium analysis and factors affecting it • The concept of elasticity of demand and supply and the factors affecting it **Chapter 4 Social welfare** (3 contact hours; 2 self-study hours) • Concept and calculation of consumer surplus, producer surplus, social surplus • The concept of deadweight losses and how to avoid it **Chapter 5 Marginal cost and marginal revenue** (3 contact hours; 2 self-study hours) • Concepts of marginal costs and marginal revenue • Calculation of marginal costs and marginal revenue **Chapter 6 Competitive market** (3 contact hours; 2 self-study hours) • Concepts and examples of competitive markets • Pricing and calculation in competitive Markets • Calculation of social welfare in competitive markets **Chapter 7 Oligopoly and monopoly markets** (3 contact hours; 2 self-study hours) • The concept of monopoly and examples • Pricing strategies in a monopolistic market • The concept and examples of oligopoly • Pricing strategy in an oligopoly market • Linkage between monopoly and competition **Chapter 8 Public goods and externality** (3 contact hours; 2 self-study hours)

	• The concept of public goods and examples • The concept of externalities and examples • Solutions to externalities and real-world practices **Chapter 9 Consumer choice theory** (3 contact hours; 2 self-study hours) • Concept of road pricing • Concepts and differences between system optimization and user equilibrium • Road pricing in practice **Chapter 10 Road pricing: theory and practice** (3 contact hours; 2 self-study hours) • Concept of road pricing • Concepts and differences between system optimum and user equilibrium • Models of road pricing: aggregate and network modelling approaches • Road pricing in practice **Chapter 11 Public transit subsidization: theory and practice** (3 contact hours; 2 self-study hours) • Subsidization model in public transit • Public transit subsidization in practice **Chapter 12 On-demand ridesourcing market: theory and practice** (3 contact hours; 2 self-study hours) • Models and theories of on-demand ridesourcing markets • Regulation analysis of on-demand ride-sourcing markets **Chapter 13 Cost and pricing of transport** (3 contact hours; 2 self-study hours) • Characteristics of different modes of transportation and passenger flows • Pricing of transportation under different target orientations
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 20% • Essay 10% • Final Exam 60%
Reading list	**Required books** [1] Tang, K. Transport Economics [M]. Beijing Jiaotong University Press, 2019. **Reference books** [1] Jia, S. Transportation Economics [M]. China Communication Press, 2019. [2] Mohring, H. Transportation Economics [M]. Ballinger Press, Cambridge, Massachusetts, 1976. **Other materials**

	[1] PPT courseware (self-compiled)

4.5 Traffic Engineering

Competence field	Engineering Applications
Module designation	Traffic Engineering
Semester(s) in which the module is taught	3rd semester
Person responsible for the module	Dr. LI Baicheng, Associate Professor
Language	Chinese
Relation to curriculum	This course is compulsory for transportation major, designed to teach students in the field who are interested in transportation planning and management about the basic knowledge of traffic engineering, and to cultivate their practical skills. The course focuses on traffic flow theory, traffic management and control methods, fundamentals in traffic planning and design, intersection signaling, and traffic safety. The course covers seven aspects of rail vehicles: 1) traffic flow theory and traffic survey, 2) traffic management and control, 3) intersection signal design and optimization, 4) fundamentals in traffic planning and design, 5) traffic safety.
Teaching methods	lecture-based teaching; case-based learning; blended learning; hands-on labs; cooperative learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36hours
Credit points	3.0
Recommended prerequisites	Advanced Mathematics A1, A2
Module objectives/intended learning outcomes	This course aims to enable students to gradually and progressively understand basic traffic flow theory, traffic management and control methods, fundamentals in traffic planning and design, intersection signaling, and traffic safety, as well as to become acquainted with common methods for traffic survey and intersection signal simulation. Specific objectives include: **Knowledge:** Traffic engineering is the backbone course of the transportation profession, this course is a systematic description of the basic characteristics of the traffic system, traffic investigation, traffic flow theory, road capacity and service level, road traffic planning, road traffic design, road traffic management and control, traffic safety, etc., to reveal the law between people, vehicles, roads, in order to seek the maximum efficiency of travel, the least number of traffic accidents, fastest speed, transportation, transportation, cost saving, minimum environmental impact, minimum energy consumption. The course aims to find the transportation system planning, construction and management plan with maximum travel efficiency, minimum traffic accidents, fastest speed, minimum transportation cost, minimum environmental impact and minimum energy consumption, so as to enable the students to systematically and comprehensively master the basic knowledge, theories, concepts and methods of transportation engineering, and to lay

	a foundation for the students to study and research in-depth on transportation engineering and to engage in the practical work of transportation engineering in the future. **Skills:** Students will be able to: 1) Learn the basic concepts of the traffic system, traffic investigation, traffic flow theory, road capacity and service level, road traffic planning, road traffic design, road traffic management and control, traffic safety, etc., to reveal the law between people, vehicles, roads, in order to seek the maximum efficiency of travel, the least number of traffic accidents, fastest speed, transportation, transportation, cost saving, minimum environmental impact, minimum energy consumption. 2) Find the transportation system planning, construction and management plan with maximum travel efficiency, minimum traffic accidents, fastest speed, minimum transportation cost, minimum environmental impact and minimum energy consumption. 3) Perform simulation of road traffic via the simulation tool VISSIM. **Competences:** Upon completion of this course, students will have developed: 1) Practical abilities and innovative thinking in the field of traffic engineering. 2) The capacity to apply learned knowledge to real-world engineering scenarios, demonstrating competence in the planning and design of traffic systems. 3) An understanding of the trends in the development of roadway traffic system in China.
Contents	**Part A Theoretical teaching** (37 contact hours; 29 self-study hours) **Chapter 1 Introduction to traffic engineering** (2 contact hours; 2 self-study hours) • Definition of transportation engineering; • Scope of study and characteristics of the discipline of traffic engineering • Overview of the emergence and development of the discipline of traffic engineering • The current situation and development trend of traffic engineering in China **Chapter 2 Characteristics of traffic** (3 contact hours; 3 self-study hours) • Basic person-vehicle-roadway characteristics • Traffic volume characteristics • Traffic flow characteristics **Chapter 3 Traffic survey and data collection** (3 contact hours; 3 self-study hours) • Principles and methods of data collection • Traffic volume survey methods and analysis of data • Vehicle speed survey methods and analysis of data • Traffic density survey methods and analysis of data • Traffic delay survey methods and analysis of data • Capacity survey methods and analysis of data **Chapter 4 Traffic theory** (5 contact hours; 4 self-study hours)

	• Basic characteristics of continuous and interrupted flow • Follow-through modeling • Fluid modeling • Probabilistic statistical models • Queueing theory models **Chapter 5 Roadway capacity and level of service** (4 contact hours; 2 self-study hours) • Capacity concepts, basic roadway capacity and level of service • Capacity and level of service at grade crossings • Capacity and level of service of bus transit routes • Bicycle path capacity and level of service • Pedestrian transportation facilities capacity and level of service **Chapter 6 Road transport planning** (4 contact hours; 4 self-study hours) • General design of urban road transportation planning work • Basic information survey in urban road traffic planning • Urban transportation demand development forecast • Urban road network layout planning program design • Comprehensive evaluation of urban road traffic planning scheme **Chapter 7 Traffic design** (4 contact hours; 3 self-study hours) • Concept of traffic design • Basis and basic principles of traffic design • Basic methods of traffic design **Chapter 8 Traffic management and control** (4 contact hours; 3 self-study hours) • Purpose and classification of traffic management on urban roads • Traffic demand management and traffic system management • Road traffic regulations and signs and markings • Plane intersection traffic management methods • Road traffic management methods • Urban road traffic signal control theory and methods • Urban road traffic management planning • **Chapter 9 Traffic safety** (4 contact hours; 3 self-study hours) • Traffic accidents and influencing factors • Traffic safety analysis • Traffic safety management **Chapter 10 Traffic and environment** (4 contact hours; 2 self-study hours) • Environmental impacts of road traffic and their hazard classification • Air pollution, noise pollution, light pollution and vibration pollution, the impact of road traffic on natural ecology **Part B Practical teaching** (17 contact hours; 7 self-study hours) **Project 1 Investigation and Analysis of Urban Road Traffic Flow Characteristics Experiment** (4 contact hours; 2 self-study hours) • Understand the important role of traffic survey in transportation

	management • Master the basic methods and implementation process of road traffic flow survey • Initially have the basic ability to analyze the actual road traffic problems and put forward ideas, approaches or solutions to solve the problem **Project 2 Traffic Data Analysis and Processing Experiment** (7 contact hours; 3 self-study hours) • Data screening and statistical analysis of given traffic data to analyze the basic parameters and characteristics of road traffic flow. **Project 3 Signalized Intersection Traffic Simulation Experiment** (6 contact hours; 2 self-study hours) Using the microsimulation software VISSIM for: • Planar intersection lane mapping • Traffic flow, traffic rules, signal timing settings at planar intersections • Evaluation of signalized intersection level of service, and recommendations for improvement based on simulation findings
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Homework 15% • Presentation 10% • Essay 30% • Final Exam 40%
Reading list	**Required books** [1] Wang, W., Chen, J., Guo, X. Traffic Engineering (3rd Edition) [M]. Southeast University Press, 2019. **Reference books** [1] Ren, F., Liu, X. Traffic Engineering (3rd Edition) [M]. China Communication Press, 2017. [2] Wu, F., Ma, C. Traffic Engineering [M]. China Communication Press, 2014. **Other materials** [1] PPT courseware (self-compiled)

Module 5 Electives

5.1 Introduction to Intelligent Transportation System

Competence field	Electives
Module designation	Introduction to Intelligent Transportation System
Semester(s) in which the module is taught	2th semester
Person responsible for the module	Dr. JIN Meihan, Assistant Professor
Language	English
Relation to curriculum	Intelligent Transportation System (ITS) is top issue in transportation field. It is one of the important courses for undergraduate students majored in transportation. Recent years, with the development of computer science, electronic technologies as well as the development of economy in China, research on ITS keeps booming. The importance of the ITS course keeps escalating. This course will enlighten students with basic concepts of ITS, recent research review of the development of ITS. It can also provide the students with ITS theories and application technologies. Students can benefit from the course by obtaining the wide knowledge about ITS and by improving the abilities in ITS applications.
Teaching methods	lecture-based teaching; case-based learning; blended learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Linear Algebra, Engineering Drawing and CAD
Module objectives/intended learning outcomes	This course aims to enable students to gradually and progressively understand the theory, structures, and technologies of Intelligent Transportation System, as well as the development and future trends of Intelligent Transportation System. Specific objectives include: **Knowledge:** This course will provide a comprehensive and a systematic knowledge of Intelligent Transportation System. The student will learn about 1) fundamentals of ITS, including its definition, purpose, and benefits; 2) overview of ITS architecture and its components; 3) key ITS standards and frameworks; 4) role of advanced technologies in transportation and 5) emerging trends in autonomous and connected vehicles. Students will have deep insight in diverse applications of ITS in traffic management, transportation planning and individual travel service. **Skills:** Students will be able to: 1) Learn methods to consult relevant standards and literature to carry out

	practical projects, deepening their understanding of intelligent transportation system. 2) Develop ITS-based solutions for challenges like congestion, traffic incidents, or inefficient public transport systems. Integrate emerging technologies into existing transportation networks to enhance their performance. 3) Prepare and present technical reports on ITS concepts, project designs, or case studies. **Competences:** Upon completion of this course, students will have developed: 1) System thinking ability: holistically approach transportation challenges by understanding the interplay between technology, infrastructure, and human behavior. 2) Innovation and Adaptability: stay abreast of technological advancements in ITS and adapt to rapidly changing transportation landscapes. 3) Global Perspective: understand ITS applications and challenges across different regions and contexts, preparing for roles in global transportation projects.
Contents	**Theoretical teaching** (54 contact hours; 36 self-study hours) **Chapter 1 Overview of Intelligent Transportation System** (7 contact hours; 4 self-study hours) • Content: Definition and characteristics of ITS, components of ITS, evaluation of ITS, development history of ITS, development trends of ITS, typical comprehensive application cases of ITS at home and abroad. • Objective: Master the concept of intelligent transportation systems, understand the components of intelligent transportation systems, and comprehend the development history and trends of intelligent transportation systems. **Chapter 2 Fundamentals and Technologies of Intelligent Transportation Systems** (6 contact hours; 4 self-study hours) • Content: Basic theories of intelligent transportation systems, including graph theory, systems theory, information theory, control theory, etc., technical system of intelligent transportation systems, including human factors engineering, sensor technology, artificial intelligence, pattern recognition and machine learning technology, communication technology, computing technology, GIS technology, GPS technology, dynamic traffic allocation technology, etc. • Objective: Master the basic theories and technologies related to intelligent transportation systems. **Chapter 3 Automatic Traffic Information Collection Technology** (6 contact hours; 4 self-study hours) • Content: Magnetic field traffic information collection technology, microwave/radar traffic information collection technology, pressure-based traffic information collection technology, video traffic information collection technology, CPS floating car traffic information collection technology, traffic information collection technology in the era of Internet of Things/vehicle networking, traffic sensor networks. • Objective: Understand the necessity of traffic information

	collection, master the working principles and technical characteristics of automatic traffic information collection technology. **Chapter 4 Traffic Database Technology** (7 contact hours; 6 self-study hours) • Content: Characteristics of traffic data, traffic data structure, traffic database design, traffic data warehouse design, data mining technology, GIS-T technology. • Objective: Familiarize with the characteristics of traffic data, understand the design process of traffic databases. **Chapter 5 Urban Traffic Integrated Information Platform** (7 contact hours; 6 self-study hours) • Content: System composition and basic functions of the platform, distributed parallel computing technology, multi-source information fusion technology, intelligent decision support technology, cloud computing and cloud service technology, traffic information platforms in the era of big data. • Objective: Master the system composition and basic functions of the urban traffic integrated information platform, understand the related technologies involved in traffic information collection, management, and dissemination on the platform. **Chapter 6 Intelligent Traffic Control System** (7 contact hours; 4 self-study hours) • Content: Components of intelligent traffic control system, traffic signal control system, video surveillance system, traffic guidance system, red light violation electronic police system, GPS vehicle control system. • Objective: Familiarize with the components of the intelligent traffic control system, focus on understanding the functions and applications of the traffic signal control system, video surveillance system, and traffic guidance system. **Chapter 7 Traveler Information Service System** (7 contact hours; 4 self-study hours) • Content: System composition and functions of traveler information service system, optimal route algorithm, variable message signs, traffic radio, web-based traffic information services, vehicle navigation systems based on static data, dynamic traffic information services in the era of vehicle networking, intelligent parking system. • Objective: Master the composition and functions of the traveler information service system, understand the key technologies of the traveler information service system, and be familiar with its applications. **Chapter 8 Intelligent Public Transportation System** (7 contact hours; 4 self-study hours) • Content: Concept and functions of intelligent public transportation system, electronic card technology, intelligent scheduling methods, intelligent dispatching methods. • Objective: Master the concept and functions of intelligent public transportation systems, understand typical technologies and methods applied in intelligent public transportation systems.
Examination forms	Final Exam

Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • PPT presentation, course report, and homework 30% • Final exam 60%.
Reading list	**Required books** [4] Amit Kumar Tyagi, Niladhuri Sreenath, Intelligent Transportation Systems: Theory and Practice, Springer Singapore, 2022. **Reference books** [11] Xu Jianmin, Editor-in-Chief, "Intelligent Transportation Systems", People's Communications Press, 2014. [12] Yang Zhaosheng, Editor-in-Chief, "Introduction to Intelligent Transportation Systems (Third Edition)", People's Communications Press, 2015. [13] Gao Li, Wu Shaobin, Zhao Yanan, [UK] Park Jinam, Editors, "Intelligent Transportation Systems", Beijing Institute of Technology Press, 2016. [14] Wang Xiaoyuan, Sun Feng, Guo Yongqing, Editors, "Intelligent Transportation Systems", Southwest Jiaotong University Press, 2018. [15] Qu Dayi, Chen Xiufeng, Wei Jinli, Bing Qichun, Editors, "Intelligent Transportation Systems and Their Technological Applications (2nd Edition)", China Machine Press, 2017. **Other materials** [1] PPT courseware (self-compiled)

5.2 Fundamentals and Technology of Sensors

Competence field	Electives
Module designation	Fundamentals and Technology of Sensors
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Dr. YIN Xiaohong, Associate Professor
Language	Chinese
Relation to curriculum	This course is an elective course. It features rigorous theoretical content and strong systematic organization. The objective of this course is to equip students with a foundational understanding of sensors and detection technology through the analysis and design of commonly used sensors, detection technologies, and systems. By completing this course, students will gain basic theories, essential knowledge, and fundamental skills in sensor technology and detection techniques. The course aims to develop students' ability to analyze and solve problems while fostering an understanding of the basic principles, structures, and practical applications of sensors. It lays a solid foundation for students to undertake subsequent coursework and engage in engineering applications related to sensors and detection technologies. The application of sensor and detection technologies will integrate into the professional courses of related disciplines, enabling students to further enhance their practical skills and application capabilities in future learning endeavors.
Teaching methods	lecture-based teaching; cooperative learning; blended learning; hands-on labs; flipped classroom
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours:54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	University Physics, Advanced Mathematics, Electrical and Electronic Technology, Engineering Mechanics
Module objectives/intended learning outcomes	This course aims to equip transportation engineering students with a systematic understanding of sensor technology and its practical applications. Through studying the working principles, structural design, measurement circuits, and typical applications of sensors, students will develop foundational knowledge of non-electrical measurement and error analysis, familiarize themselves with industrial process detection techniques, and gain initial competence in integrating sensor technology with professional practices. The course is designed to provide a solid theoretical and practical foundation for advanced professional coursework and future careers in related fields. Specific objectives include: **Knowledge:** Students will comprehensively understand the basic working principles and structural features of sensors, familiarize themselves with common types of sensors (such as resistive, capacitive, inductive, and piezoelectric sensors) and their functions, and learn the fundamentals of

	measurement circuit design, signal processing, and non-electrical quantity measurement (e.g., pressure, temperature, and flow). Additionally, students will study error processing techniques for sensors, learn the measurement methods for key parameters in industrial detection, and understand the latest developments in sensor technology. **Skills:** Through a combination of theoretical instruction and experimental practice, students will develop the ability to design and debug sensor circuits proficiently. They will also learn to select appropriate sensors and design corresponding measurement schemes tailored to specific application scenarios. The course trains students in data acquisition and error analysis techniques, enhancing their hands-on experimental skills and their capacity to solve practical problems using sensor technology. **Competences:** The course emphasizes the cultivation of systematic thinking and problem-solving skills, enabling students to understand the critical role of sensors in industrial production and scientific research. With their professional background, students will be encouraged to apply sensor technology innovatively. They will also acquire the ability to accurately analyze and process non-electrical measurement data, laying a robust foundation for future roles in intelligent detection, monitoring, and control within the transportation industry.
Contents	**Part A Theoretical teaching** (36 contact hours; 18 self-study hours) **Chapter 1: Principles and Fundamentals of Sensors** (2 contact hours; 2 self-study hours) • Definition of sensors, composition of sensors, and an introduction to sensor classifications. • Methods for improving sensor performance. **Chapter 2: Basic Characteristics of Sensors** (4 contact hours; 2 self-study hours) • Concepts of basic sensor characteristics. • Static characteristics analysis of sensors, including linearity, sensitivity, resolution, hysteresis, repeatability, and drift. • Dynamic characteristics analysis of sensors, including transient response methods and frequency response methods. **Chapter 3: Resistive Sensors** (6 contact hours; 2 self-study hours) • Basic structure and working principle of resistive strain sensors, and the strain effect. • Types of resistive strain gauges, including metallic strain gauges (primarily based on the strain effect) and semiconductor strain gauges (primarily based on the piezoresistive effect). • Temperature errors of resistive strain gauges and their compensation. • Measurement circuits for resistive strain sensors: DC bridge and AC bridge. • Typical applications of resistive sensors.

	Chapter 4: Inductive Sensors (4 contact hours; 2 self-study hours) • Concept and classification of inductive sensors. • Working principle of variable reluctance inductive sensors. • Measurement circuits for inductive sensors (AC bridge, transformer-based AC bridge, and resonant measurement circuits). • Working principle of variable-gap differential transformers. • Measurement circuits and applications of differential transformer-type inductive sensors. • Definition, measurement circuits, and applications of eddy current inductive sensors. **Chapter 5: Capacitive Sensors** (4 contact hours; 2 self-study hours) • Concept and structure of capacitive sensors. • Working principles of capacitive sensors (variable area type, variable dielectric type, and variable gap type). • Measurement circuits for capacitive sensors (frequency modulation circuits, operational amplifiers, transformer-based AC bridge, and pulse width modulation circuits). • Typical applications of capacitive sensors (capacitive pressure, displacement, acceleration, and thickness sensors). **Chapter 6: Piezoelectric Sensors** (5 contact hours; 2 self-study hours) • Piezoelectric effect. • Piezoelectric materials (quartz crystals, piezoelectric ceramics, piezoelectric polymers). • Equivalent circuits and measurement circuits of piezoelectric sensors. • Connection methods for piezoelectric elements. • Typical applications (piezoelectric force and acceleration sensors). **Chapter 7: Magnetic Sensors** (4 contact hours; 2 self-study hours) • Concepts of magnetic sensors and magnetoelectric inductive sensors, along with classifications of magnetoelectric inductive sensors. • Electromagnetic induction. • Basic characteristics of magnetoelectric inductive sensors. • Measurement circuits for magnetoelectric inductive sensors. • Typical applications of magnetoelectric inductive sensors (e.g., magnetoelectric vibration velocity sensors and electromagnetic flowmeters).

	• Hall effect, Hall elements, basic measurement circuits of Hall sensors, and their applications. **Chapter 8: Thermoelectric Sensors** (4 contact hours; 2 self-study hours) • Thermoelectric effect. • Fundamental laws of thermocouples, structure and types of thermocouples, cold junction compensation, and practical temperature measurement circuits. • Applications of thermocouples. • Resistance temperature detectors (RTDs): classification and measurement circuits. • Thermistors: characteristics and applications. **Chapter 9: Radiation and Wave Sensors** (4 contact hours; 2 self-study hours) • Working principles and applications of infrared sensors (e.g., infrared thermometers, infrared gas analyzers). • Working principles and applications of microwave sensors (e.g., microwave level meters, microwave humidity sensors, microwave non-destructive testing devices, and microwave Doppler sensors). • Working principles and applications of ultrasonic sensors (e.g., ultrasonic thickness measurement, ultrasonic level measurement, ultrasonic flow measurement, and ultrasonic flaw detection). **Part B Practical teaching** (18 contact hours; 18 self-study hours) **Project 1: Temperature and Humidity Detection Experiment based on Arduino** (6 contact hours; 6 self-study hours) Design an automatic watering system using Arduino, which monitors soil moisture through a soil moisture sensor and measures indoor temperature and humidity using a temperature and humidity sensor. The system controls the actuator to perform automatic watering based on humidity levels. • Understand the design process of Arduino program development. • Master the functional modules of the Arduino development board. • Learn to use temperature and humidity sensors and relays. • Apply C programming language in practical development. **Project 2: Experiment with a Resistive Strain-Based Weighing Sensor** (6 contact hours; 6 self-study hours) Design a weighing system based on Arduino and a resistive strain sensor, including hardware setup, data acquisition, and data processing. • Observe the structure and composition of the weighing sensor. • Master the working principle, key parameters, basic characteristics, and applications of weighing sensors.

	• Install the weighing platform and connect wiring according to the labels on the weighing sensor. • Learn to acquire sensor data using Arduino and analyze the data. **Project 3: Testing Experiment for Inductive, Capacitive, Hall, Fiber Optic, and Ultrasonic Sensors** (6 contact hours; 6 self-study hours) Familiarize with inductive proximity switches, capacitive proximity switches, Hall switches, fiber optic sensors, and ultrasonic distance sensors. Perform wiring and data acquisition based on the labels provided on each of these sensors.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Homework 15% • In-Class Performance 10% • Experimental report 20% • Final exam 50%.
Reading list	**Required books** [1] Sensors and Detection Technology (4th Edition), edited by Hu Xiangdong et al., published by China Machine Press, 2021. [2] Road Traffic Information Detection Technology and Applications, edited by Li Yinghong, Zhang Yongzhong, Wang Li et al., published by China Machine Press, 2014. **Reference books** [1] Project-Based Tutorial on Sensor and Detection Circuit Design (2nd Edition), edited by Feng Chenglong, published by China Machine Press, 2021. [2] Road Traffic Information Detection and Data Processing Technology, edited by Zhang Huiling and Ao Guchang, published by People's Transportation Press, 2020. **Other materials** [1] PPT courseware (self-compiled)

5.3 Infrastructure and Equipment of Rail Transit

Competence field	Electives
Module designation	Infrastructure and Equipment of Rail Transit
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Dr. LIU Xiaozhou, Associate Professor
Lecturer(s)	Dr. LIU Xiaozhou, Associate Professor Mr. CHI Cheng, Engineer
Language	Chinese
Relation to curriculum	This course is an elective for transportation major, designed to teach the basic knowledge of rail transit facilities and equipment and develops the related practical ability for the future rail transit operation and maintenance direction of the students in this program. The course focuses on urban rail transit equipment, combining the operation and maintenance practice of high-speed railroads, general-purpose railroads and urban rail transit, introducing rail transit line and station equipment, traction power supply system, signaling equipment and passenger equipment, etc. The course explains and introduces the rail transit equipment from six aspects: 1) rail transit lines, 2) rail transit stations, 3) rail transit power supply system, 4) Rail transportation communication and signaling system.
Teaching methods	lecture-based teaching; case-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Introduction to Rail Transit
Module objectives/intended learning outcomes	This course is aim to enable students to understand and master the principles and professional knowledge related to the composition, role, and technical performance of rail transportation facilities and equipment. Specific objectives include: **Knowledge:** This course will provide a comprehensive understanding of the characteristics of railway vehicles, the fundamental concepts of gauge limits, the composition and parameters of urban rail vehicles, the types and functions of various components of bogies, the connections between axle boxes, wheel sets, and frames, as well as the connections between bogies and car bodies. Students will also learn about the structure of car bodies, the structure and working principles of coupler buffer devices, the types and parameters of coupler buffer devices, and the concepts of daily maintenance, periodic maintenance, frame repair, and major overhaul of urban rail vehicles. Additionally, students will gain knowledge on calculating train running smoothness and vibration noise

	levels, and the structure of railway vehicle bogies, applying skills from prerequisite courses to practical engineering applications. The course will also cover the use of traction calculation software for train traction calculations, aiding in the compilation of train operation diagrams. **Skills:** Students will be able to: 1) Learn methods to consult relevant standards and literature to carry out practical projects, deepening their understanding of the connotations of vehicle running smoothness and comfort. 2) Apply theoretical knowledge to practical engineering problems, particularly in the areas of bogie structures and train operation diagrams. 3) Perform calculations related to train running smoothness and vibration noise levels, enhancing their problem-solving skills in vehicle dynamics. **Competences:** Upon completion of this course, students will have developed: 1) Practical abilities and innovative thinking in the field of various railway vehicle systems and engineering technology. 2) The capacity to apply learned knowledge to real-world engineering scenarios, demonstrating competence in the practical aspects of railway vehicle maintenance and operation. 3) An understanding of the trends in the development of railway vehicles in China, the requirements of various types of urban rail transit for vehicles, and the development trends of train formation. 4) The ability to critically evaluate and contribute to the ongoing evolution of railway vehicle design, operation, and maintenance practices.
Contents	**Part A Theoretical teaching** (36 contact hours; 15 self-study hours) **Chapter 1 Introduction to Rail Transit** (6 contact hours; 2 self-study hours) • Development of global rail transit • Development of China's rail transit • Composition of rail transit equipment • Classification and characteristics of rail transit **Chapter 2 Rail Transit Lines** (7 contact hours; 3 self-study hours) • Main components of rail transit lines • Knowledge of subgrade, track structure, switches, alignment and profile of the line, bridges, and tunnel construction **Chapter 3 Rail Transit Traction Power Supply System** (8 contact hours; 3 self-study hours) • Composition and function of the power supply system • Power supply methods and load • Facilities and equipment of the power supply system **Chapter 4 Rail Transit Signaling and Communication System** (8 contact hours; 4 self-study hours) • Working principles of relays, axle counting devices, and beacons • Working principles of traditional signal system outdoor three major components: signals, point machines, and track circuits • 6502 electrical centralized interlocking operation, computer interlocking operation;

	• Principles of train automatic control systems and train traction and braking control • Communication-based train control system (CBTC) • Structural composition of urban rail transit communication system **Chapter 5 Rail Transit Stations and Other Equipment** (7 contact hours; 3 self-study hours) • Functions of stations and characteristics of urban rail transit stations • Classification of stations, composition of stations, types of stations, and concepts related to transfer stations • Vehicle depots and their main equipment, vehicle maintenance processes • Knowledge of rail transit station equipment, environmental control equipment, fire alarm systems, and other equipment systems **Part B Practical teaching** (18 contact hours; 21 self-study hours) **Project 1 Comprehensive Cognition of Rail Transit Equipment** (3 contact hours; 3 self-study hours) • Comprehensive cognition teaching of station facilities, power supply system equipment, signaling equipment, and track lines through a rail system sandbox model, understanding the rail transit facility equipment system, mastering the composition of the rail transit facility equipment system, and comprehending the characteristics of urban rail transit and its requirements for facility equipment; • Demonstration and teaching of rail vehicle routing, switch conversion, signal opening, and route unlocking experiments based on the physical scene of the switch simulation system, realizing the interlocking relationship, operation methods, logical relationships, and triggering forms between switches, signals, and routes for rail communication control cognition. **Project 2 Subway Vehicle Depot Cognition Internship** (3 contact hours; 5 self-study hours) • Subway vehicle depot cognition internship, visiting the operation depot and overhaul depot, understanding the functions of each depot in the vehicle depot; • Visiting the physical key components of the vehicle and their operating modes discussed in the theory class, learning to identify the composition of urban rail vehicles, key components, and mastering their working principles. **Project 3 ZDJ9 Switch Machine System Cognition and Operation Maintenance** (4 contact hours; 5 self-study hours) • Teaching of the physical composition of the ZDJ9 switch machine, working principles, internal structure, and circuit composition; • Explanation of the dynamic working principles of the ZDJ9 switch machine, analysis of the action process; • Connection of the switch machine's electrical circuit, operation, fault setting, fault analysis, and maintenance operations. **Project 4 Basic Operation Practice Based on Integrated Signal Experiment Box** (4 contact hours; 4 self-study hours) • Explanation of the functions, composition, and principles of the rail transit signaling and control embedded integrated experiment box;

	• Typical experiment operation teaching of the rail transit signaling and control embedded integrated experiment box, basic function explanation, and operation. **Project 5 Signal Light and Switch Machine Control Programming Practice Based on Integrated Signal Experiment Box** (4 contact hours; 4 self-study hours) • Basic composition, circuit form, basic experiment teaching, and operation verification of the signal light and switch machine of the integrated experiment box; • Independent control design exploration and verification of the signal light and switch machine experiments of the integrated experiment box.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 8%; • Presentation 8% • Experimental report 24% • Final Exam 50%
Reading list	**Required books** [1] Yan, H. Urban Rail Transit Equipment [M]. Science Press, 2018. **Reference books** [1] Song, B., & Wang, Y. Urban Rail Transit Communication and Signal Control [M]. Beijing Jiaotong University Press, 2015. [2] Guo, J. Railway Signal Fundamentals [M]. China Railway Press, 2010. [3] Guo, J. Railway Signal Basic Equipment [M]. Southwest Jiaotong University Press, 2008. [4] Beijing Urban Construction Design and Research Institute (Ed.). Subway Design Code GB50157-2013 [M]. China Planning Press, 2013. [5] China Railway Press. Railway Technical Management Regulations [M]. 2018. **Other materials** [1] PPT courseware (self-compiled)

5.4 Traffic Information Detection and Processing

Competence field	Electives
Module designation	Traffic Information Detection and Processing
Semester(s) in which the module is taught	5rd semester
Person responsible for the module	Dr. LEI Tian, Associate Professor
Language	Chinese
Relation to curriculum	This course is an elective course for transportation majors, aiming at teaching the basic knowledge of traffic information detection and processing and cultivating the practical ability of students who are interested in the related work in the field of Intelligent Transportation Systems. The main contents of the course include the overview of intelligent transportation system and its information detection needs, traffic information detection technology based on roadside fixed perception, traffic information detection technology based on mobile perception and information detection data preprocessing technology.
Teaching methods	lecture-based teaching; project-based learning; case-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Advanced Mathematics A1, A2
Module objectives/intended learning outcomes	This course is designed to provide students with a systematic understanding of the needs of intelligent transportation systems for information detection and processing, and an understanding and mastery of commonly used traffic information detection and processing methods. Specific objectives include: **Knowledge:** Through the study of this course, the students will have a comprehensive understanding of the relevant methods of traffic information detection. Moreover, they will comprehensively understand and master the basic requirements of intelligent transportation system on information detection, traffic information detection methods based on magnetic frequency, RFID, wave frequency and video technology, traffic information detection technology based on mobile sensing technology as well as the relevant information processing technology and other related knowledge. **Skills:** Students will be able to: 1) Master the relevant principles of different traffic information detection technologies, information acquisition methods and relevant applications in intelligent transportation systems; 2) Use of relevant equipment, techniques and methods for the

	collection and analysis of actual road traffic information. **Competences:** Upon completion of this course, students will have developed: 1) Ability to utilize relevant traffic information detection technology to realize practical work such as traffic information acquisition, traffic data processing and analysis, etc. 2) Qualities for further study of the professional knowledge related to intelligent transportation systems.
Contents	**Part A Theoretical teaching** (36 contact hours; 24 self-study hours) **Chapter 1 Intelligent Transportation System (ITS) Overview** (3 contact hours; 2 self-study hours) • Introduction of ITS; • Traffic information contained in ITS. **Chapter 2 Magnetic Frequency-based Vehicle Detection Technology** (6 contact hours; 4 self-study hours) • Principles of Magnetic Frequency Based Vehicle Detection Technology • Commonly used magnetic frequency-based vehicle detectors • Traffic information detection methods of magnetic frequency-based vehicle detectors and their applications in ITS **Chapter 3 RF-based Vehicle Detection Technology** (6 contact hours; 4 self-study hours) • RFID technology development and RFID system components • RFID working principle, working process and technical characteristics • Applications of RFID in ITS **Chapter 4 Wave Frequency-based Vehicle Detection Technology** (6 contact hours; 4 self-study hours) • Major types of wave frequency-based vehicle detection technology • Operation principles and applications of ultrasonic vehicle detectors • Types, principles, characteristics and applications of microwave vehicle detectors • Working principles, performance and application of infrared vehicle detectors **Chapter 5 Video-based Vehicle Detection Technology** (6 contact hours; 4 self-study hours) • The development of video-based detection technology and the composition of video-based vehicle detection system • Video-based target detection and tracking methods and principles • Installation and application of video-based vehicle detection system **Chapter 6 Mobile Traffic Information Detection Technology** (6 contact hours; 4 self-study hours) • Major types of mobile traffic information collection technology • Basic principle of GPS-based floating vehicle traffic information acquisition technology, the composition and function of GPS-based floating vehicle information acquisition system • Floating vehicle sample selection methods for mobile traffic flow detection system

	Chapter 7 Information detection data preprocessing techniques (3 contact hours; 2 self-study hours) • Methods for defining and identifying erroneous data for traffic detection • Methods of repairing missing data for traffic detection • Traffic speed collection and statistical processing methods **Part B Practical teaching** (12 contact hours; 18 self-study hours) **Project 1 RFID-based high-speed toll collection system simulation experiment** (6 contact hours; 4 self-study hours) • When a vehicle enters the expressway, the RFID reader reads the number of the RFID tag and records the number, and at the same time records the information of the toll station where the vehicle enters; • When the vehicle leaves the expressway, read the RFID tag number and query the corresponding driving into the station information, calculate the charge information and open the gate. **Project 2 Vehicle Counting and Sorting Experiment Based on Ultrasonic Sensors** (6 contact hours; 4 self-study hours) • The ultrasonic wave returns the distance information when the vehicle passes by, through which it can judge whether there is a vehicle; • Since different types of vehicles have different heights, the classification and counting of vehicles can be realized according to the difference of the returned distance information. **Project 3 Video-based motion target detection experiment** (6 contact hours; 4 self-study hours) • Image processing with MATLAB for image reading and writing, image display, image gray scaling, binarization, median filtering, edge extraction operators and detection of moving objects in video
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Homework 20% • In-class test 5% • Experiment report 30% • Final Exam 40%
Reading list	**Required books** [1] Yinghong Li, Yongzhong Zhang, Li Wang. Road Traffic Information Detection Technology and Application [M]. Beijing: Machinery Industry Press, 2014. **Reference books** [1] Zhang Huiling, Ao Guchang. Road Traffic Information Detection and Data Processing Technology [M]. Beijing: People's Transportation Press, 2020.

	[2] Zhang Xiaoting. Road Traffic Information Acquisition and Processing [M]. Beijing: People's Transportation Press, 2016. [3] Wang Bing, Guo Dudu. Transportation Information Technology and Applications [M]. Beijing: Machinery Industry Press, 2016. **Other materials** [1] PPT courseware (self-compiled)

5.5 Railway Vehicle and Operation Control

Competence field	Electives
Module designation	Railway Vehicle and Operation Control
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Dr. LIU Xiaozhou, Associate Professor
Language	Chinese
Relation to curriculum	This course is an elective for transportation major, designed to teach students in the field who are interested in the operation of rail transit about the basic knowledge of rail transit vehicles and their operation control, and to cultivate their practical skills. The course focuses on urban rail transit vehicles, and combines conventional railway and high-speed rail vehicles to introduce the functions, composition, working principles, and technical development directions of rail transit vehicle equipment. The course covers seven aspects of rail vehicles: 1) Overview of rail vehicles, 2) Composition of urban rail vehicles, mainline locomotive vehicles, and high-speed EMU systems, 3) Structure and function of bogies, 4) Car body and interior fittings and equipment, 5) Coupler and buffer devices, 6) Maintenance of rail vehicles, 7) Fundamentals of rail vehicle dynamics.
Teaching methods	lecture-based teaching; case-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Introduction to Rail Transit, Engineering Mechanics, Fundamentals of Transportation Electrotechnics Technology
Module objectives/intended learning outcomes	This course aims to enable students to gradually and progressively understand and master the functions, structures, and principles of rail transit vehicle systems, as well as to become acquainted with common methods for handling equipment failures and the dynamic characteristics of vehicle operation. Specific objectives include: **Knowledge:** This course will provide a comprehensive understanding of the characteristics of railway vehicles, the fundamental concepts of gauge limits, the composition and parameters of urban rail vehicles, the types and functions of various components of bogies, the connections between axle boxes, wheel sets, and frames, as well as the connections between bogies and car bodies. Students will also learn about the structure of car bodies, the structure and working principles of coupler buffer devices, the types and parameters of coupler buffer devices, and the concepts of daily maintenance, periodic maintenance, frame repair, and major overhaul of urban rail vehicles. Additionally, students will gain knowledge on calculating train running smoothness and vibration noise levels, and the structure of railway vehicle bogies, applying skills from

	prerequisite courses to practical engineering applications. The course will also cover the use of traction calculation software for train traction calculations, aiding in the compilation of train operation diagrams. **Skills:** Students will be able to: 1) Learn methods to consult relevant standards and literature to carry out practical projects, deepening their understanding of the connotations of vehicle running smoothness and comfort. 2) Apply theoretical knowledge to practical engineering problems, particularly in the areas of bogie structures and train operation diagrams. 3) Perform calculations related to train running smoothness and vibration noise levels, enhancing their problem-solving skills in vehicle dynamics. **Competences:** Upon completion of this course, students will have developed: 1) Practical abilities and innovative thinking in the field of various railway vehicle systems and engineering technology. 2) The capacity to apply learned knowledge to real-world engineering scenarios, demonstrating competence in the practical aspects of railway vehicle maintenance and operation. 3) An understanding of the trends in the development of railway vehicles in China, the requirements of various types of urban rail transit for vehicles, and the development trends of train formation. 4) The ability to critically evaluate and contribute to the ongoing evolution of railway vehicle design, operation, and maintenance practices.
Contents	**Part A Theoretical teaching** (36 contact hours; 15 self-study hours) **Chapter 1 Overview of Rail Vehicles** (3 contact hours; 1 self-study hour) • Introduction to the development history of rail vehicles • Types, characteristics of locomotives, multiple units, and urban rail vehicles **Chapter 2 Urban Rail Vehicles** (4 contact hours; 2 self-study hours) • Study the characteristics and classification of urban rail transit vehicles • Basic structure and principles of various types of urban rail vehicles such as subways, light rails, linear motor vehicles, trams, monorails, and maglevs **Chapter 3 Basic Knowledge of Rail Vehicles** (4 contact hours; 2 self-study hours) • Study train formation • Study rail transit limits • Rail vehicle bogies • Parameters and composition of rail vehicles • Basic knowledge of typical locomotives, multiple units, and urban rail vehicles **Chapter 4 Bogies** (6 contact hours; 3 self-study hours) • Study the functions, composition, and classification of bogies Introduction to typical subway train bogies

	• Introduction to frames and suspension systems • Introduction to wheel sets and their connection to frames Introduction to the connection between the car body and bogie • Explanation of drive devices **Chapter 5 Car Body, Interiors, and Equipment** (3 contact hours; 2 self-study hours) • Introduction to types and characteristics of car bodies • Introduction to typical rail vehicle car bodies • Introduction to car interior and car body equipment **Chapter 6 Car End Connecting Devices** (6 contact hours; 2 self-study hours) • Study the function, structure, and classification features of coupler buffer devices • Study the installation and working principles of coupler buffer devices • Introduction to typical fully automatic couplers **Chapter 7 Maintenance of Rail Vehicles** (5 contact hours; 2 self-study hours) • Study the maintenance of multiple units • Study the maintenance of urban rail vehicles **Chapter 8 Fundamentals of Rail Vehicle Dynamics** (5 contact hours; 1 self-study hour) • Introduction to the causes and forms of train vibration • Introduction to the content of dynamic studies • Study the evaluation methods related to train running smoothness, stability, and vibration and noise • Study the knowledge related to train curve negotiation **Part B Practical teaching** (18 contact hours; 21 self-study hours) **Project 1 Rail Vehicle Structure and Principle Recognition Experiment** (3 contact hours; 3 self-study hours) • Understanding the structure and working principles of rail transit vehicles' car body, underframe, gangway, bogie, doors, coupler buffer devices, air conditioning units, electrical equipment, and traction braking system through VR devices. **Project 2 Bogie Structure Recognition and Drawing** (5 contact hours; 5 self-study hours) • Drawing the three-dimensional structure and exploded views of the specified or self-selected bogie model. **Project 3 Rail Vehicle Ride Comfort Evaluation Experiment** (3 contact hours; 5 self-study hours) • Introduction to the testing and evaluation methods of vehicle ride comfort, guiding students in conducting on-site tests. **Project 4 Subway Vehicle Section Recognition Internship** (4 contact hours; 5 self-study hours) • Subway vehicle section recognition internship, visiting the operation depot and overhaul depot, understanding the functions of each depot in the vehicle section; visiting the key components of

	the vehicles discussed in theory classes and their operating modes, learning to identify the composition of urban rail vehicles, key components, and mastering their working principles. **Project 5 Train Traction Calculation** (3 contact hours; 3 self-study hours) • Introduction to the significance of traction calculation, explanation of train traction calculation methods, and introduction to traction calculation software and its usage methods.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 8% • Presentation 8% • Experimental report 24% • Final Exam 50%.
Reading list	**Required books** [1] Meng, Y. Rail Vehicle Structure and Principle [M]. Tsinghua University Press, 2019. **Reference books** [1] Lyu, G. Urban Rail Transit Vehicle Introduction [M]. Beijing Jiaotong University Press, 2019. [2] Yang, J., & Zhang, Y. Urban Rail Transit Vehicle Engineering [M]. China Railway Press, 2015. [3] Yue, J. Rail Vehicle Detection Technology [M]. Science Press, 2016. [4] Xu, C., Zhang, Z., & Jiang, Y. New Technologies in Rail Transit Vehicles [M]. Southwest Jiaotong University Press, 2019. [5] Liu, Y. Urban Rail Vehicles [M]. Science Press, 2016. **Other materials** [1] PPT courseware (self-compiled)

5.6 Road Traffic Design

Competence field	Electives
Module designation	Road Traffic Design
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Dr. GONG Lei, Associate Professor
Language	Chinese
Relation to curriculum	This course is a professional elective course to introduce the basic theory and basic skills of urban road traffic design. Through the study of the course, students master the basic theoretical knowledge of urban road traffic design, know how to consult the relevant urban road design specifications, urban road design atlas and other information, and can use the knowledge for urban road design and traffic facilities design. The course mainly introduces road traffic design from the following eight aspects: 1) basic concepts and contents of traffic design; 2) investigation and analysis for traffic design; 3) spatial and temporal technical characteristics of planar intersections; 4) traffic design of planar intersections; 5) unsignalized intersections and special intersections design; 6) intersection traffic signs and marking design; 7) traffic design of road sections; 8) bus priority Traffic design.
Teaching methods	lecture-based teaching; case-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 50 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36hours
Credit points	3.0
Recommended prerequisites	Introduction to Transportation Engineering，Introduction to Railway Transportation, Intelligent Transport Engineering
Module objectives/intended learning outcomes	The course “Road Traffic Design” aims to train students to master the basic theories and methods of planning, designing and managing road traffic systems. Through the study of this course, students will be able to understand the basic characteristics of traffic flow, master the geometric design of road sections and intersections, the design of traffic control facilities, the design of public transport priority and organization strategies, as well as traffic safety analysis. The aim of the course is to enable students to apply their knowledge comprehensively to solve problems in actual road traffic design, improve road use efficiency, ensure traffic safety, and promote sustainable transportation development. Specific objectives include: **Knowledge:** This course will provide a comprehensive introduction to the basic concepts and content of traffic design, traffic design-oriented investigation and analysis, spatial and temporal technical characteristics of planar intersections, traffic design of planar intersections, unsignalized intersections and special intersection design, intersection traffic sign and marking design, roadway traffic design, and transit priority traffic design. In addition, students will select an actual

	operating intersection or roadway section within the city and carry out hands-on activities in the whole process from the design of the survey program, the implementation of the survey program, the identification and analysis of the current situation problems, and the design of the traffic improvement program. **Skills:** Students will be able to: ● Learn the method of reviewing relevant standards and literature, carry out practical projects, and deepen the understanding of the connotation of the design of intersections, road sections and other transportation facilities. ● Apply theoretical knowledge to practical engineering problems, especially in the fields of intersection design and road section traffic design. ● Skills in designing, organizing and implementing traffic survey programs for intersections and road sections, and being able to identify traffic problems and develop solutions based on the results of traffic surveys. **Competences:** Upon completion of this course, students will have developed: ● The process and content points of traffic design for new and reconstructed intersections, roadway segments and other roadway facilities. ● The ability to apply the knowledge gained to real-world engineering scenarios, demonstrating competence in intersection traffic design, roadway segment traffic design, and transit priority traffic design. ● Ability to design, organize and implement traffic investigation programs for urban road intersections, road sections, transportation hubs and other transportation facilities. ● Ability to analyze and develop solutions to traffic problems of urban road intersections, road sections, transportation hubs and other transportation facilities.
Contents	**Part A Theoretical teaching** (27 contact hours; 24 self-study hours) **Chapter 1 Concept and General Contents of Traffic Design** (1 contact hour; 1 self-study hour) • Basic concepts of transportation design; • Functional orientation of transportation design; • Objects of traffic design; • Content of traffic design. **Chapter 2 Traffic Survey for Traffic Design** (1 contact hour; 1 self-study hour) • Static information survey; • Dynamic information survey; • Analysis and evaluation of the current situation. **Chapter 3 Basis and Rationale of Traffic Design** (2 contact hours; 2 self-study hours) • The main basis for the process of carrying out traffic design work; • The basic principles of traffic design. **Chapter 4 Traffic Design for Planar Intersections** (15 contact hours; 12 self-study hours)

	• Spatiotemporal characterization and design points for signal-controlled planar intersections; • Optimal design of planar intersection space-motorized vehicle lanes; • Optimized design of planar intersection space-non-motorized lane; • Spatial optimization design of planar intersection-pedestrian crossing; • Optimization of intersection space - drainage design. **Chapter 5 Traffic Design for Unsignalized Intersections and Special Intersections** (2 contact hours; 2 self-study hours) • Traffic design for Unsignalized Intersections • Traffic design for Special Intersections **Chapter 6 Traffic Design Case Studies for Level Intersections** (2 contact hours; 2 self-study hours) • Diagnosis and analysis of existing problems; • Improvement objectives and improvement countermeasures development; • Program design; • Program evaluation. **Chapter 7 Intersection Traffic Sign Marking Design** (1 contact hour; 1 self-study hour) • Traffic signs commonly used at intersections; • Traffic markings commonly used at intersections. **Chapter 8 Roadway traffic design (expressways, arterial)** (1 contact hour; 1 self-study hour) • Traffic design of expressways • Traffic design of arterial **Chapter 9 Traffic Design of Prioritized Public Transit** (1 contact hour; 2 self-study hours) • Design of bus lanes on road sections; • Bus-only lane design at intersection entrance and exit lanes; • Signal strategy for bus priority. **Part B Practical teaching** (27 contact hours; 12 self-study hours) **Project 1 CAD Application in Drawing Intersection** (6 contact hours; 2 self-study hours) • The basic process of CAD drafting in the field of road traffic; • The basic specification of CAD drawing in the field of road traffic; • The common commands of CAD drawing in the field of road traffic. **Project 2 Intersection Mapping** (3 contact hours; 1 self-study hour) • Basic elements of an intersection treadmill; • Work program development for the intersection treadmill; • The division of labor and coordination plan of the intersection survey; • Organization of intersection survey results. **Project 3 Development of traffic Survey Proposal** (3 contact hours; 2 self-study hours)

	• Intersection treadmill survey results compilation; • Intersection traffic survey program development. • Report on the intersection survey and traffic survey program. **Project 4 Traffic Survey Implementation** (3 contact hours; 2 self-study hours) • Implement traffic surveys at intersections in accordance with the Traffic Survey Program; • Conduct speed and saturation flow rate surveys at intersections (recommended).. **Project 5 Transportation Survey Results Collation** (3 contact hours;1 self-study hour) • Identify the results of the intersection survey; • Identify problems with the current state of the intersection and sort out preliminary ideas for solutions. **Project 6 Presentation on Intersection Improvement** (3 contact hours; 2 self-study hours) • Refinement of the first draft of the Improvement Program Report and further development of the final Improvement Program Report • Intersection Improvement Program Report **Project 7 Simulation of the Intersection with Vissim** (6 contact hours; 2 self-study hours) • Familiarize yourself with the basic operation of Vissim traffic simulation software; • Completion of current state reproduction of traffic survey intersections using Vissim. • Simulation of improvement schemes for traffic survey intersections using Vissim.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Homework 10% • Presentations 15% • Reports 20% • Final exam 50%
Reading list	**Required books** [1] Qiaojun Xiang. Road Traffic Design [M]. China Communication Press, 2022. **Reference books** [1] Hao Yue, Xu Zhang. Urban Traffic Design [M]. Beijing Jiaotong University Press, 2023. [2] Jing Shi. Planning, Design and Operation of Urban Road Design[M]. China Communication Press, 2023. **Other materials**

	[1] PPT courseware (self-compiled)

5.7 Operation Organization and Management of Rail Transit

Competence field	Electives
Module designation	Operation Organization and Management of Rail Transit
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Dr. HUANG Junsheng , Lecturer
Language	Chinese
Relation to curriculum	This course is an elective course for students in this major who intend to pursue a career in rail transit operations. It provides foundational knowledge in operations organization and management, while developing relevant practical skills. Focusing on urban rail transit, the course introduces and explains operations organization and management across nine areas: 1) Overview of Urban Rail Transit Operation Systems, 2) Passenger Flow in Rail Transit, 3) Planning and Scheduling of Metro Train Operations, 4) Overview of Transport Capacity and Line Throughput, 5) Train Turnaround Capacity and Capacity Enhancement, 6) Station Passenger Service Management, 7) Station Passenger Flow Organization, 8) Crew Management, and 9) Ticketing Management.
Teaching methods	lecture-based teaching; case-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Introduction to Rail Transit, Transportation Organization Theory
Module objectives/intended learning outcomes	The course aims to cultivate students' ability to analyze and solve practical problems in urban rail transit system operations, as well as to prepare them for practical work in train operation planning, operations scheduling, and organizational tasks. It enables students to master the basic theories and skills required for transportation organization in rail transit, equipping them with the foundational abilities for engaging in rail transit transportation work and research. Specific objectives include: **Knowledge:** Master the basic classification, system composition, and operation management knowledge of urban rail transit. Understand key concepts and calculation methods in passenger flow management, transport capacity, and train operation planning, including temporal and spatial

	distribution characteristics of passenger flow and capacity calculations for various systems. Be familiar with the basic components, operational models, and technical formats of ticketing systems and crew management. Grasp the current situation and future planning of urban rail transit development in China, laying a theoretical foundation for analyzing and solving practical issues. **Skills:** Students will be able to: 1) Master the analysis methods of temporal and spatial distribution of passenger flow. 2) Develop the ability to plan urban rail train schedules and all-day operation schedules. 3) Proficiently apply calculation methods to analyze line capacity and turnaround capacity. 4) Familiarize with crew and ticketing management compilation and statistical methods. 5) Conduct data-based passenger flow analysis and forecasting. **Competences:** Upon completion of this course, students will have developed: 1) Possess the ability to systematically analyze and plan urban rail transit passenger flow. 2) Enhance the ability to coordinate and optimize urban rail train operations. 3) Strengthen adaptability analysis capabilities for urban rail transport capacity issues. 4) Improve comprehensive management skills in ticketing systems and crew scheduling.
Contents	**Part A Theoretical teaching** (36 contact hours; 15 self-study hours) **Chapter 1 Overview of Urban Rail Transit Operation Systems** (3 contact hours; 1 self-study hour) • Content covered in the "Urban Rail Transit Operation Organization and Management" course. • The significance and purpose of studying this course. • Classification of urban rail transit. • Composition of the urban rail transit system. **Chapter 2 Passenger Flow in Rail Transit** (4 contact hours; 2 self-study hours) • The concept and classification of passenger flow. • Factors influencing passenger flow. • Passenger flow forecasting. • Passenger flow surveys and statistical indicators. • Passenger flow indicators for urban rail transit networks. **Chapter 3 Planning and Scheduling of Metro Train Operations** (4 contact hours; 2 self-study hours) • Calculation methods for urban rail transit passenger flow planning. • Preparation of the all-day train operation schedule for urban rail transit. • Calculation methods for the number of trains in operation. **Chapter 4 Overview of Transport Capacity and Line Throughput** (6 contact hours; 2 self-study hours)

	• Principles of line throughput capacity calculation. • The relationship between transport capacity and throughput capacity. **Chapter 5 Train Turnaround Capacity and Capacity Enhancement** (3 contact hours; 2 self-study hours) • Calculation principles and methods for train turnaround capacity. • The difference between turnaround departure interval time and turnaround station dwell time. • Principles and methods for calculating the usable line throughput capacity for trains. • Analysis methods for assessing the adaptability of transport capacity to demand. • Measures to enhance transport capacity. **Chapter 6 Station Passenger Service Management** (6 contact hours; 2 self-study hours) • Basic requirements for train operation tasks. • Basic organizational methods for train dispatching, train reception, and turnaround operations. **Chapter 7 Station Passenger Flow Organization** (5 contact hours; 2 self-study hours) • Methods and principles for organizing large passenger flows. • Evaluation methods for passenger service quality. **Chapter 8 Crew Management** (3 contact hours; 1 self-study hour) • Types and scheduling of crew. • Preparation of crew scheduling plans. • Statistics of crew performance indicators. **Chapter 9 Ticketing Management** (2 contact hours; 1 self-study hour) • Overview, technical standards, components, and functions of the Automatic Fare Collection (AFC) system, and related operational models. • Management of urban rail transit tickets. • Ticketing systems and fare structures for urban rail transit. **Part B Practical teaching** (18 contact hours; 21 self-study hours) **Project 1 Analysis and Calculation of Passenger Flow Data** (3 contact hours; 3 self-study hours) • This experiment focuses on the verification and analysis of metro passenger flow data. Students are tasked with collecting, processing, and analyzing passenger flow data to understand the temporal and spatial distribution of passengers in urban rail systems. By working through this exercise, students will develop skills in data processing and the application of statistical methods to real-world scenarios, enabling them to assess and predict passenger flow trends accurately. This experiment is essential for students aiming to understand the factors influencing passenger volume and improve their capacity for data-driven decision-making in urban rail transit operations. **Project 2 Development and Scheduling of Train Operation Plans** (5 contact hours; 5 self-study hours)

	• In this design-based experiment, students are responsible for creating a comprehensive train operation plan for the metro system. This includes calculating passenger flow, determining train frequency, and scheduling trains to meet demand throughout the day. The experiment emphasizes the importance of balancing train frequency with operational constraints and passenger needs. Students will practice using analytical tools and models to optimize scheduling and enhance the efficiency of train operations, equipping them with the skills necessary to manage train scheduling in real urban transit settings. **Project 3 Drawing and Transformation of Train Timetables** (3 contact hours; 5 self-study hours) • This experiment involves the design and transformation of train timetables, focusing on aligning schedule data with operational requirements in a metro context. Students will learn to draw accurate timetables, adjust train departure and arrival times, and consider factors like track capacity and passenger demand. This experiment is essential for students to gain experience with timetable optimization and the tools needed to improve train operations on complex rail networks. By the end of this project, students will be better prepared to handle the logistical challenges of train scheduling. **Project 4 ATS (Automatic Train Supervision) Dispatch Experiment** (4 contact hours; 5 self-study hours) • This comprehensive experiment immerses students in the use of Automatic Train Supervision (ATS) systems for metro dispatching. Students will simulate real-time dispatching scenarios, adjusting train schedules to respond to delays, increased passenger flow, or operational disruptions. This practical exercise is designed to improve students' ability to make rapid, effective decisions in dynamic metro environments. By mastering the principles of ATS, students will be able to maintain punctuality and reliability in metro services, essential for smooth urban rail transit operations. **Project 5 Simulation of Station Passenger Flow Organization** (3 contact hours; 3 self-study hours) • In this simulation-based experiment, students explore methods for organizing and managing passenger flow within metro stations. They will use software tools to simulate various scenarios, such as peak hour congestion, and test strategies for optimizing passenger movement. This experiment allows students to apply theoretical knowledge of passenger flow dynamics to practical situations, enabling them to assess and improve station design and passenger management strategies. This hands-on practice is critical for students aiming to improve passenger experience and safety in high-demand urban transit stations.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Regular grades 50%: including attendance, classroom questions, as well as homework, course design, lab reports, etc

	• Final exam 60%
Reading list	**Required books** [1] Luo, Q. Urban Rail Transit Operation Organization and Management [M]. Southwest Jiaotong University Press, 2017. **Reference books** [1] Peng, Q., Wang, C. Railway Operation Organization [M]. China Railway Publishing Press, 2017. [2] Peng, Q., Wen, C. Fundamentals of High-Speed Railway Transportation Organization [M]. Southwest Jiaotong University Press, 2014. **Other materials** [1] PPT courseware (self-compiled)

5.8 Traffic Planning

Competence field	Electives
Module designation	Traffic Planning
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Dr. ZHANG Xiongfei, Associate Professor
Language	Chinese
Relation to curriculum	This course is an elective for transportation major, designed to systematically teach students in this major, who are interested in the direction of traffic planning and management, the basic concepts and related theories of urban rail transit system planning, and to cultivate their practical abilities. The main content of this course includes the basics of urban rail transit demand analysis, traffic survey methods, traffic demand forecasting methods, urban rail transit passenger flow forecasting methods, urban rail transit network planning scheme design and evaluation methods, and the application of traffic planning software in urban rail transit planning.
Teaching methods	lecture-based teaching; project-based learning; case-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Traffic Engineering
Module objectives/intended learning outcomes	This course aims to cultivate students' comprehensive understanding and mastery of the basic theories and methods of urban rail transit planning, and to equip them with the basic abilities and qualities to engage in the planning and design of urban rail transit systems. Specific objectives include: **Knowledge:** 1) Understand the development status of urban rail transit domestically and internationally, as well as the construction procedures of China's urban rail transit systems. Comprehend the functions of urban rail transit and its role in solving urban transportation problems. 2) Be acquainted with the workflow and content of transportation planning. Grasp the relationship between land use and transportation demand, as well as the principles of traffic zone division. 3) Master the methods of traffic surveys. Understand the principles and model calculations of the four-stage demand forecasting method (including trip generation, trip distribution, mode split, and trip assignment). 4) Grasp the content of rail transit passenger flow forecasting and be familiar with the methods of rail transit passenger flow forecasting. 5) Master the calculation methods for the reasonable scale of rail transit networks and the characteristics of different rail transit network

	configurations. Be familiar with the methods of forming network configuration schemes. 6) Master the comprehensive evaluation methods for urban rail transit network planning schemes. **Skills:** Students will be able to: 1) Learn traffic planning data collection methods and possess the ability to conduct travel data surveys and analyze and process data. 2) Master the principles and application methods of TransCAD software, and learn to correctly draw road networks, import road network data, use model calculations, and perform network data analysis. 3) Initially possess the ability and quality for traffic demand analysis, traffic planning scheme design, optimization, and decision-making. **Competences:** Upon completion of this course, students will have developed: 1) The basic ability to engage in the planning and design of urban rail transit systems, and to comprehensively understand and master the basic theories and methods of urban rail transit planning. 2) Critical thinking and problem-solving abilities to identify transportation issues in the development of urban rail transit and propose effective solutions. 3) A certain level of innovation and research ability, fostering a sense of innovation and encouraging new ideas in traffic planning and design.
Contents	**Part A Theoretical teaching** (36 contact hours; 18 self-study hours) **Chapter 1 Introduction** (2 contact hour; 0 self-study hour) • Urban traffic issues and urban rail transit • Development of urban rail transit • Functions of urban rail transit • Construction procedures for urban rail transit systems in China **Chapter 2 Fundamentals of Urban Rail Transit Demand Analysis** (2 contact hour; 1 self-study hour) • Overview • Urban rail transit planning methods • Land use and urban rail transit demand • Methods for urban rail transit demand analysis **Chapter 3 Traffic Survey** (2 contact hours;1 self-study hour) • Overview of traffic survey • OD survey • Road traffic flow characteristic survey • Public transit passenger survey • Rail transit passenger survey • Parking survey **Chapter 4 Traffic Generation** (4 contact hours; 2 self-study hours) • Overview of traffic generation

	• Factors affecting traffic generation forecasting • Methods for traffic generation forecasting **Chapter 5 Traffic Distribution** (4 contact hours; 4 self-study hours) • Overview of traffic distribution • Growth factor method • Gravity model method • Other forecasting models **Chapter 6 Mode Split** (4 contact hours; 2 self-study hours) • Overview of mode split • Factors influencing mode choice • Classification of mode split forecasting methods • Introduction to practical models **Chapter 7 Traffic Assignment** (6 contact hours; 4 self-study hours) • Overview of traffic assignment • Foundations of traffic assignment • Unbalanced assignment methods • Balanced assignment methods • Extended assignment models **Chapter 8 Urban Rail Transit Passenger Forecasting** (2 contact hours; 1 self-study hour) • Overview of rail transit passenger forecasting • Characteristics of rail transit passenger forecasting work • Methods for rail transit passenger forecasting • Passenger assignment in rail transit • Indicators and analysis for rail transit passenger forecasting • Accuracy analysis for rail transit passenger forecasting **Chapter 9 Urban Rail Transit Network Planning Scheme Design** (4 contact hours; 1 self-study hour) • Overview of urban rail transit network planning • Scheme design methods for urban rail transit network planning • Research on the rational scale of the network • Research on the network framework **Chapter 10 Evaluation of Urban Rail Transit Network Planning Schemes** (4 contact hours; 1 self-study hour) • Overview of evaluation for urban rail transit network planning schemes • Workflow for scheme evaluation • Content analysis for scheme evaluation • Comprehensive evaluation methods • Comprehensive review of candidate schemes **Chapter 11 Traffic Planning Software** (2 contact hour; 1 self-study hour) • Introduction to traffic planning software • Basics of TransCAD

	• Traffic data processing and analysis • Application of TransCAD in traffic planning **Part B Practical teaching** (18 contact hours; 18 self-study hours) **Project 1 TransCAD Road Network Modeling Experiment** (6 contact hours; 6 self-study hours) Master the basic operations of TransCAD road network modeling and complete the following experimental tasks: • Build a small road network (including at least 10 road segments), input current road data such as lane numbers, speed, capacity, and traffic volume (not exceeding capacity); • Based on the road network model, modify map styles, set annotations; generate road capacity maps, traffic volume maps, etc.; • Divide traffic zones, generate a traffic zone division map (including at least 5 traffic zones), and generate centroids and centroid connectors; • Determine population, per capita income, car ownership, and other data for each zone, and establish OD demand, creating an OD demand data table; • Draw color thematic maps, point density thematic maps, and expected line graphs based on traffic zone data. **Project 2 TransCAD Comprehensive Experiment** (12 contact hours; 12 self-study hours) Based on known data and materials, carry out: • Analysis of current traffic conditions • Prediction of traffic generation • Prediction of traffic distribution • Prediction of mode split • Prediction of traffic assignment • Analysis of the forecast results
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Homework 12% • Experiment report 8% • Curriculum design 15% • Final Exam 60%.
Reading list	**Required books** [1] Xiongfei Zhang. Urban Rail Transit Demand Analysis and Network Planning[M]. Southwest Jiaotong University Press, 2020. **Reference books** [1] Baohua Mao. Urban Rail Transit Planning and Design (Second Edition)[M]. People's Communications Press, 2011. [2] Chunfu Shao. Principles of Transportation Planning (2nd Edition) [M]. China Railway Press, 2014. [3] Huapu Lu, Huangjun Huang[M]. Frontiers in Transportation Planning Theory Research[M]. Tsinghua University Press, 2007.

	Other materials [1] PPT courseware (self-compiled)

5.9 Rail Transit Train Operation Organization

Competence field	Electives
Module designation	Rail Transit Train Operation Organization
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Dr. LI Wei, Associate Professor
Language	Chinese
Relation to curriculum	This course is an elective designed for students in the transportation major who are interested in pursuing careers in traffic planning and management. It provides foundational knowledge related to rail transit operation organization and develops relevant practical skills. The course focuses on helping students understand the basic concepts, principles, and methods of rail transit operation organization. It covers five key aspects of rail transit operation organization: 1) Station work organization, 2) Freight train formation planning, 3) Train schedules and railway capacity, 4) Railway hub stations work organization, and 5) Railway production planning and transportation scheduling.
Teaching methods	lecture-based teaching; project-based learning; case-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours =54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	This course aims to enable students to study how to fully utilize the capacity of transportation equipment, apply scientific organizational methods, and maximize the fulfillment of customer requirements, ensuring that rail transit transportation tasks are completed safely, swiftly, economically, conveniently, and environmentally. Specific objectives include: **Knowledge:** This course will cover station work organization, freight train composition planning, train operation schedules, railway capacity, technical plans, transportation schemes, and transport dispatch work. It aims to cultivate students' ability to effectively solve complex railway transportation engineering problems, enabling them to master the basic theories and skills of rail transit transportation organization. Students will gain the foundational abilities required for engaging in rail transit transportation work and research. **Skills:** Students will be able to: 1) Understand station work organization, freight train composition planning, and train operation schedules, applying these concepts to solve complex transportation problems.

	2) Learn to plan and organize railway transport, including managing freight, passenger trains, and railway station operations. 3) Apply theoretical knowledge to design and implement train operation schedules and optimize railway capacity. **Competences:** Upon completion of this course, students will have developed: 1) Practical abilities in organizing and managing railway transport systems, particularly in station work, freight train composition, and train operation scheduling. 2) The capacity to handle complex railway transport scenarios, contributing to the effective and efficient operation of rail networks. 3) A deep understanding of railway production planning, including the preparation of transport and technical plans, and how to apply this knowledge to real-world railway operations. 4) The ability to critically assess and design solutions for railway production planning and operations, enhancing the overall efficiency of rail transport systems.
Contents	**Part A Theoretical teaching** (27 contact hours; 24 self-study hours) **Chapter 1: Station Work Organization** (5 Contact Hours; 4 Self-Study Hours) • Introduction to the concept and functions of stations, station classification, and train types. • Overview of shunting work, including its significance, basic factors, time standards, and shunting operations such as line shunting and hump shunting. • Train reception and dispatch operations at intermediate stations, including the technical operations of train uncoupling and coupling at these stations. • Work organization at technical stations, including their production activities and technical operations. **Chapter 2: Freight Train Marshalling Plan** (5 contact hours; 4 self-study hours) • Introduction to the freight train marshalling process and time calculation. • Study of car delivery and pickup operations, including issues such as car frequency and the sequence of delivery on radiating tracks. • Overview of station work plans, scheduling, and statistical analysis. • Detailed understanding of freight train marshalling plans, including concepts like train flow organization, marshalling plan formulation, and path selection. • Introduction to the compilation of direct freight train plans and technical station marshalling plans. **Chapter 3: Train Operating Diagram and Railway Capacity** (5 contact hours; 4 self-study hours) • Understanding the significance of train operation diagrams and their elements, such as station intervals. • Introduction to railway section capacity and the basic principles for calculating capacity in parallel and non-parallel operating diagrams. • Study of section management organization, including work volume and freight train scheduling schemes. • Mastery of train operation diagram formulation methods for both passenger and freight trains.

	Chapter 4: Travel Behavior Analysis, Modeling, and Simulation (6 contact hours; 6 self-study hours) • Introduction to the division of work within railway hubs, including tasks like car flow modification, technical work for transit trains, and freight operations. • Overview of train flow and operation organization within hubs. **Chapter 5: Agent-Based Modeling and Simulation** (6 contact hours; 6 self-study hours) • Overview of railway transport freight plans and their formulation. • Study of the technical aspects of transport production plans, including locomotive and freight car operation indices. • Introduction to decentralized self-regulation scheduling systems (CTC), including system structure, functions, and operation principles. **Part B Practical Teaching** (27 contact Hours; 12 self-Study Hours) **Project 1 Station Work Organization and Train Operation Diagram Design** (27 contact hours; 12 self-study hours) • Use CAD tools to draw a bidirectional longitudinal marshalling yard station layout. • Draw a hump yard layout. • Draw a hump shunting operation plan. • Draw a station technical operation table. • Use the table analysis method to compile a technical station train marshalling plan. • Draw a train operation diagram. • Convert a train operation diagram. • Compile a railway transport production plan.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 10% • Presentation 10% • Experiment 30% • Final Exam 40%
Reading list	**Required books** [1] Peng, Q., & Wang, C. (Eds.). (2015). Railway train operation organization (2nd ed.). China Railway Publishing House. **Reference books** [1] Yang, H. (Ed.). (2011). Railway transportation organization. China Railway Publishing House. [2] Peng, Q., & Wen, C. (Eds.). (2014). Fundamentals of high-speed railway transportation organization (2nd ed.). Southwest Jiaotong University Press.

5.10 Modeling and Simulation of Transportation System

Competence field	Electives
Module designation	Modeling and Simulation of Transportation System
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Dr. LI Wei, Associate Professor
Language	Chinese
Relation to curriculum	This course is an elective for transportation major, aimed at the students who are interested in the field of transportation planning and management. It provides foundational knowledge of transportation system modeling and simulation, aimed at developing practical skills for future professionals in this field. The focus of the course is to introduce students to simulation technology and its applications in transportation. Students will be able to address specific transportation issues by approaching them from various aspects: simulation objects, modeling, programming, experiments, and result analysis. The course covers nine key areas related to transportation system modeling and simulation: 1) Introduction to transportation system simulation, 2) Traffic data and surveys, 3) Principles and methods of simulation modeling, 4) Modeling and simulation of travel behavior analysis, 5) Agent-based modeling and simulation, 6) Dynamic path choice simulation modeling, 7) Capacity constraints under congested network conditions, 8) Distributed parallel simulation algorithms for transportation networks, and 9) Development and implementation of integrated transportation network simulation systems.
Teaching method	lecture-based teaching; project-based learning; case-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Python Programming, C# programming, Traffic Planning
Module objectives/intended learning outcomes	This course is designed to equip students with the research and application skills necessary for simulations, particularly in computer software applications, to tackle challenges in urban traffic operations and management. It emphasizes the development of analytical capabilities and the application of traffic simulation technology to address real-world issues within urban transportation systems. Additionally, the course prepares students for practical careers in areas such as traffic planning, intelligent transportation, and big data analysis. It fosters a comprehensive understanding of the principles of transportation system simulation, helping students cultivate essential skills for further study in urban transportation-related fields. Specific objectives include: **Knowledge:**

	This course will provide a comprehensive introduction to the fundamental knowledge of transportation simulation systems. Students will gain an understanding of simulation technology and its applications in the transportation field. Focusing on specific transportation issues, the course will cover aspects such as simulation objectives, simulation modeling, simulation programming, experimental simulations, and analyzing simulation results. Students will be equipped to proficiently apply traffic simulation to solve practical problems in transportation systems. **Skills:** Students will be able to: 1) Understand the fundamental concepts of transportation system simulation and its application in the transportation field. 2) Apply discrete event system simulation strategies and techniques, and implement these methods in transportation-related problems. 3) Understand and apply travel behavior analysis methods and models, including activity-based travel behavior modeling. 4) Understand and apply the principles of capacity limitation and queuing theory in congested network simulations. 5) Perform system requirement analysis, database design, and overall design for integrated transportation network simulation systems. **Competences:** Upon completion of this course, students will have developed: 1) The ability to apply traffic simulation techniques to solve real-world transportation problems. 2) The ability to understand and implement various simulation methods, including discrete event simulation and agent-based modeling, in transportation planning and management. 3) A strong understanding of travel behavior analysis, including methods for simulating and predicting travel patterns. 4) Practical skills in dynamic path selection and simulation of transportation demand, with the ability to implement these methods in real-world applications. 5) Competence in handling capacity limitations and queuing systems within congested traffic networks and simulating these conditions. 6) The ability to apply parallel computing strategies to traffic network simulations, improving the efficiency and scalability of transportation simulations. 7) Proficiency in developing and implementing integrated transportation network simulation systems, including the design of simulation outputs and integration with traffic data.
Contents	**Part A Theoretical teaching** (27 contact hours; 21 self-study hours) **Chapter 1: Introduction to Transportation System Simulation** (3 Contact Hours; 2 Self-Study Hours) • Basic concepts of transportation system simulation • Conceptual framework and basic steps of simulation modeling • Applications and development trends of transportation simulation technology **Chapter 2: Transportation Data and Surveys** (3 contact hours; 2 self-study hours) • Transportation data • Transportation surveys

	• Transportation arrival distribution • Queuing theory **Chapter 3: Principles and Methods of Simulation Modeling** (3 contact hours; 2 self-study hours) • Advancing system simulation • Discrete event system simulation strategies • General steps in discrete event system simulation **Chapter 4: Travel Behavior Analysis, Modeling, and Simulation** (3 contact hours; 2 self-study hours) • Basic concepts of travel behavior analysis • Basic methods of travel behavior analysis • Travel behavior analysis models **Chapter 5: Agent-Based Modeling and Simulation** (3 contact hours; 2 self-study hours) • Agent concept • Defining and setting up agents • Agent-based simulation modeling • Simulation of complex adaptive systems **Chapter 6: Dynamic Path Selection Simulation Modeling** (3 contact hours; 2 self-study hours) • Overview of traffic distribution • Determining the set of possible paths between OD pairs • Dynamic path selection models and algorithms • Simulation control of dynamic path selection **Chapter 7: Capacity Constraints and Queuing Theory in Congested Networks** (3 contact hours; 3 self-study hours) • Capacity constraints • Queuing theory • Simulation systems for congested networks **Chapter 8: Distributed Parallel Simulation Algorithms for Traffic Networks** (3 contact hours; 3 self-study hours) • Necessity and research progress of distributed parallel simulation • Parallel computing environments and parallelization strategies for traffic simulation • Implementation of distributed parallel traffic simulation systems **Chapter 9: Comprehensive Traffic Network Simulation System Development and Implementation** (3 contact hours; 3 self-study hours) • Requirement analysis for comprehensive traffic network simulation systems • Database requirement analysis and design • Overall design and implementation of a comprehensive traffic network simulation system **Part B Practical Teaching** (27 contact Hours; 15 self-Study Hours)

	Project 1 Integrated Simulation of Urban Rail Network Train Operations and Passenger Flow (27 contact hours; 15 self-study hours) • Basic principles and code implementation of integrated simulation of urban rail network train operations and passenger flow. • Guide students to design an integrated simulation software for urban rail network train operations and passenger flow from scratch, and gradually enrich the simulation system as the course progresses. This will help students consolidate and master the main content of the course.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 10% • Presentation 10% • Exercise report 20% • Final Exam 50%
Reading list	**Required books** [1] Jian, Z. (2011). Traffic System Modeling and Simulation (ISBN: 9787030306005). Science Press. **Reference books** [1] Ci, Y., & Wu, L. (2021). Traffic System Modeling and Simulation (ISBN: 9787114169519). People's Traffic Publishing House. [2] Wu, J. (2012). Traffic System Simulation and Applications (2nd ed., ISBN: 9787560849751). Tongji University Press [3] Liu, Y. (2002). Traffic System Simulation Technology (4th ed., ISBN: 9787114043987). People's Traffic Publishing House

5.11 Traffic Management and Control

Competence field	Electives
Module designation	Traffic Management and Control
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Dr. ZHANG Xiongfei, Associate Professor
Language	Chinese
Relation to curriculum	This course is an elective for the transportation major, designed for students who are interested in pursuing a career in traffic planning and management. It introduces the basic concepts and methods of traffic management and control, aiming to cultivate students' abilities to apply relevant theories, methods, and technologies to solve practical traffic problems. The purpose of this course is to explore how to scientifically apply various traffic management and control measures to existing road traffic facilities to enhance their traffic efficiency and safety. The main content includes traffic administrative management, enforcement management, traffic operation management, traffic priority management, traffic system management and traffic demand management, individual intersection signal control, arterial intersection traffic signal coordination control, and regional traffic signal control systems.
Teaching methods	lecture-based teaching; project-based learning; case-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Traffic Engineering
Module objectives/intended learning outcomes	The course aims to enable students to comprehensively understand the basic theories and methods of traffic management and control, master the necessary skills for scientific traffic governance, and possess the ability to apply relevant theories, methods, and technologies to solve practical traffic problems in the future field of transportation. Specific objectives include: **Knowledge:** 1) Grasp the concepts of traffic management and traffic control, and understand the stages of development and evolution of traffic management and the main principles of traffic management. 2) Master the content of motor vehicle traffic order management, the characteristics, classification, and functions of road traffic signs and markings, and understand the rules of motor vehicle driving. 3) Master the methods and characteristics of motor vehicle speed management, lane management, and prohibition management, and master the principles and methods of traffic management at unsignalized intersections.

	4) Master the main measures of public transport priority passage management, and grasp the concepts and measures of traffic system management and traffic demand management. 5) Master the basic concepts related to traffic signal control, and grasp the basic methods of signal timing design for individual intersections and the basic principles of inductive signal control. 6) Master the main parameters and basic requirements of arterial signal coordination control, and understand the graphical method of fixed-time arterial signal coordination control. **Skills:** Students will be able to: 1) Possess the ability to design and optimize traffic management plan. Master the basic methods of intersection signal timing design, and possess certain abilities and qualities in traffic management plan design, optimization, and decision-making. 2) Master traffic simulation software operation skills. Master the basic operations and usage methods of traffic simulation software, and be able to use simulation software for traffic modeling, traffic control plan evaluation, and optimization. 3) Obtain experimental techniques and basic skills. Master the basic laws of road traffic operation and intersection traffic control methods, and develop good experimental habits and a rigorous scientific style. **Competences:** Upon completion of this course, students will have developed: 1) The ability to solve practical traffic problems, and cultivate the ability to use relevant theories, methods, and technologies to solve practical traffic problems. 2) Comprehensive experimental and scientific work ability, improving the comprehensive ability to conduct scientific experimental work, including practical hands-on ability, analytical judgment ability, independent thinking ability, innovative and creative ability, and summarization ability. 3) Innovation and research ability, cultivating students' innovative consciousness, and encouraging new ideas in traffic planning and design.
Contents	**Part A Theoretical teaching** (36 contact hours; 18 self-study hours) **Chapter 1 Introduction to Traffic Management** (2 contact hour; 0 self-study hour) • What is traffic management and control • Why conduct traffic management and control • How to conduct traffic management and control **Chapter 2 Traffic Management Regulations** (1 contact hour; 1 self-study hour) • Formulation of traffic regulations • Content of traffic regulations • Implementation of traffic regulations **Chapter 3 Traffic Administrative Management** (1 contact hour; 0 self-study hour) • Driver management • Vehicle management and vehicle inspection

	• Traffic business management **Chapter 4 Traffic Enforcement Management** (4 contact hours; 2 self-study hours) • Traffic circulation order management • Road use management • Traffic safety violations and accident handling • Traffic enforcement management facilities • Management of highway traffic order **Chapter 5 Traffic Operation Management** (6 contact hours; 4 self-study hours) • Motor vehicle operation management • Pedestrian management • Parking management • Management of uncontrolled at-grade intersections • Expressway traffic management **Chapter 6 Priority Passage Management** (2 contact hours; 1 self-study hour) • History, current status, development policies, and management of public transportation in china • Conventional public transit priority management • Priority management for other vehicles **Chapter 7 Traffic System Management and Traffic Demand Management** (2 contact hour; 1 self-study hour) • Traffic System Management • Traffic Demand Management **Chapter 8 Special Event Traffic Management** (1 contact hour; 0 self-study hour) • Classification and traffic characteristics of special events • Traffic impact and management of sudden events • Traffic impact and management of planned events • Principles and measures of special event traffic management **Chapter 9 Traffic Congestion Management** (1 contact hour; 0 self-study hour) • Traffic congestion issues • Concepts, functions, and strategies of traffic congestion management • Introduction to traffic congestion management systems **Chapter 10 Introduction to Traffic Signal Control** (2 contact hour; 1 self-study hour) • Traffic signals and traffic lights • Basis for setting traffic lights • Categories of traffic light control

	Chapter 11 Signal Control for Individual Intersections (4 contact hours; 3 self-study hours) • Fixed-time signal control • Induction signal control • Signal control methods for roundabouts **Chapter 12 Arterial Intersection Traffic Signal Coordination Control** (4 contact hours; 2 self-study hours) • Fixed-time coordinated control • Sensing-based coordinated control • Connection methods of arterial signal coordination control systems • Basis for selecting arterial signal coordination control systems **Chapter 13 Regional Traffic Signal Control Systems** (2 contact hours; 1 self-study hour) • Concepts and classifications • Fixed-time offline operating systems • Adaptive online operating systems **Chapter 14 Expressway Traffic Control Systems** (2 contact hour; 1 self-study hour) • Mainline control systems • On-ramp control • Off-ramp control Introduction to Expressway Traffic Anomaly Monitoring and Passage Monitoring Systems **Chapter 15 Intelligent Traffic Management and Control Technology** (2 contact hour; 1 self-study hour) • The latest methods and cutting-edge technologies in traffic management and control **Part B Practical teaching** (18 contact hours; 18 self-study hours) **Project 1 Urban Intersection Simulation Modeling Experiment** (8 contact hours; 8 self-study hours) Based on the learned VISSIM software simulation operations, complete the following experiment: • Select an intersection and determine the control method (signalized/ Unsignalized); • Establish a simulation model of the intersection, setting the passage rules for uncontrolled intersections or the signal timing plan for signalized intersections; • Simulate by changing traffic flow to analyze the relationship between intersection flow and delay, as well as the capacity situation, and discuss the applicability of intersection control methods; • Organize and write an experimental report based on the results. **Project 2 of Fixed-Time Signal Timing Design for a Single**

	Intersection (6 contact hours; 6 self-study hours) Based on the given traffic data, complete the following experiment: • Determine the channelization plan and signal phase plan for the intersection based on basic traffic conditions and traffic data (design at least two schemes); • Use the fixed-time control method to calculate signal timing; • Evaluate the delay and queue length of the signalized intersection using simulation tools; • Compare and analyze the results of different schemes and select the optimal one. **Project 3 VISSIM Secondary Development Experiment** (4 contact hours; 4 self-study hours) • Introduction to VISSIM COM secondary development features; • Modification of simulation parameters, control of simulation process, and output of simulation evaluation results using VISSIM COM; • Implementation of VISSIM COM case studies.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Homework 15% • Experiment 5%; • Curriculum design 15% • Final Exam 60%
Reading list	**Required books** [1] Wu Bing and Li Ye. Traffic Management and Control (7th Edition) [M]. People's Communications Press, 2023. **Reference books** [1] Chen Jun et al. Traffic Management and Control (Second Edition) [M]. People's Communications Press, 2018. [2] Yuan Zhenzhou et al. Urban Traffic Management and Control[M]. Beijing Jiaotong University Press, 2013. **Other materials** [1] PPT courseware (self-compiled)

5.12 Green Manufacturing and Environment

Competence field	Electives
Module designation	Green Manufacturing and Environment
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Dr. LIU Hui, Associate Professor
Language	Chinese
Relation to curriculum	This course is a public elective course open to all students of Shenzhen Technology University. Green development and talent-oriented are the basic policies of "Made in China 2025". As standards have become an important support and strategic means for the development of green manufacturing projects and the "going out" of Made in China, the demand for standardized talents serving the green development of various industries is increasingly urgent. The course aims to help students establish the concept of green development through the study of theoretical knowledge such as sustainable development, green manufacturing system, carbon peaking and carbon neutrality, group activities such as carbon trading simulation and green project research, and enterprise classrooms such as visiting green manufacturing enterprises. It enables students to master the application methods of green standardization, improve the application ability of green standardization, promote standardization construction and integrate green development in product design and manufacturing, organizational management and service processes of various industries, cultivate high-quality engineers with green standardization awareness and international vision, and train compound application-oriented talents with green standardization literacy for various industries in society.
Teaching methods	lecture-based teaching; blended learning; case-based learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching; practice teaching; enterprise classroom Contact hours: 36 hours Size of class: no more than 80 students for theoretical teaching
Workload	Workload = 60 hours Contact hours = 36 hours Self-study hours = 24 hours
Credit points	2.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	The overall goal of the course is to help students establish the concept of green development, master the application methods of green standardization, improve the application ability of green standardization, promote standardization construction and integrate green development in product design and manufacturing, organizational management and service processes of various industries, and cultivate compound application-oriented talents with green standardization literacy. **Knowledge:** 1) Master the definitions of standard, standardization and quality; the definition, connotation, three principles and 17 goals of sustainable

	development; the composition of green manufacturing system and the definitions and key focus points of green products, green factories, green parks and green supply chains; the basic concepts and basic principles of product environmental awareness design, key nodes of the design process and design strategies; the concepts of product environmental labeling, carbon footprint, water footprint and environmental footprint; the carbon emission rights trading process and the greenhouse gas quantification process and key links; the product scope and response measures of WEEE, RoHS and ErP; the energy classification and core terms related to energy management, and the process and requirements for establishing an energy management system; the core terms related to environmental management, the content of each stage of PDCA and the process and requirements for establishing an environmental management system; the concept of Life Cycle Assessment (LCA) and its evaluation process; the composition of the ecological environment standard system and environmental public hazard events; the basic concepts of carbon peaking and carbon neutrality, types of carbon neutrality and general response actions (carbon neutrality "five-step process" and specific content). 2) Understand the meaning of green from different perspectives and the relationship between green and standards; the relationship between ecological civilization and sustainable development; the evaluation index system of green factories, green products, green parks and green supply chains; the significance of introducing environmental awareness design into products; the common product environmental labels in life and their meanings, and the environmental label certification process; China's strategic route and emission reduction measures for addressing climate change, and the impact of the greenhouse effect; the responsibilities of relevant parties of WEEE, RoHS and ErP, and the certification steps of ErP; the PDCA concept of the three management systems; the scope of application and basic conditions of GB/T 24001-2016 standard; how to use standardized methods to quantify energy and material consumption and environmental emissions at each stage; the sources and hazards of air and water pollution; China's strategic route for carbon peaking and carbon neutrality. 3) Know about the global green development status and green solutions; the development process of ecological civilization and the three understandings of "green mountains" and "golden mountains"; the current status of green manufacturing and the impact and role of green manufacturing system standards on the manufacturing industry; the design process of product environmental awareness design; the development process, management and practice of product environmental labeling, and the list of materials required for environmental label certification; the manifestations and impacts of global climate change, and the overview of domestic and foreign carbon trading markets (including Shenzhen); domestic and foreign energy conservation management laws and regulations, and the development process of China's energy management standardization; the overview of environmental management system; the development and application of domestic and foreign LCA standardization; the basic content of water and acoustic environment standards; the progress of carbon peaking and carbon neutrality in various countries. **Skills:** Students will be able to 1) Calculate carbon allowances and carbon emissions, and simulate carbon emission market transactions and performance.

	2) Collect domestic and foreign literature and conduct research and analysis to propose green campus creation goals and measures, and form a green campus creation or optimization plan; compile research reports and conduct defense reports (proposal, mid-term, final). 3) Collect domestic and foreign standards, conduct standard comparison research and investigation analysis, follow the drafting rules of standardized documents, form standard texts, and conduct defense reports (proposal, mid-term, final). 4) Visit green manufacturing-related enterprises, understand the application of standards in practical work, and describe the processes of green manufacturing, green buildings and solid waste treatment and disposal and their standardized management requirements. 5) Develop independent thinking and teamwork skills, and collaborate with group members to complete in-class practice projects and off-campus practice tasks. **Competences:** Upon completion of this course, students will have developed: 1) Establish a green development concept and green standardization awareness, and recognize the important role of green manufacturing and environmental standardization in promoting sustainable social development. 2) Improve the ability to apply green standardization knowledge to analyze and solve practical problems in product design, manufacturing, environmental management and other fields. 3) Enhance international vision, understand the global development trend of green manufacturing and environmental standardization, and lay a foundation for participating in international green cooperation in the future. 4) Cultivate the ability to combine theoretical knowledge with practical applications, and develop the literacy of compound application-oriented talents with green standardization awareness.
Contents	**Part A: Theoretical Teaching** (27 contact hours; 17 self-study hours) **Chapter 1: Knowledge of Ecological Civilization and Sustainable Development Blueprint** (2 contact hours; 1 self-study hour) • Teaching Content: Green solutions such as regulations and labels (themed on the green path triggered by electronic waste); Meaning of green and green standardization, standards and quality; "2030 Agenda for Sustainable Development" - definition, connotation, three principles, 17 goals of sustainable development; Development process of ecological civilization, three understandings of "green mountains" and "golden mountains"; Relationship between sustainable development and ecological civilization; Course content, internal connections and practical activity arrangements. • Learning Outcomes: Master the definitions of standard, standardization and quality, and the definition, connotation, three principles and 17 goals of sustainable development; understand the meaning of green from different perspectives and the relationship between green and standards, and the relationship between ecological civilization and sustainable development; know about the global green development status and green solutions, and the development process of ecological civilization and the three understandings of "green mountains" and "golden mountains". **Chapter 2: Knowledge of Green Manufacturing System**

	(2 contact hours; 1 self-study hours) • Teaching Content: How green development promotes ecological civilization construction; Green manufacturing system and key standards (green products, green factories, green parks, green supply chains); Example of textile industry to realize green manufacturing. • Learning Outcomes: Master the composition of green manufacturing system and the definitions and key focus points of green products, green factories, green parks and green supply chains; understand the evaluation index system of green factories, green products, green parks and green supply chains; know about the current status of green manufacturing and the impact and role of green manufacturing system standards on the manufacturing industry. **Chapter 3:Knowledge of Product Environmental Awareness Design** (2 contact hours; 1 self-study hours) • Teaching Content: Basic concepts and basic principles of product environmental awareness design; Design process of product environmental awareness design; Design strategies of product environmental awareness design; Design flow of product environmental awareness design. • Learning Outcomes: Master the basic concepts and basic principles of product environmental awareness design, key nodes of the design process and design strategies; understand the significance of introducing environmental awareness design into products; know about the design flow of product environmental awareness design. **Chapter 4: Knowledge of Product Environmental Labeling** (2 contact hours; 1 self-study hours) • Teaching Content: Overview of product environmental labeling (concept, domestic and foreign product environmental labels, development process, management and practice); Environmental footprint family (product carbon footprint, water footprint, product environmental footprint); Environmental label certification (certification process, list of materials). • Learning Outcomes: Master the concept of product environmental labeling and the concepts of carbon footprint, water footprint and environmental footprint; understand the common product environmental labels in life and their meanings, and the environmental label certification process; know about the development process, management and practice of product environmental labeling, and the list of materials required for environmental label certification. **Chapter 5:Knowledge of Global Climate Change and Enterprise Emission Reduction** (2 contact hours; 1 self-study hours) • Teaching Content: Manifestations/impacts of global climate change. Climate change response (global governance, domestic emission reduction). Carbon trading (domestic/foreign/Shenzhen market overview). GHG quantification (standards, process/key links). • Learning Outcomes: Master carbon trading process & GHG quantification; understand China’s climate change strategy; know about carbon trading markets.

	Chapter 6:Product Environmental Protection Standards & Regulations (2 contact hours; 2 self-study hours) • Teaching Content: Overview of WEEE/RoHS/ErP (product scope, responsibilities, response measures); their connections & differences. • Learning Outcomes: Master product scope/response measures of WEEE/RoHS/ErP & their connections/differences; understand responsibilities of related parties; know about their background/revision. **Chapter 7:Energy Management System** (2 contact hours; 2 self-study hours) • Teaching Content: Overview of 3 management systems. Energy-related content (domestic/foreign energy conservation laws, energy classification). Interpretation of GB/T 23331-2020 (standardization history, application scope, core terms). Establishment process/requirements of energy management system. Case analysis. • Learning Outcomes: Master energy classification/core terms & establishment process of energy management system; understand PDCA concept; know about energy conservation laws. **Chapter 8:Environmental Management System** (2 contact hours; 2 self-study hours) • Teaching Content: Overview of environmental management system (development history, international standardization, domestic/foreign laws). Interpretation of GB/T 24001-2016 (application scope, core terms, PDCA stages). Establishment process/requirements of environmental management system. • Learning Outcomes: Master core terms/PDCA stages & establishment process of environmental management system; understand application scope of GB/T 24001-2016; know about environmental management system overview. **Chapter 9:Life Cycle Assessment (LCA)** (2 contact hours; 2 self-study hours) • Teaching Content: Overview of LCA (concept, standardization development/application). LCA methodology (standards/model levels, evaluation process). Case analysis. • Learning Outcomes: Master LCA concept/evaluation process; understand standardized quantification of energy/material consumption; know about LCA standardization development. **Chapter 10:Enterprise Environmental Protection & Standard Application** (2 contact hours; 2 self-study hours) • Teaching Content: Air/water pollution overview (sources, pollutants, incidents, Shenzhen status). Ecological environment standard system (origin, nature/characteristics/functions, composition). Interpretation of key standards. • Learning Outcomes: Master composition of ecological environment standard system & environmental public hazard events; understand pollution sources/pollutants; know about water/acoustic environment standards.

	Chapter 11:Carbon Peaking & Carbon Neutrality Response Paths (2 contact hours; 2 self-study hours) • Teaching Content: Overview of carbon peaking/carbon neutrality (basic concepts, types). Domestic progress/policies (carbon emission status, goals; global response actions). City/enterprise response path cases. • Learning Outcomes: Master basic concepts/types of carbon peaking/carbon neutrality & "five-step process"; understand China's strategic path; know about global progress. **Part B: Practical Teaching** (9 contact hours; 6 self-study hours) **Practice Project 1: Carbon Trading Simulation** (2contact hours; 2 self-study hours) • Teaching Content: Calculation of carbon allowances/emissions; simulation of carbon trading/compliance. • Learning Outcomes: Master relationship between carbon intensity & target emissions; carbon trading/compliance process. • Implementation Form: Groups (each group = 1 controlled unit) conduct trading/compliance based on pre-allocated allowances & actual emissions. • Assessment Content: 100 points (30% for target emission calculation; 30% for compliance; 40% for simulation income). **Practice Project 2: Green Campus Creation** (6 contact hours 2 self-study hours) • Teaching Content: Collect domestic/foreign literature, conduct investigation, propose green campus goals/measures, form optimization plans. • Learning Outcomes: Consolidate theoretical knowledge, improve literature collection/reporting abilities, cultivate teamwork. • Implementation Form: Independent research + tutor guidance; 3 defenses (proposal: confirm direction; mid-term: progress; final: results). • Assessment Content:100 points (30% for proposal defense; 30% for mid-term defense; 40% for final defense). **Practice Project 3: Standard Development in Green Development Fields** (6 contact hours; 2 self-study hours) • Teaching Content: Collect domestic/foreign standards, conduct comparison research, follow drafting rules, form standard texts. • Learning Outcomes: Master standard comparison methods/development process, improve document drafting abilities. • Implementation Form: Independent research + tutor guidance; 3 defenses (same as Project 2). • Assessment Content:100 points (30% for proposal defense; 30% for mid-term defense; 40% for final defense). **Part C: Off-campus Practice** (2 contact hours; 1 self-study hours) **Practice Project 1: Carbon Trading Simulation** (2contact hours; 1 self-study hours) • Teaching Content: Organize 2-3 enterprise classes to conduct research and learning at enterprises and institutions that have performed outstandingly in standardization, including green manufacturing enterprises, green buildings, solid waste resource utilization enterprises or waste incineration power stations. The full-time standardization personnel of the enterprises will explain

	the standardization in their daily work and typical cases of applying standards to green manufacturing, green buildings and solid waste treatment and disposal. • Learning Outcomes: Understand practical application of standards in green manufacturing/buildings/solid waste treatment. • Implementation Form: Including on-site visits and corporate lectures. Visit the exhibition hall, laboratory or production area on site and attend the green manufacturing standardization lecture hall taught by enterprise instructors.
Examination forms	1. Regular assessment (50% of total grade): - Attendance (10%): Random check of students' participation in in-class teaching, in-class practice, and off-campus enterprise classrooms; unexcused absence will deduct points accordingly. - Class performance (10%): Evaluation based on students' participation in class Q&A, discussions, and interactive activities (e.g., responses to theoretical knowledge of green manufacturing, feedback on case analysis). - In-class quizzes (30%): Multiple quizzes arranged during the semester (aligned with key chapters such as green manufacturing system, carbon trading, and environmental management system) to test mastery of theoretical knowledge. 2. Final assessment (50% of total grade): - Individual contribution coefficient (40%): Evaluated based on individual performance in in-class practice (e.g., participation in carbon trading simulation, preparation for defense of green campus creation/standard development projects, completion of team tasks). - Group competition results (60%): Comprehensive score of group practice projects, including the quality of green campus creation plans, standard texts of green development fields, and performance in proposal/mid-term/final defenses.
Study and examination requirements	1. Study requirements: - Students must actively participate in all teaching links, including in-class teaching, in-class practice (carbon trading simulation, project defenses), and off-campus enterprise classrooms; unexcused absence from more than 1/3 of the total teaching hours will result in disqualification from the final assessment. - Complete assigned learning tasks on time: Submit materials required for practice projects (e.g., literature collection reports for green campus creation, standard comparison drafts for green development fields), and finish practical learning reports after enterprise classroom visits. - Prepare for in-class quizzes and project defenses: Review key theoretical knowledge (e.g., green manufacturing system standards, GHG quantification methods) and be familiar with the progress and details of group projects. 2. Examination requirements: - The minimum passing score for the course is 60/100. - The overall grade is composed of regular assessment (50%) and final assessment (50%): - Regular assessment = Attendance (10%) + Class performance (10%) + In-class quizzes (30%); - Final assessment = Individual contribution coefficient (40%) × Group competition results (60%). - For group practice projects, if a student's individual contribution is deemed insufficient (e.g., failing to participate in project research or defense), the individual contribution coefficient will be reduced, affecting the final assessment score

Reading list	**Required Textbook:** None **Reference Books:** 1. National Manufacturing Power Construction Strategy Advisory Committee, Green Manufacturing, Electronic Industry Press, Not specified in the syllabus. 2. American Manufacturing Association, Zhao Daozhi, Ji Fang, Green Manufacturing: How Enterprises Achieve Sustainable Development, People's Posts and Telecommunications Press, Not specified in the syllabus. 3. National Green Factory Promotion Alliance, China Electronics Standardization Institute, Beijing Saixi Certification Co., Ltd., Green Manufacturing Standardization White Paper (2021 Edition), Not specified in the syllabus, 2021.

5.13 Geographic Information System and Application

Competence field	Electives
Module designation	Geographic Information System and Application
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Dr. JIN Meihan, Assistant Professor
Language	Chinese
Relation to curriculum	GIS is a fundamental course for the students majored in intelligent transportation system and smart city. This course provides an opportunity to the students to learn the fundamental knowledge in the field of geographic information system and its application in the transportation field. It provides the knowledge of transportation data collection, transportation data structure and transportation data management methods. During the course, the students will learn the types, features, formats, and components of data in GIS field. Main types of coordinate systems and conversion among coordinate systems are also included in this course. Meanwhile, principles of route choice as well as basic operation skill of utilizing GIS software will also be taught in this course.
Teaching methods	lecture-based teaching; case-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Engineering Drawing, Engineering Measurement Practice
Module objectives/intended learning outcomes	This course aims to enable students to gradually and progressively understand and apply the theories, methods, and technologies of geographic information systems in transportation field, as well as to become acquainted with common spatial analysis methods and technologies in GIS. Specific objectives include: **Knowledge:** This course will provide a comprehensive understanding of the characteristics of geographic information systems, the fundamental concepts of geographic information, the composition of geographic information systems, dynamics of spatial data, spatial analysis method for transportation problems. Students will also study the spatial data modeling methods, different types of GIS databases and the georeferenced coordination of GIS data. **Skills:** Students will be able to: 1) Learn methods to consult relevant standards and literature to carry out practical projects, deepening their understanding of the theories of

	geographic information systems. 2) Apply theoretical GIS knowledge and methods to practical transportation problems, particularly in the areas of temporal and spatial real data analysis. 3) Skilled in manipulating the most widely used geographic information system software and solve transportation problems. **Competences:** Upon completion of this course, students will have developed: 1) Practical abilities and innovative thinking in the field of various temporal and spatial data structures and spatial analysis methods. 2) The capacity to apply learned knowledge to abstract real world spatial entities and relationships into information world, demonstrating necessity of manipulating the big spatial and temporal transportation data. 3) An understanding of the trends in the development of geographic information systems and application in China and worldwide. 4) The ability to evaluate and contribute to the ongoing evolution of transportation big data analysis and visualization in practices.
Contents	**Part A Theoretical teaching** (36 contact hours; 18 self-study hours) **Chapter 1 Overview of Geographic Information Systems** (4 contact hours; 2 self-study hours) • What is GIS? • Why transportation expertise needs to learn GIS? • Properties of GIS • History of GIS development • Application of GIS in transportation **Chapter 2 GIS Softwares** (4 contact hours; 2 self-study hours) • Development of GIS software • Structure of GIS software • Types of GIS software • Introduction of wide-applied GIS software **Chapter 3 Georeferencing** (4 contact hours; 2 self-study hours) • Importance to Learn Georeferencing • Earth Space • Earth Models • Map Coordinate Systems • Map Projection **Chapter 4 Representation and Recognition of Spatial Data** (4 contact hours; 2 self-study hours) • Spatial is Special (The uniqueness of space) • Spatial Cognition • Expression of Space • Spatial Relationships • Metadata • Focus on the patterns of various phenomena as they change with space and geographic location • Explain the main basis for sample control in scientific sampling • Formation and measurement of spatial differentiation • Spatial Autocorrelation

	Chapter 5 Spatial Data Models (4 contact hours; 2 self-study hours) • Concept of the construction of a digital model of some aspect of the Earth's surface. • The geographic world is extremely complex, so it is necessary to make choices, about what to represent, at what level of detail, and over what time period • Generalization methods are used to remove detail that is unnecessary for an application, in order to reduce data volume and speed up operations. **Chapter 6 Spatial Data Collection and Processing** (4 contact hours; 2 self-study hours) • Spatial data types related to transportation • Transportation spatial data collection • Spatial data qualities • Spatial data processing **Chapter 7 Spatial Data Management** (4 contact hours; 2 self-study hours) • Spatial databases • Spatial data organization form • Spatial database applications **Chapter 8 Spatial Analysis** (4 contact hours; 2 self-study hours) • Spatial data calculations • Spatial relationships • Spatial analysis **Chapter 9 GIS-T Applications and visualizations** (4 contact hours; 2 self-study hours) • Map output standard • Producing map of transportation • Visualization analysis **Part B Practical teaching** (18 contact hours; 18 self-study hours) **Project 1 Software installation** (2 contact hours; 2 self-study hours) • Understanding and practice the installation of ArcGIS software **Project 2 Georeferencing and Coordination Transformation** (2 contact hours; 2 self-study hours) • Learn and practice to define the georeferencing and projection coordinate of spatial data. • Learn and practice to transform spatial data from different coordinate. **Project 3 Spatial adjustments and geographical matching** (2 contact hours; 2 self-study hours) • Learn and practice the spatial adjustment method to relocate unknown coordinate data. • Relocate and set coordinate of raster data. **Project 4 Basic Function of ArcGIS Software** (2 contact hours; 2 self-study hours) • Learn the basic function of ArcMap.

	• Understanding and practice symbolization, data frame setting, content checking etc. **Project 5 Attributes and Labeling** (2 contact hours; 2 self-study hours) • Checking the attribute table of spatial data. • Visualize spatial data with different categories. • Label spatial data with different preference **Project 6 Map Editing** (2 contact hours; 2 self-study hours) • Lear how to vectorize data, including adding new features, adding attributes and editing features and attributes. **Project 7 Attributes Table Connection and Selection** (2 contact hours; 2 self-study hours) • Learn how to connect attribute table to other data, and data filtering, and further build Geodatabases **Project 8 Spatial Analysis I** (2 contact hours; 2 self-study hours) • Learn and practice spatial adjacent analysis and spatial overlaying analysis **Project 9 Spatial Analysis II** (2 contact hours; 2 self-study hours) • Network analysis, learn how to build network, check topology of the network and practice shortest path searching methods
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance and classroom performance 10% • Homework and experiment reports 40% • Final exam 60%
Reading list	**Required books** [1] Tang Guoan, Zhao Mudan, Yang Xin, Zhou Yi. "Geographic Information Systems (Second Edition)", Science Press, 2019.1. **Reference books** [1] Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind. Geographic Information Science & Systems. [2] Li Qingquan, Xiao Shi Lun, Fang Zhixiang, Yang Bisheng, et al. "Transportation Geographic Information System Technology and Frontier Development". Science Press, 2012. [3] Harvey J. Miller, Shih Lung Shaw. "Geographic Information Systems for Transportation: Principles and Applications". [4] Song Yan, Peng Ke. "Urban Spatial Analysis GIS Application Guide". China Architecture & Building Press, 2015. [5] Liu Xuejun, Xu Peng. "Transportation Geographic Information Systems". Science Press, 2008. [6] Wang Fahui [USA], translated by Jiang Shiguo, Teng Junhua. "Quantitative Methods and Applications Based on GIS". The

	Commercial Press, 2011.Yang, J., & Zhang, Y. Urban Rail Transit Vehicle Engineering [M]. China Railway Press, 2015. **Other materials** [1] PPT courseware (self-compiled)

5.14 Control Engineering Basis

Competence field	Electives
Module designation	Control Engineering Basis
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Dr. CHENG Tao, Professor
Language	Chinese
Relation to curriculum	This course employs a variety of teaching methods and formats, including classroom lectures, teacher-student discussions, course experiments and design (papers), and/or company visits and field research, as well as literature reading and surveys. Centered around the students as the main subjects, the course establishes core ideas such as systems theory and systems engineering, information theory and control theory, and scientific methodology. It particularly emphasizes understanding and becoming familiar with the concepts, methods, and technologies of control engineering, as well as the basic knowledge, role, main applications, and latest developments of systems. Students will learn the main concepts, fundamental theories, and principles, and will begin to analyze control problems. They will also gain basic methods and foundational tools and techniques for modeling and describing control systems, designing, simulating, and evaluating their performance. This lays the necessary foundation for students to develop the ability to apply control science and engineering ideas, methods, technologies, and systems to solve automated problems in various fields, including but not limited to transportation logistics, industrial and agricultural production, national defense and military, aerospace, and everyday life.
Teaching methods	lecture-based teaching; problem-based learning; case-based learning; hands-on labs; seminar-based teaching
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Advanced Mathematics
Module objectives/intended learning outcomes	The course aims to enable students to focus on mastering the basic theory of feedback control and the relevant mathematical foundations, methods for modeling control systems, and analysis and design methods for linear systems in the time and frequency domains as well as root locus techniques. Students will also gain an understanding and comprehension of system correction methods, as well as the basic theoretical methods for nonlinear systems and sampled systems. They will learn the fundamental knowledge and skills to construct, describe, design, and analyze automatic control systems. Specific objectives include: **Knowledge:**

	This course systematically introduces the fundamental concepts and principles of control engineering, including the definitions and importance of control and feedback. It covers the basic structure and components of automatic control systems, distinguishing between open-loop and closed-loop (semi-closed and fully closed) systems. The course delves into the mathematical modeling of control systems, exploring linear and nonlinear systems, differential equations, and Laplace transforms. Additionally, it examines the time-domain and frequency-domain analysis of control systems, stability criteria, and control system design methods. Students will gain an understanding of the application of control theory in various fields, such as industrial automation, intelligent transportation systems, and autonomous systems. **Skills:** Students will be able to: 1) Understand the development and frontiers of control engineering technologies, and master the theoretical foundations of control systems. 2) Analyze and model control systems using mathematical tools such as differential equations and Laplace transforms. 3) Apply time-domain and frequency-domain analysis techniques to evaluate the performance of control systems. 4) Design and implement control strategies using methods like PID control, state-space control, and frequency response techniques. 5) Utilize software tools like MATLAB/Simulink for simulation and analysis of control systems. 6) Understand and apply stability criteria to assess the stability of control systems. **Competences:** Upon completion of this course, students will have developed: 1) Practical abilities and innovative thinking in the design and analysis of control systems, applying engineering technology knowledge to solve real-world problems. 2) The ability to critically analyze and solve complex control engineering problems, demonstrating a deep understanding of control theory and its applications. 3) Effective communication skills to explain and document control system designs and analyses, both in written and oral forms. 4) A rigorous approach to engineering problem-solving, emphasizing accuracy, precision, and ethical considerations in the application of control systems.
Contents	**Part A Theoretical Teaching (36 contact hours; 24 self-study hours)** **Chapter 1 Course Introduction and Schedule Requirements** • Content summary • Case analysis introduction • Basic concepts of automation and control systems **Chapter 2 Mathematical Models of Control Systems (1)** • Content summary and case introduction • Role of mathematical models in control systems and comparison of common mathematical models and modeling methods • "Human brain cognition and behavior control mechanism + intelligent perception + industrial internet of things + big data and applications + traffic operation and control" • Class discussion on "automatic control technology in transportation vehicles"; review of differential equations in advanced mathematics

	Chapter 3 Mathematical Models of Control Systems (2) • Differential equations of control systems **Chapter 4 Mathematical Models of Control Systems (3)** • Complex numbers and complex functions, introduction to Laplace transform and its differences from Fourier transform and Z-transform, physical significance • Definition of Laplace transform, related theorems, and application examples • Laplace transform of typical time functions, Laplace transform table of common functions, and applications **Chapter 5 Mathematical Models of Control Systems (4)** • Definition and relationship of Laplace inverse transform with Laplace transform and differential equations • Rational fractions of image functions and zeros and poles • Methods for solving the original function of image function F(S) in several cases and example explanations **Chapter 6 Mathematical Models of Control Systems (5)** • Review and classroom exercises on solving the original function of function F(S) with/without repeated poles and conjugate complex roots using Laplace inverse transform • Definition, characteristics, expression, properties, and main functions of transfer functions • Examples and explanations of transfer functions **Chapter 7 Mathematical Models of Control Systems (6)** • Steps and methods for solving transfer functions • Classroom exercises and explanations on transfer functions • Transfer functions of typical components **Chapter 8 Mathematical Models of Control Systems (7)** • Structure diagrams and signal flow graphs of control systems • Transfer functions of automatic control systems • Summary of the lecture and several points for explanation and reflection • Ideological and political part and thought-provoking questions **Chapter 9 Time-Domain Performance Analysis of Control Systems (1)** • Time-domain response and performance indicators of control systems • Mathematical model of first-order systems and analysis of unit step response **Chapter 10 Time-Domain Performance Analysis of Control Systems (2)** • Unit impulse response, unit ramp (velocity) response, and unit acceleration response of first-order systems • Main characteristics of linear time-invariant systems • Summary of typical responses of first-order systems • Mathematical model and differential equation of second-order systems, transfer function model • Typical second-order systems and their open/closed-loop transfer functions

	Chapter 11 Time-Domain Performance Analysis of Control Systems (3) • Time-domain performance analysis of second-order systems • Time-domain performance analysis of higher-order systems • Stability criteria of control systems **Chapter 12 Time-Domain Performance Analysis of Control Systems (4)** • Steady-state error analysis of control systems **Chapter 13 Root Locus Method of Linear Systems** • Content summary • Concept and equation of root locus and its main function • Rules and methods for drawing root loci • Generalized root locus **Chapter 14 Frequency-Domain Performance Analysis of Control Systems (1)** • Basic concepts of frequency characteristics • Frequency characteristics of typical links **Chapter 15 Frequency-Domain Performance Analysis of Control Systems (2)** • Review and summary of typical link polar coordinate diagrams, Bode diagrams, and their frequency characteristic analysis • Frequency characteristics of typical links **Chapter 16 Frequency-Domain Performance Analysis of Control Systems (3)** • Review of knowledge related to the stability of control systems; limitations of stability criteria based on characteristic roots • Basic concepts, connotations, and mathematical foundation analysis of the Nyquist criterion based on open-loop frequency characteristics (argument principle - mapping theorem) • Nyquist criterion based on auxiliary function F(S); Nyquist criterion based on open-loop transfer function G(s)H(s) • Nyquist criterion based on open-loop frequency characteristics G(jω)H(jω) and its application **Chapter 17 Frequency-Domain Performance Analysis of Control Systems (4)** • Relative stability analysis of control systems • Closed-loop frequency characteristics, closed-loop frequency characteristics of unit feedback systems and non-unit feedback systems • Relationship between frequency response and time-domain response, relationship between system dynamic characteristics and open-loop frequency characteristics (relationship between frequency characteristics and time-domain performance, low-frequency segment, mid-frequency segment, high-frequency segment) **Chapter 18 Control System Correction Methods** • Basic concepts of control system design • Control system correction, correction devices (series phase-lead correction, phase-lag correction, phase-lag-lead correction devices and characteristics)

	• Time-domain method correction • Frequency method correction - series lead correction; Frequency method correction - series lag correction - feedback correction, feedforward and compound control. **Part B Practical Teaching (18 contact hours; 12 self-study hours)** **Project 1 Matlab Programming Fundamentals and Training** • MATLAB, meaning "matrix factory" (matrix laboratory), is a high-tech computing environment that integrates numerical analysis, matrix computation, scientific data visualization, and modeling and simulation of nonlinear dynamic systems. It is widely used in data calculation and analysis, sensors and information processing, machine vision and image processing, deep learning, control systems, and many other fields, providing a comprehensive solution for scientific research, engineering design, and many scientific fields that require effective numerical computation. In the category of mathematical scientific application software, it is preeminent in numerical computation. This experimental project aims to enable students to learn and understand the MATLAB programming environment, system structure, main functions and modules with toolboxes (such as Simulink), data representation and processing capabilities, graphical processing methods, demonstration examples, and application fields, and to initially model control systems. **Project 2 Time-Domain Characteristics Analysis of Control Systems** • This experimental project mainly involves mastering the software simulation (or electronic simulation) methods of typical links, learning the testing methods of time-domain responses, and clarifying the relationship between the step response of the system and its performance indicators and structural parameters. Students will become familiar with using MATLAB (or analog circuits) to construct, simulate, and analyze the time-domain characteristics of first- and second-order systems; understand the time-domain characteristics of first-order systems and the impact of the time constant T on system performance; learn the testing methods of second-order system response characteristics, and understand the time-domain characteristics of second-order systems. **Project 3 Frequency-Domain Characteristics Analysis of Control Systems** • This experimental project mainly involves mastering the software simulation (or electronic simulation) methods of typical links, deepening the understanding of the concept of frequency characteristics, learning and mastering the testing principles of frequency characteristics of links or systems and the testing methods of amplitude-frequency characteristic curves, and being able to use MATLAB to draw the Nyquist diagram and Bode diagram of the open-loop system to analyze the characteristics of control systems. **Project 4 "Design and Simulation Analysis of XXX Automatic Control System Based on Carsim+Simulink" (Course Design/Paper)** • This course design is one of the main practical teaching links of "Control Engineering Fundamentals." Its purpose is to consolidate and deepen the understanding of the basic theories and knowledge of control engineering fundamentals. Students are required to use the

	basic theories and methods of control theory, analysis, and design to practice the design and performance analysis and evaluation of automatic control systems for actual problems, including but not limited to new energy intelligent (connected) vehicles, intelligent transportation systems, vehicle-road collaborative systems, unmanned vehicle-drone-robot cooperative systems, and urban rail transit fields. This aims to promote the application of advanced control concepts, methods, and information technology in transportation.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 3% • Homework 9% • Experimental report 9% • Presentation 6% • Course design 23% • Final exam 50%
Reading list	**Required books** [1] Hu, S. (2019). Principles of Automatic Control (7th ed.) [M]. Science Press. [2] Dong, J., Zhao, C., Guo, M., Chen, Z., Liu, Y., & Li, D. (2022). Fundamentals of Control Engineering (5th ed.) [M]. Tsinghua University Press. [3] Shen, Y., Sun, Y., & Yu, H. (2020). Fundamentals of Control Engineering (2nd ed.) [M]. Tsinghua University Press. [4] Kong, X., & Yao, C. (2019). Fundamentals of Control Engineering (4th ed.) [M]. Mechanical Industry Press. **Reference books** [1] Hu, S. (2015). Automatic Control Principles (6th ed.) [M]. Science Press. [2] Zou, X. (2017). Automatic Control Principles [M]. Mechanical Industry Press. **Other materials** [1] PPT courseware (self-compiled)

5.15 Traffic Safety Engineering

Competence field	Electives
Module designation	Traffic Safety Engineering
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Dr. HUANG Junsheng, Lecturer
Language	Chinese
Relation to curriculum	This course is a professional elective aimed at raising awareness of the importance of traffic safety. It enables students to gain a comprehensive understanding of the various factors that influence traffic safety and to master the basic principles and methods for achieving traffic safety. The course introduces traffic safety engineering from seven aspects: 1) Basic principles of traffic safety, 2) Traffic safety and traffic accidents, 3) Road environment and traffic safety, 4) Road facilities and traffic safety, 5) Vehicle factors and traffic safety, 6) Human factors and traffic safety, 7) Traffic safety management.
Teaching methods	lecture-based teaching; problem-based learning; case-based learning; hands-on labs; seminar-based teaching
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Introduction to Rail Transit, Traffic Engineering, Transportation Organization Theory
Module objectives/intended learning outcomes	This course aims at helping students gain a comprehensive understanding of the basic principles and methods of traffic safety. The course covers various aspects of traffic safety, including traffic accidents, road environment, facilities, vehicle factors, and human factors. By integrating theory with practice, the course enhances students' awareness of traffic safety and their practical skills in implementation. Specific objectives include: **Knowledge:** The knowledge objective of this course is to enable students to master the basic theories and principles of traffic safety engineering, and understand the various factors influencing traffic safety, such as traffic accidents, road environment, facilities, vehicles, and human factors. By studying traffic safety management, students should be able to understand how to improve road safety and reduce traffic accidents through systematic approaches, and accurately identify key issues in traffic safety engineering and their solutions. The course emphasizes the integration of theory and practice, enabling students to apply theoretical knowledge to real-world problems and improve their overall competence in the field of traffic safety. **Skills:**

	Students will be able to: 1) Analyze the causes and influencing factors of traffic accidents using traffic safety principles. 2) Master the methods for designing and evaluating road safety facilities, and conduct on-site safety inspections and assessments. 3) Assess the effectiveness of traffic safety management systems. 4) Analyze traffic safety issues using real-world data and propose reasonable solutions. **Competences:** Upon completion of this course, students will have developed: 1) Enhance students' ability to analyze and solve traffic safety issues, enabling them to independently identify and address traffic safety problems. 2) Cultivate students' ability to comprehensively apply traffic safety knowledge to analyze real-world traffic accident cases. 3) Improve students' ability to design and optimize traffic safety facilities in practical engineering projects. 4) Develop students' ability to work in multidisciplinary teams to solve traffic safety problems, enhancing their practical engineering skills and communication abilities.
Contents	**Part A Theoretical teaching** (36 contact hours; 15 self-study hours) **Chapter 1 Introduction** (3 contact hours; 1 self-study hour) • Basic concepts of safety systems engineering and traffic safety engineering; • Introduction to the field of traffic safety engineering. **Chapter 2 Basic Principles of Traffic Safety** (4 contact hours; 2 self-study hours) • Reliability theory; • Accident causation theory; • Accident prevention theory; • Principles of traffic system safety control. **Chapter 3 Traffic Safety and Traffic Accidents** (4 contact hours; 2 self-study hours) • Road transportation safety and traffic accidents; • Railway transportation safety and traffic accidents; • Water transportation safety and traffic accidents; • Air transportation safety and traffic accidents; • Pipeline transportation safety and traffic accidents. **Chapter 4 Road Traffic Environment and Traffic Safety** (6 contact hours; 3 self-study hours) • Road alignment and traffic safety; • Road cross-section and traffic safety; • Roadbed and pavement safety; • Intersection and traffic safety; • Tunnels and traffic safety; • Road design consistency and traffic safety; • Traffic conditions, road landscape, weather, and their impact on traffic safety. **Chapter 5 Road Traffic Facilities and Traffic Safety**

	(3 contact hours; 2 self-study hours) • Traffic signals and traffic safety; • Road traffic signs, markings, and traffic safety; • Guardrails, fences, and traffic safety; • Anti-glare facilities, visual guidance facilities, and traffic safety. **Chapter 6 Vehicle Factors and Traffic Safety** (6 contact hours; 2 self-study hours) • Vehicle performance and traffic safety; • Tires and traffic safety; • Passive safety technology for vehicles; • Active safety technology for vehicles; • Other factors affecting traffic safety; • Vehicle yielding at pedestrian crossings and traffic safety. **Chapter 7 Human Factors and Traffic Safety** (5 contact hours; 2 self-study hours) • Physiological and psychological aspects; • Drivers and traffic safety; • Characteristics of non-motorized vehicle drivers and traffic safety; • Pedestrian characteristics and traffic safety; • Traffic safety education for all traffic participants. **Chapter 8 Road Traffic Safety Management** (5 contact hours; 1 self-study hour) • Safety management of road transportation vehicles and drivers; • Safety management of road passenger transportation; • Safety management of road freight transportation; • Emergency response and management of road transportation accidents. **Part B Practical teaching** (18 contact hours; 21 self-study hours) **Project 1 Road Traffic Accident Causation Analysis and Countermeasures** (3 contact hours; 3 self-study hours) • This project aims to analyze the causes of road traffic accidents and explore the major influencing factors by applying accident causation and prevention theories. By studying real accident cases, potential risk factors can be identified, and effective safety improvements proposed to reduce future accident rates. **Project 2 Design of an Intelligent Traffic Signal Control System** (5 contact hours; 5 self-study hours) • This project involves designing an intelligent traffic signal control system that uses sensor data to optimize traffic light timing, aiming to improve traffic flow and reduce congestion. Simulation software can be used to test different control strategies and evaluate their impact on traffic safety and efficiency. **Project 3 Evaluation of Vehicle Safety Technologies** (3 contact hours; 5 self-study hours) • This project evaluates various vehicle safety technologies, such as active and passive safety systems, by analyzing their working principles, effectiveness, and role in reducing accidents. This project provides a deeper understanding of the importance of vehicle technology in traffic safety. **Project 4 Design of a Traffic Safety Education Program for**

	Pedestrians and Non-Motorized Vehicle Users (4 contact hours; 5 self-study hours) • This project involves designing a traffic safety education program aimed at pedestrians and non-motorized vehicle users. The program should include ways to raise safety awareness, promote adherence to traffic rules, and outline specific educational measures. Innovative outreach methods, such as videos, posters, and social media campaigns, can enhance the effectiveness of traffic safety education. **Project 5 Analysis of the Impact of Road Traffic Environment on Traffic Safety** (3 contact hours; 3 self-study hours) • This project studies the impact of road environment factors (such as pavement conditions, weather, road design, etc.) on traffic safety. Relevant data and case analysis are used to evaluate the role of these factors in traffic accidents and to propose recommendations for improving the road environment for enhanced safety.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Homework 30% • Class discussion 5% • Final Exam 60%
Reading list	**Required books** [1] Pan, F., Zhang L., Yang, J. et al. Traffic Safety Engineering [M]. Beijing: China Machine Press, 2018. **Reference books** [1] Rune, E., Alena, H., and Truls, V. The Handbook of Road Safety Measures (Second Edition) [M]. Michael Sorensen. 2009. [2] George, Y., and Simon, C. Traffic Safety [M]. Wiley-ISTE, June 2016. **Other materials** [1] PPT courseware (self-compiled)

5.16 Data Analysis and Mining

Competence field	Electives
Module designation	Data Analysis and Mining
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Dr. HE Yuxin, Associate Professor
Language	Chinese
Relation to curriculum	Data Analysis and Data Mining is an elective course tailored for students majoring in Transportation Engineering. This course focuses on the core theories and techniques of data analysis and mining, providing an in-depth introduction to the main functions of data mining, commonly used mining algorithms, and their applications. By analyzing real datasets, students not only gain a better understanding and mastery of various data mining models but also enhance their ability to analyze and solve practical problems. The primary aim of this course is to familiarize students with the working principles and methods of data analysis, and to equip them with skills in data analysis, design, and visualization using Python. Additionally, students will acquire fundamental skills in data mining, including data processing, model building, and interpretation of results, laying a solid foundation for future work in data-related fields, particularly in the analysis and mining of transportation data.
Teaching methods	lecture-based teaching; problem-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 80 students for theoretical teaching
Workload	Workload =90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Probability and Statistics, Advanced Mathematics, Python Programming
Module objectives/intended learning outcomes	This course aims to enable students to progressively understand and master the basic concepts, methods, and techniques of data analysis and mining, and how these tools can be applied to real-world transportation systems to improve decision-making, optimization, and forecasting. Specific objectives include: **Knowledge:** This course will provide a comprehensive understanding of the key concepts and techniques in data mining, including data preprocessing, classification, prediction, clustering analysis, association analysis, and anomaly detection. Students will gain proficiency in preparing and analyzing large datasets, applying appropriate algorithms, and interpreting the results to identify patterns and trends in transportation-related data. The course will also introduce the use of various data mining tools and software for transportation data analysis. **Skills:** Students will be able to:

	8) Apply data preprocessing techniques to clean and organize large datasets for analysis. 9) Use classification and prediction algorithms to analyze and forecast transportation-related issues such as traffic patterns, demand prediction, and vehicle routing. 10) Implement clustering analysis and association rule mining to identify key relationships and patterns in transportation data. 11) Conduct anomaly detection to identify and address irregularities and outliers in transportation data, improving system efficiency and reliability. **Competences:** Upon completion of this course, students will have developed: 5) Practical skills in using data mining techniques and software to analyze and interpret transportation-related data. 6) The ability to apply these skills in real-world transportation scenarios, such as optimizing routes, predicting traffic patterns, and enhancing decision-making. 7) A deep understanding of how data analysis can be applied to improve transportation systems and inform policy decisions in the context of urban mobility and logistics. 8) The ability to evaluate and communicate findings effectively, contributing to the ongoing development of smart transportation systems.
Contents	**Part A Theoretical teaching** (36 contact hours; 24 self-study hours) **Chapter 1 Basic Concepts of Data Mining** (2 contact hours; 1 self-study hour) • Introduction to Data Mining • Problems Addressed by Data Mining • The Origins of Data Mining • Tasks in Data Mining • Types of Data • Data Quality **Chapter 2 Data Preprocessing** (6 contact hours; 3 self-study hours) • Introduction to Data Cleaning • Data Integration and Transformation **Chapter 3 Classification** (10 contact hours; 8 self-study hours) • Introduction to the Basic Concepts of Classification • General Classification Framework • Decision Tree Classifier • Nearest Neighbor Classifier • Naive Bayes Classifier • Logistic Regression • Artificial Neural Networks • Support Vector Machines • Class Imbalance Problem • Multi-class Problem **Chapter 4 Prediction** (6 contact hours; 4 self-study hours) • Basic Concepts of Prediction

	• General Prediction Framework • Linear and Multivariable Regression • Nonlinear Regression • Other Regression Models • Overfitting of Models • Model Selection • Model Evaluation • Use of Hyperparameters **Chapter 5 Clustering Analysis** (6 contact hours; 4 self-study hours) • Basic Concepts of Clustering Analysis • K-Means Algorithm • Agglomerative Hierarchical Clustering • Cluster Evaluation • **Chapter 6 Association Analysis** (4 contact hours; 2 self-study hours) • Basic Concepts of Association Analysis • Generation of Frequent Itemsets • Generation of Rules. • **Chapter 7 Anomaly Detection** (2 contact hours; 2 self-study hours) • Characteristics of Anomaly Detection Problems • Characteristics of Anomaly Detection Methods • Anomaly Detection Based on Statistical Methods • Anomaly Detection Based on Proximity • Anomaly Detection Based on Clustering • Anomaly Detection Based on Reconstruction • Anomaly Detection Evaluation. • **Part B Practical teaching** (18 contact hours; 12 self-study hours) **Project 1 Setting Up the Python Development Platform and Installing Data Analysis Tools** (2 contact hours; 1 self-study hour) • Setting Up the Python Development Platform • Introduction to Using Python • Python Data Analysis Tools. **Project 2 Data Mining in the Catering Industry** (2 contact hours; 1 self-study hour) • Basic Tasks of Data Mining • Data Mining Modeling Process • Common Data Mining Modeling Tools. **Project 3 Exploring Data and Preprocessing with Python** (4 contact hours; 2 self-study hours) • Data Quality Analysis • Data Feature Analysis • Key Python Functions for Data Exploration • Statistical Plotting Functions. **Project 4 Classification and Prediction Model Implementation with Python** (6 contact hours; 5 self-study hours)

	• Classification and Prediction Model Implementation with Python **Project 5 Clustering Algorithm Implementation with Python** (4 contact hours; 3 self-study hours) • Common Clustering Algorithms • Implementation Process of K-means
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Homework 20% • Presentation 5% • Exercise report 10% • Final Exam 60%
Reading list	**Required books** [1] Tan, P.-N., & et al. Introduction to Data Mining (2nd ed.) [M]. Translated by Duan, L., Zhang, T. Q., Machinery Industry Press, 2019. **Reference books** [1] Zhang, L., & et al. Python Data Analysis and Mining Practical Guide (2nd ed.) [M]. Machinery Industry Press, 2021. [3] Hastie, T., & et al. The Elements of Statistical Learning: Data Mining, Inference, and Prediction (2nd ed.) [M]. Translated by Zhang, J. P., Tsinghua University Press, 2020. [4] Chen, Y. Y., & et al. Transportation Big Data Technology and Its Applications [M]. People's Transportation Press, 2021. [5] Ma, X. L., & et al. Public Transportation Big Data Mining and Analysis [M]. People's Transportation Press, 2018. **Other materials** [1] PPT courseware (self-compiled)

5.17 Planning and Design of Transportation Terminals

Competence field	Electives
Module designation	Planning and Design of Transportation Terminals
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Dr. HUANG Junsheng, Lecturer
Language	Chinese
Relation to curriculum	This course, as an elective for the major, focuses on the planning and design theories of transportation stations and hubs, primarily for rail transit while also considering other transportation modes. Through this course, students will learn the principles and methods of planning and setting up transportation stations and hubs. The course covers six key areas: (1) Introduction to transportation stations and hubs, (2) Hubs and traffic flowlines, (3) Technical conditions for railway station design, (4) Passing, overtaking, and intermediate stations, (5) Section stations, and (6) Marshalling yards.
Teaching methods	lecture-based teaching; problem-based learning; case-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Introduction to Rail Transit, Transportation Organization Theory.
Module objectives/intended learning outcomes	This course aims to develop students' fundamental skills in analyzing, calculating, and drawing station layout diagrams, and to provide foundational knowledge in the design of intermediate, section, and marshalling stations. Additionally, students will be enabled to offer insights and suggestions on station design proposals. Specific objectives include: **Knowledge:** The course aims to equip students with a comprehensive understanding of the foundational theories in the planning and design of ports and transportation hubs. Students will gain an in-depth comprehension of the basic concepts, classifications, and functions of transportation stations and hubs, as well as their significance in integrated transport systems. By studying traffic flow design and optimization, technical conditions for railway station layouts, and characteristics of various types of stations (e.g., passing stations, overtaking stations, section stations, marshalling yards), students will master planning methods for transportation hubs. The course also covers the technical specifications and design standards for railway station equipment, laying a solid theoretical foundation for practical applications. **Skills:** Students will be able to:

	1) Master the analysis and design methods for traffic flowlines, enabling students to draw and optimize traffic flow charts. 2) Apply design standards to railway station layouts, including turnout configurations, track spacing, and yard planning. 3) Develop proficiency in designing layouts for various station types (e.g., intermediate and marshalling stations) and conducting case studies. 4) Skillfully use design software like CAD for basic drawings and designs of ports and hubs. **Competences:** Upon completion of this course, students will have developed: 1) Develop the ability to apply transportation hub planning theories to solve real-world problems and propose feasible design solutions. 2) Analyze and evaluate the layout and flowline design of transportation hubs to optimize station operational efficiency. 3) Demonstrate the ability to independently complete design and planning reports for station hub projects, with critical thinking skills. 4) Collaborate effectively within a team on research, design, and implementation of transportation projects, enhancing practical application skills.
Contents	**Part A Theoretical teaching** (36 contact hours; 15 self-study hours) **Chapter 1 Introduction to Transportation Stations and Hubs** (4 contact hours; 1 self-study hour) • Concepts, functions, classifications, and significance of ports and hubs. • Principles, basic requirements, strategies, steps, and influencing factors for planning and layout of ports and hubs. **Chapter 2 Hubs and Traffic Flowlines** (4 contact hours; 2 self-study hours) • Definition and description of traffic flowlines. • Types and analysis of traffic flowlines. • Relationships and coordination of traffic flowlines. • Design and organization of traffic flowlines. • Configuration of traffic signage and markings. **Chapter 3 Technical Conditions for Railway Station Design** (6 contact hours; 3 self-study hours) • Basic concepts of railway station design: track lines, clearance limits, station classification, sections, numbering rules, etc. • Methods for determining track spacing at railway stations. • Connection of railway station tracks. • Calculation of the total and effective length of station tracks. • Ladder tracks and yard design. • Horizontal and vertical profile design of railway stations. **Chapter 4 Passing, Overtaking, and Intermediate Stations** (8 contact hours; 3 self-study hours) • Basic concepts of passing stations, overtaking stations, and intermediate stations. • Layout features, advantages, and disadvantages of passing station designs. • Layout features, advantages, and disadvantages of overtaking station designs.

	• Layout features of intermediate station designs and types of equipment used. • Renovation and upgrading of intermediate stations. **Chapter 5 Section Stations** (8 contact hours; 3 self-study hours) • Distribution, classification, types of operations, and equipment of section stations. • Layout of section stations. • Design and layout of operational equipment in section stations. • Calculation of throughput capacity in section stations. **Chapter 6 Marshalling Yards** (6 contact hours; 3 self-study hours) • Definition, types, operations, and equipment used in marshalling yards. • Classification of marshalling yard layouts and main layout types. • Selection of marshalling yard layout types. • Calculation of throughput capacity in marshalling yards. **Part B Practical teaching** (18 contact hours; 21 self-study hours) **Project 1 Functional Analysis and Planning of Transportation Stations and Hubs** (3 contact hours; 3 self-study hours) • Conduct a functional analysis of a real-world urban transportation hub based on the concepts of ports and hubs. Consider the classification, functions, and role of the hub in an integrated transportation system, and propose planning improvements to enhance analytical skills in transportation hub planning. **Project 2 Optimization Design of Traffic Flowlines** (5 contact hours; 5 self-study hours) • Select a transportation hub scenario (such as a railway station or airport) to analyze internal traffic flowlines and propose optimization solutions. Draw flow diagrams, identify bottlenecks, and design improvements to enhance the efficiency of passenger and cargo flow, focusing on practical application in traffic flowline design and optimization. **Project 3 Layout and Turnout Design for Railway Stations** (3 contact hours; 5 self-study hours) • Design the layout of a railway station, including turnout configurations, track spacing, and yard planning. Follow relevant design standards and consider the requirements of different station types to ensure safety and operational efficiency, mastering the technical conditions of railway station design. **Project 4 Case Study Analysis of Intermediate and Section Stations** (4 contact hours; 5 self-study hours) • Conduct case studies on intermediate and section stations by analyzing typical examples from both domestic and international contexts. The analysis should cover layout characteristics, functional zoning, and operational efficiency, followed by a report with improvement suggestions to enhance understanding of practical railway station planning and design. **Project 5 Marshalling Yard Design and Capacity Calculation**

	(3 contact hours; 3 self-study hours) • Design the layout of a marshalling yard and perform capacity calculations. Consider various operational processes and equipment configurations, analyzing their impact on overall railway efficiency to develop comprehensive skills in marshalling yard planning and design.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 15% • Homework 25% • In-class tests 10% • Final exam 50%
Reading list	**Required books** [1] Zhang, C. Design of Railway Stations and Hubs [M]. Southwest Jiaotong University Press, 2019. **Reference books** [1] Liu, Z. Transport Ports and Hubs [M]. Southwest Jiaotong University Press, 2018. [2] Deng, Y. Planning and Design of Urban Transportation Stations and Hubs [M]. People's Transportation Publishing House Co., Ltd., 2018. **Other materials** [1] PPT courseware (self-compiled)

5.18 Traffic System Analysis

Competence field	Electives
Module designation	Traffic System Analysis
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Dr. HE Yuxin, Associate Professor
Language	Chinese
Relation to curriculum	Traffic System Analysis is an elective course tailored for students majoring in Transportation Engineering. This course comprehensively covers the core theories, methods, and practical applications of traffic systems. The curriculum encompasses a variety of modules including general system theory and introduction to traffic system analysis, traffic demand and supply analysis, traffic network system analysis, traffic hub system analysis, regional traffic system analysis, traffic system evaluation and decision-making, traffic transportation layout and planning, and informationization and intelligentization of traffic systems. Students will master the definition, attributes, and classification of systems, learn about the evaluation and decision-making methods of traffic systems, grasp the analysis process and thinking of traffic systems, and cultivate the ability to collect and research information, as well as skills in analysis and reporting..
Teaching methods	lecture-based teaching; problem-based learning; case-based learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching Contact hours: 54 hours Size of class: no more than 80 students for theoretical teaching
Workload	Workload =90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Operations Research, Traffic Engineering, Transport Economics
Module objectives/intended learning outcomes	This course aims to equip students with a comprehensive understanding of traffic system analysis, enabling them to analyze and evaluate the dynamics of traffic networks, transportation systems, and regional planning. It will provide a foundation in both the theoretical and practical aspects of traffic system operations, including traffic demand and supply, network design, transportation planning, and the intelligent management of traffic systems. Specific objectives include: **Knowledge:** This course will offer a detailed understanding of the general principles of traffic system analysis, including traffic demand and supply analysis, traffic network systems, traffic hubs, and regional traffic systems. Students will learn about traffic system evaluation, decision-making processes, transportation layout and planning, and the integration of information technology and intelligence into traffic systems. Additionally, students will explore the methods used to analyze and optimize traffic flow and evaluate system efficiency.

	Skills: Students will be able to: 12) Apply traffic demand-supply models to real-world situations to understand and predict traffic flow patterns. 13) Use traffic network models to evaluate the performance and efficiency of transportation systems. 14) Employ system evaluation methods to analyze the effectiveness of various traffic strategies and policies. 15) Apply principles of transportation layout and planning to design efficient and sustainable urban transportation systems. 16) Use traffic system simulation tools to assess traffic management practices and propose intelligent transportation solutions. **Competences:** Upon completion of this course, students will have developed: 9) The ability to conduct comprehensive analyses of traffic systems and networks, applying both theoretical and practical tools. 10) The capability to assess and optimize transportation systems in urban and regional settings, considering factors such as traffic demand, infrastructure, and technological integration. 11) A critical understanding of the current challenges and trends in traffic system management and intelligent transportation systems. 12) The skills to design and implement strategies for improving the performance and sustainability of transportation systems.
Contents	**Part A Theoretical teaching** (36 contact hours; 24 self-study hours) **Chapter 1 General Introduction to Systems and Traffic System Analysis** (2 contact hours; 1 self-study hour) • Explain the definition and attributes of a system; • Introduce the classification, structure, and functions of systems; • Teach students how to integrate systems thinking and system science; • Introduce the overview of traffic systems and the basic theories of traffic system analysis, thereby laying a theoretical foundation for the study of traffic system analysis. **Chapter 2 Traffic Demand and Supply Analysis** (8 contact hours; 6 self-study hours) • Explain how to analyze traffic demand and the passenger and freight flow system; • Explain how to analyze traffic supply; • Discuss methods for analyzing traffic supply and demand equilibrium **Chapter 3 Traffic Network System Analysis** (8 contact hours; 6 self-study hours) • Explain the formation of traffic networks; • Network equilibrium and traffic flow; • Network flow distribution models; • Structural optimization of traffic networks. • These are important aspects of traffic system analysis, regional, and urban traffic planning. **Chapter 4 Traffic Hub System Analysis**

	(6 contact hours; 3 self-study hours) • Explain the system characteristics, functions, and classification of traffic hubs; • Configuration of equipment systems within traffic hubs; • Coordination of various modes of transport within traffic hubs **Chapter 5 Regional Traffic System Analysis** (4 contact hours; 2 self-study hours) • Introduce the relationship between regional economy and regional traffic; • Introduce the content of regional traffic system analysis; • Analyze regional integrated transport systems and comprehensive transport capacity • **Chapter 6 Traffic System Evaluation and Decision-Making** (4 contact hours; 2 self-study hours) • Introduce the evaluation index system of traffic systems; • Introduce methods for system evaluation and decision-making • **Chapter 7 Transportation Layout and Planning** (2 contact hours; 2 self-study hours) • Introduce relevant theories and practical cases in transportation layout and planning; • Evaluate transportation planning. • **Chapter 8 Traffic System Informatization and Intelligence** (2 contact hours; 2 self-study hours) • Introduce Intelligent Transportation Systems (ITS) and the main subsystems of ITS; • Introduce railway transportation management information systems, waterway intelligent transportation systems, and aviation intelligent transportation systems. **Part B Off-class practice** (18 contact hours; 12 self-study hours) **Project 1 Group investigation and presentation** (18 contact hours; 12 self-study hours) • Publish relevant case studies related to each chapter of the course. Students are required to select a case that interests them, investigate, and collect data, then analyze the case using system analysis methods. • Form groups independently. Each group should complete an investigation report (indicating the division of work among team members) and prepare a PowerPoint presentation, followed by a report lasting no longer than 20 minutes.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, and assignment completion rate over 2/3 are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance& Class performance 15% • In-class test 10% • Presentation 7% • Investigation report 8% • Final exam 60%
Reading list	**Required books** [1] Liu, L., et al. Transportation System Analysis (2nd Edition) [M].

	Southwest Jiaotong University Press, 2014. **Reference books** [1] Drafting Group of the Outline for the Construction of a Strong Transportation Nation. Study Reader for the Outline for the Construction of a Strong Transportation Nation [M]. People's Transport Press Co., Ltd., 2020. [2] Chu, C., et al. Development Strategy for Transportation Science and Technology Innovation in the New Era [M]. People's Transport Press, 2020. [3] Feng, S. Transportation System Analysis [M]. People's Transport Press Co., Ltd., 2016. [4] Zhang, G. Transportation System Analysis [M]. Southwest Jiaotong University Press, 2007. **Other materials** [1] PPT courseware (self-compiled)

5.19 Project Management

Competence field	Electives
Module designation	Project Management
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Dr. ZHANG Ting, Associate Professor
Language	Chinese
Relation to curriculum	This course provides students with a comprehensive introduction to the basic principles and application characteristics of project management. It combines typical project management case studies to introduce core concepts of project management, as well as application skills in communication management, conflict management, risk management, and team management. The course also uses project examples to illustrate the application of methods and tools such as milestone planning, work breakdown structure, network planning techniques, resource cost curves, earned value analysis, and MS Project in the project management process. Additionally, it introduces comprehensive application cases of project management in engineering construction, software development, product development, and program management. The course also showcases practical applications of project management in enterprises through examples from Huawei's project management, Tianshi Li's project-based management, and the project management system construction of China National Petroleum Corporation's Design Company.
Teaching methods	lecture-based teaching; problem-based learning; case-based learning; hands-on labs; seminar-based teaching; flipped classroom
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Operations Research
Module objectives/intended learning outcomes	This course aims to cultivate students' ability to integrate management science and engineering technology, as well as their abstract thinking and logical reasoning skills. It also seeks to develop students' ability to apply knowledge of management science to solve practical problems, laying a solid foundation for further studies and scientific research. Specific objectives include: **Knowledge:** This course systematically introduces the fundamental concepts and principles of project management, including the lifecycle of a project, the ten knowledge areas, and the five process groups. It covers the development of project management, its characteristics, and how it aligns with organizational strategy. The course also delves into the tools

	and techniques used in project scope, time, quality, risk, and cost management, as well as the importance of integrating these areas for effective project execution. **Skills:** Students will be able to: 1) Understand the development and evolution of project management, and master the theoretical foundations of project management processes and knowledge areas. 2) Analyze and apply project management tools such as work breakdown structures (WBS), network diagrams, and earned value management. 3) Develop project management plans, including scope, time, quality, risk, and cost management plans. 4) Utilize software tools like Microsoft Project for project planning, scheduling, and resource allocation. 5) Identify and manage risks, including risk identification, analysis, and response planning. 6) Conduct quality planning, assurance, and control to ensure project deliverables meet stakeholder expectations. **Competences:** Upon completion of this course, students will have developed: 1) Practical abilities to manage projects from initiation to closure, applying project management knowledge areas and process groups effectively. 2) The ability to critically analyze project requirements and constraints, and to make informed decisions throughout the project lifecycle. 3) Effective communication and collaboration skills to work with diverse project teams and stakeholders. 4) A strategic mindset to align project objectives with organizational goals and to contribute to strategic planning and execution. 5) An innovative approach to problem-solving and adapting project management practices to meet the unique challenges of different projects and industries.
Contents	**Part A Theoretical teaching (36 contact hours; 24 self-study hours)** **Chapter 1 Project Management Concepts** (5 contact hours; 3 self-study hours) • Development and characteristics of project management applications domestically and internationally • Basic principles of successful project management • How to achieve project-based management of corporate strategy **Chapter 2 Project Scope Management** (6 contact hours; 4 self-study hours) • Project scope planning • Project requirement collection • Project scope decomposition • Project scope control **Chapter 3 Project Time Management** (6 contact hours; 4 self-study hours) • Project activity decomposition and sequencing • Project activity resource estimation • Network diagrams • Project schedule formulation

	• Calculation of flow rhythm • Project progress control **Chapter 4 Project Quality Management** (7 contact hours; 5 self-study hours) • Overview of project quality management • Project quality planning • Project quality assurance • Project quality control **Chapter 5 Project Risk Management** (5 contact hours; 3 self-study hours) Overview of project risk management • Project risk management planning • Project risk identification • Project risk evaluation • Project risk response strategies • Project risk control **Chapter 6 Project Cost Management** (7 contact hours; 5 self-study hours) • Overview of project cost management • Project resource planning • Project cost budgeting • Project cost control • Earned value analysis **Part B Practical teaching** (18 contact hours; 12 self-study hours) **Project 1 Microsoft Project 2013 Cognition** (6 contact hours; 4 self-study hours) • Installation and configuration of Project • Basic operations of Project **Project 2 Project Management Process Experiment** (6 contact hours; 4 self-study hours) • Project time management experiment • Project progress management experiment • Project resource management experiment • Project cost management experiment **Project 3 Project Management Plan Design and Implementation Based on Microsoft Project 2013** (6 contact hours; 4 self-study hours) • Mastering the joint control and management of project progress, resources, and costs through operation • Practical operation of project files
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 10% • Presentation 5% • Report 5% • Test 20%

	• Final exam 50%
Reading list	**Required books** [1] Chen, G. (2021). Project Management [M]. China Renmin University Press. **Reference books** [1] Zuo, X., et al. (2017). Project Management Theory and Practice [M]. Mechanical Industry Press. [2] Jing, R., et al. (2018). Project Management Experiment Tutorial [M]. Shanghai University of Finance and Economics Press.

5.20 Modern C++ Programming

Competence field	Electives
Module designation	Modern C++ Programming
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Dr. JIN Meihan, Assistant Professor
Language	Chinese
Relation to curriculum	"Modern C++ Programming" is one of the courses in the direction of intelligent transportation. C++ programming is the fundamental language for using computers to solve practical problems. Through the study of this course, students will master the basic knowledge of C++ programming and programming methods, as well as use computers to solve actual traffic problems. The course aims to cultivate students' abilities, qualities, and ways of thinking in computer programming design, with an emphasis on improving programming skills and project completion capabilities. It serves as technical support for the construction of intelligent transportation systems and the design of complex traffic algorithms, and lays a solid foundation for courses such as "Artificial Intelligence Technology and Applications".
Teaching methods	lecture-based teaching; blended learning; hands-on labs
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Linear Algebra
Module objectives/intended learning outcomes	The course C++ Programming is designed to provide students with a solid foundation in programming principles and practices using the C++ language. The overarching goal is to equip students with the knowledge, technical skills, and problem-solving competencies necessary to design, develop, and debug efficient and robust software applications. Students will have developed a comprehensive understanding of C++ programming, gained hands-on experience in solving real-world problems, and acquired the foundational skills necessary to pursue advanced topics in software development or related fields. Specific objectives include: **Knowledge:** This course will provide a basic and a systematic knowledge of C++ Programing. The student will learn about 1) fundamental concepts of programing, including variables, data types, operators, and expressions; 2) object-oriented programming 3) algorithm and data structures; 4) managing files and 5) advantages and applications of using C++ programing. **Skills:**

	Students will be able to: 1) Programming proficiency: Writing, compiling, and executing C++ programs. Utilizing modern integrated development environments (IDEs) effectively. 2) Debugging and testing: identifying and resolving syntax, runtime, and logical errors and writing test cases to validate program functionality. 3) Code optimization: improving code efficiency in terms of performance and memory usage **Competences:** Upon completion of this course, students will have developed: 1) Problem-solving Skills: decomposing complex problems into manageable components and developing algorithms and implementing them using C++. 2) Team collaboration: working on group projects to develop larger software applications. 3) Analytical thinking: evaluating program performance and refining solutions and understanding and implementing design patterns in software development.
Contents	**Part A Theoretical teaching** (36 contact hours; 18 self-study hours) **Chapter 1 Brief Introduction of Programming** (4 contact hours; 2 self-study hours) • To master: characteristics of the C++ programming language. • To comprehend: basic principles of programming languages. • To know about: differences between C++ and other programming languages. **Chapter 2 Fundamentals of C# Programming** (4 contact hours; 2 self-study hours) • To master: declaration and usage of variables and use of operators and expressions, including increment, decrement, and ternary operators. • To know about: differences between value types and reference types. **Chapter 3 Control Flow** (4 contact hours; 2 self-study hours) • To master: • 1) Boolean logic. • 2) Branching statements. • 3) Looping statements. **Chapter 4 Complex Variables** (4 contact hours; 2 self-study hours) • To master: usage of arrays and string class and its common properties and methods. • To comprehend: storage structure of strings and physical storage structure of arrays. **Chapter 5 Functions** (4 contact hours; 2 self-study hours) • To master: definition and usage of functions and declaration and scope of function variables. • To comprehend: scope of different types of variables.

	Chapter 6 Error and Exception Handling (4 contact hours; 2 self-study hours) • To master: try-catch statements and exception handling. • To know about: mechanisms for catching exceptions. **Chapter 7 Object-Oriented Programming** (4 contact hours; 2 self-study hours) • To master: 1) fields and member variables; 2) object-oriented programming principles; 3) interfaces, delegates, and events; 4) method overloading and overriding, abstract classes, and abstract methods; 5) operator overloading, generics, and namespaces. • To comprehend: parameters in method, fields, member variables, and properties. **Chapter 8 File Reading and Editing** (4 contact hours; 2 self-study hours) • To master: Input and output streams, file streams, functions and usage of the file, functions and usage of the directory reading. • To know about: working mechanism of streams, asynchronous file access, and monitoring file structures. **Chapter 9 Windows Forms Programming** (4 contact hours; 2 self-study hours) • Overview of form interface design. • Design of main menus and context menus. • Toolbars and status bars: • Designing menus and toolbars with reliable functionalities. • Creating MDI applications. • To master:1) designing and implementing application menus using menu controls such as MenuStrip, writing event-handling code, and implementing menu functionalities; 2) designing toolbars and status bars using toolbar and status bar controls, writing event-handling code, and implementing functionalities; 3) writing applications to invoke common dialog boxes using dialog box classes. **Part B Practical teaching** (18 contact hours; 18 self-study hours) **Project 1 Basics of Programming and Mathematical Calculations** (2 contact hours; 2 self-study hours) • Master the fundamentals of program design. • Understand input and output methods. • Learn the use of operators in programming. **Project 2 Array Traversal** (2 contact hours; 2 self-study hours) • Learn how to define and initialize arrays. • Understand the method for generating random numbers. • Master the use of iteration to traverse arrays. **Project 3 Functions and Class Encapsulation** (4 contact hours; 4 self-study hours) • Learn how to define and implement class interfaces, achieving multiple inheritance through interfaces. • Understand delegates, events, and how to dynamically call methods using them. • Master the concept of polymorphism and its application. • Learn operator overloading and the basic use of generics in

	programming. **Project 4 File Management and Processing** (4 contact hours; 4 self-study hours) • Master the use of input and output streams. • Read and write .txt files. • Read and write Word files (.docx). • Read and write Excel files (.xlsx). **Project 5 Management System Design** (6 contact hours; 6 self-study hours) • Learn the methodology for designing a comprehensive and functional management information system. • Integrate the knowledge and programming techniques learned in the course to create and implement a self-defined MIS.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 5% • Homework 20% • In-class test 5% • Experiment report 30% • Final Exam 40%
Reading list	**Required books** [1] Stanley B.Lippman, Essential C++, Publishing House of Electronics Industry, 2013. **Reference books** [1] Bjarne Stroustrup. The C++ Programming Language, 4th Edition, Addison-Wesley Professional, 2013. [2] Stanley B. Lippman , José Lajoie , Barbara E. Moo, C++ Primer 5th Edition, Addison-Wesley Professional, 2012. [3] Stanley B.Lipman, Inside The C++ Object Model, Publishing House of Electronics Industry, 2012. [4] Scott Meyers. Effective C++, Publishing House of Electronics Industry, 2012. **Other materials** [1] PPT courseware (self-compiled)

5.21 Measurement and Application of Key Standards

Competence field	Electives
Module designation	Measurement and Application of Key Standards
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Ms. WEI Mei, Engineer
Language	Chinese
Relation to curriculum	This course is a public elective course open to all students of Transportation Program. In the new era, national quality infrastructure centered on metrology plays an indispensable supporting role in enhancing independent innovation, promoting high-quality development, and facilitating social governance. With the development of modern enterprises, especially the in-depth integration of industrialization and informatization, the importance of metrology and testing will be further highlighted. Giving full play to the restrictive, guiding, and measuring role of metrology and standards is conducive to driving the upgrading of technological processes and equipment in key fields, as well as the implementation of systems such as energy-saving product certification. The course helps students establish the concept of metrology system, master metrology calibration and testing methods, improve the ability to apply metrology and standards, and promote the development of standardization construction and the application of metrology testing technology in product design and manufacturing, organizational management and service processes in various industries.
Teaching methods	lecture-based teaching; blended learning; case-based learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practice teaching Contact hours: Total 36 hours Size of class: no more than 80 students for theoretical teaching
Workload	Workload = 60 hours Contact hours = 36 hours Self-study hours = 24 hours
Credit points	2.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	The overall goal of this course is to enable students to master the basic concepts and mechanism of action of metrology, understand the principles and methods of metrology management and the content of key standards; through learning the application of standardization in metrology work and demonstration cases, students can have a clear understanding of key metrology management standards; at the same time, group activities themed on metrology and key standardization management are arranged to help students deeply understand the significance and role of metrology and standards, establish the concept of metrology system, master metrology calibration and testing methods, and improve the ability to apply metrology and standards. **Knowledge:** 1) Master the definition, characteristics and important role of metrology; master the methods of radionuclide metrology, the current situation of radiological health standard management, the vertex power quantity

	traceability and transmission system, the development of ophthalmic optical metrology devices and their standards, the definition and application of ionizing radiation metrology system, the medical application of ionizing radiation, the national food safety chemical metrology value traceability system, the basic concepts and traceability of reference materials, medical metrology and medical device supervision, and medical metrology technical regulations. 2) Understand the international metrology system and organizational structure, the responsibilities and tasks of national metrology institutes, the basic situation of the National Institute of Standards and Technology (NIST) of the United States, China's nanometrology capabilities, the main characteristics of metrology management, measurement standards, radioactive detection principles, ionizing radiation detectors, the introduction of the international "Ophthalmic Optics and Instruments" sub-technical committee and related standards, the three elements of metrology detection, national calibration and measurement capabilities in the field of food safety, medical metrology and the development of modern medicine, the new situation faced by medical metrology, and medical quality and safety management standards. 3) Know about international mutual recognition agreements on metrology, national strategies for metrology services, the definition of the International System of Units (SI), the application of nano-measuring instruments in key fields, comprehensive metrology support of micro-nano testing platforms, nano-material testing and standards, the development laws of metrology management, the discovery, development and application of radioactivity, ophthalmic optical metrology instruments, the development history of ionizing radiation metrology, the international mutual recognition platform for food safety chemical metrology, international cooperation in the field of food safety metrology, and medical-related metrology technical committees. **Skills:** Students will be able to 1) Collect and analyze domestic and foreign literature and case data related to metrology and standards, summarize the application status and future prospects of metrology testing technology in related professional fields, and complete group project research reports. 2) Participate in enterprise classroom activities, conduct on-site investigations and learning in institutions with outstanding metrology application and standardization management, and compile practical learning reports to reflect the practical application of metrology and standards. 3) Make PPT based on course content, conduct project reporting (including project proposal, mid-term and final reporting), and demonstrate the ability to present research results and respond to on-site questions. 4) Develop independent thinking and teamwork ability, and collaborate with group members to complete in-class practice tasks. **Competences:** Upon completion of this course, students will have developed: 1) Recognize the important role of metrology in national quality infrastructure, social and economic development, and people's health protection, and form a systematic understanding of the metrology system. 2) Establish the awareness of standardization, and be able to apply

	metrology and standard knowledge to analyze the role of standardization construction in product design, manufacturing, organizational management and service processes. 3) Improve communication and cooperation skills through group project research and on-site practice, and learn to coordinate and solve problems in team collaboration. 4) Cultivate the ability to connect theoretical knowledge with practical applications, and explore the application potential of metrology and standards in different professional fields.
Contents	**Part A: Theoretical Teaching** (27 contact hours;20 self-study hours) **Chapter 1: Concept and Role of Metrology** (4 contact hours; 2 self-study hours) • Teaching Content: Definition of metrology: Formation and development of China's metrology system; Importance of metrology; Characteristics of metrology. Role of metrology: Achievements of China's metrology basic research; Metrology supporting national needs and national economy; Metrology for people's health: safeguarding concepts, execution ways, practical effects. • Learning Outcomes: Master the definition and important role of metrology; understand the international metrology system and organizational structure; know about international mutual recognition agreements on metrology and national strategies for metrology services. **Chapter 2: Domestic and Foreign Metrology Systems and International Metrology Cooperation** (4 contact hours; 2 self-study hours) • Teaching Content: Overview of the international metrology system; International cooperation of the National Institute of Metrology of China (bilateral cooperation, multilateral cooperation, technical assistance). • Learning Outcomes: Master international metrology organizations and metrology institutions of major industrialized countries; understand the responsibilities and tasks of national metrology institutes and the basic situation of the National Institute of Standards and Technology (NIST) of the United States; know about the definition of the International System of Units (SI). **Chapter 3:Metrology and Key Standards in the Micro-Nano World** (4 contact hours; 3 self-study hours) • Teaching Content: Nanometrology: Nanometrology: definition, core roles, application scenarios; Nanometrology and nanotechnology standards; Nanogeometric quantity traceability system (whole chain): overall design concepts, design methods, practical application value ;National metrology standard devices. Traceability and transmission system: Development and demonstration application of nano-standard devices ;Nanometrology social public metrology standards: establishment concepts, formulation methods, implementation effects. • Learning Outcomes: Master the main content of nanometrology and the overall design of the nanogeometric quantity traceability system; understand the current situation of China's nanometrology capabilities; know about the application of nano-measuring

	instruments in key fields, comprehensive metrology support of micro-nano testing platforms, and nano-material testing and standards. **Chapter 4: Metrology Management** (4 contact hours; 3 self-study hours) • Teaching Content: Basic principles of metrology management; Basic methods of metrology management; International & regional metrology organizations: core concepts, development status, future trends; Metrology management of developed countries: management concepts, implementation methods, development strategies • Learning Outcomes: Master the basic principles of management and the basic tasks of metrology management; understand the main characteristics of metrology management and measurement standards; know about the development laws of metrology management. **Chapter 5:Nuclear Metrology and Practical Application of Related Standards** (2 contact hours; 2 self-study hours) • Teaching Content: Definition of radioactivity and nuclides; Detection of radioactivity; Radionuclide metrology: Quantities and units; Value traceability system; Radionuclide metrology: core characteristics, measurement methods, practical values.Radiological medical management standardization: construction concepts, implementation methods, practical cases. • Learning Outcomes: Master the methods of radionuclide metrology and the current situation of radiological health standard management; understand the principle of radioactive detection and ionizing radiation detectors; know about the discovery, development and application of radioactivity. **Chapter 6:Ophthalmic Optical Metrology and Practical Application of Related Standards** (2 contact hours; 2 self-study hours) • Teaching Content: Current situation of domestic ophthalmic optical metrology work; Ophthalmic optical metrology work: Research content; Vertex power quantity traceability and transmission system: system concepts, construction methods, operation effects; Metrology base standards: standard concepts, formulation bases, application scopes; Vertex power quantity traceability and transmission system: system concepts, construction methods, operation effects. Interpretation of ophthalmic optical instrument standards. • Learning Outcomes: Master the vertex power quantity traceability and transmission system and the development of ophthalmic optical metrology devices and their standards; understand the introduction of the international "Ophthalmic Optics and Instruments" sub-technical committee and the summary of related standards; know about ophthalmic optical metrology instruments. **Chapter 7:Ionizing Radiation Metrology and Practical Application of Related Standards** (2 contact hours; 2 self-study hours) • Teaching Content: Concept of metrology system; Ionizing radiation metrology system: Ionizing radiation physical quantities;

	Ionizing radiation metrology system in life: application concepts, practical scenarios, functional values; Ionizing radiation medical application: application directions, implementation methods, practical effects.Interpretation of standards related to ionizing radiation protection and radiation source safety. • Learning Outcomes: Master the definition and application of the ionizing radiation metrology system and the medical application of ionizing radiation; understand the three elements of metrology detection; know about the development history of ionizing radiation metrology. **Chapter 8:Food Safety Metrology and Practical Application of Related Standards** (2 contact hours; 2 self-study hours) • Teaching Content: Overview of food safety chemical metrology: Food safety chemical metrology vs. analytical testing: comparison dimensions, core differences, practical application scenarios; National food safety chemical metrology value traceability system: system concepts, construction methods, operation effects; Reference materials: basic concepts, traceability principles, application standards. Current situation of food safety chemical metrology: National calibration and measurement capabilities (food safety field): capability scope, technical standards, application scenarios.International reference material database; Food safety reference materials (national metrology institutes worldwide): material types, technical indicators, application values.Application of food safety chemical metrology. • Learning Outcomes: Master the national food safety chemical metrology value traceability system and the basic concepts and traceability of reference materials; understand the national calibration and measurement capabilities in the field of food safety; know about the international mutual recognition platform for food safety chemical metrology and international cooperation in the field of food safety metrology. **Chapter 9:Medical Metrology and Practical Application of Related Standards** (2 contact hours; 2 self-study hours) • Teaching Content: Basic knowledge of medical metrology; Medical metrology serving medical device supervision: Medical metrology (various departments) value traceability system: system structure, operation methods, application effects;Medical equipment value traceability: traceability principles, implementation paths, practical functions; Medical metrology technical regulations: regulation connotations, formulation standards, implementation requirements. Application of medical metrology: Ophthalmic optical metrology: core objects, measurement methods, application scenarios; Medical radiation metrology: measurement indicators, technical standards, practical functions; Vital sign measurement and support: measurement objects, support methods, application values. Application and practice of standardized system in medical management. • Learning Outcomes: Master medical metrology and medical device supervision and medical metrology technical regulations; understand medical metrology and the development of modern medicine, the new situation faced by medical metrology, and medical quality and safety management standards; know about

	medical-related metrology technical committees. **Part B: Practical Teaching** (9 contact hours; 4 self-study hours) **Practice Project 1: Investigation on the Application of Metrology Testing Technology in Related Professional Fields** (6 contact hours; 3 self-study hours) • Teaching Content: Based on the learning of basic metrology knowledge and the practice of standardization application, form thematic project groups, collect domestic and foreign literature and cases, conduct investigation and analysis, and summarize the application status and future prospects of metrology testing technology in related professional fields. • Learning Outcomes: Consolidate existing theoretical knowledge, exercise practical operation ability, enable students to be familiar with the collection channels of domestic and foreign literature and data, cultivate the habit of reading literature materials, improve the ability of reporting and on-site response, and at the same time cultivate students' independent thinking and teamwork spirit. • Implementation Form: Each group conducts investigation and reporting activities (proposal, mid-term, final reporting) according to the topic of the in-class practice project. • Assessment Content: Pre-data collection, progress division of labor; Learning of new knowledge and skills, feasibility and innovation of arguments, integrity of results, on-site reporting, efficient and smooth teamwork. The score is based on 100 points (50% for individual contribution, 50% for group competition results). **Practice Project 2: Enterprise Classroom** (3 contact hours; 1 self-study hour) • Teaching Content: Organize students to visit institutions with outstanding performance in metrology application and standardization management for investigation and learning, and have professionals from the institutions explain knowledge related to metrology application and metrology standards and typical cases. • Learning Outcomes: Understand the requirements of metrology management and the application of standards, and through on-site observation, practically understand the application of metrology testing and metrology standards in practical work and their effects. • Implementation Form: Visit well-known institutions, on-site perception, lectures by enterprise teachers, sharing and interview exchanges. Assessment Content: Compile a practical learning report as homework.
Examination forms	1. Regular assessment: Attendance (random check), class performance (class Q&A and interaction), PPT presentation (based on course content, including project proposal, mid-term and final reporting), in-class practice (performance in practice activities, practical learning report). 2. Final assessment: Group competition (comprehensive evaluation based on the review score of the group's research results and final reporting).
Study and examination requirements	1. Students must actively participate in in-class teaching and in-class practice activities (including group project research, enterprise classroom visits, project reporting), and complete the assigned learning tasks (literature collection, group research reports, practical learning reports, PPT production) on time. 2. The composition of the overall grade (minimum passing score: 60) is as follows: • Regular Grades 50% (Attendance 10%, Class Performance 20%, PPT

	Presentation 10%, In-class Practice 10%); • Final Exam (Group Competition Results) 50%.
Reading list	**Required Textbook:** None **Reference Books:** 1. Li Dongsheng, Fundamentals of Metrology, China Machine Press, 2014. 2. Hong Shengwei, Metrology Management, China Quality Inspection Press & China Standards Press, 2020. 3. Li Deming, Wang Aosheng, Fundamentals of Metrology, Tongji University Press, 2007.

5.22 Artificial Intelligence Technology and Application

Competence field	Electives
Module designation	Artificial Intelligence Technology and Application
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Dr. LI Wei, Associate Professor
Language	Chinese
Relation to curriculum	This course is an elective for transportation major, aimed at those who are interested in the field of intelligent transportation. It introduces the basic knowledge of artificial intelligence (AI) and develops practical skills in relevant areas. The course focuses on providing an understanding of AI concepts, its historical development, and the three main concepts of AI. Students will explore major research areas and application domains, including computer vision, speech recognition, and natural language processing. Key AI technologies such as knowledge representation, expert systems, knowledge graphs, search techniques, machine learning, artificial neural networks, deep learning, robotics, and intelligent driving will also be introduced. The course will explain AI technologies from eleven perspectives: 1) Overview of artificial intelligence, 2) Learning from nature: intelligent search algorithms, 3) Deterministic knowledge systems, 4) Uncertain knowledge systems, 5) Machine learning, 6) Weak artificial intelligence: neural networks, 7) Natural language processing and image processing, 8) Distributed intelligence, 9) Autonomous driving and vehicle-road collaboration, 10) AI and fully automated subway driving, 11) The evolution of AI: strong AI and superintelligence.
Teaching method	lecture-based teaching; case-based learning; hands-on labs
Type of teaching, contact hours	Targeted students: students from Transportation major Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	Python Programming, Linear Algebra A, Probability and Statistics A
Module objectives/intended learning outcomes	Through this course, students will develop the research and application abilities necessary to address issues related to urban transportation operation and management, with a particular focus on computer software applications. The course will cultivate their skills in analyzing and solving practical problems within urban transportation systems, preparing them for roles in transportation planning, intelligent transportation, big data analysis, and related fields. Additionally, students will gain a solid understanding of intelligent transportation management concepts, setting the stage for further study in urban transportation and relevant professional knowledge. Specific objectives include:

	Knowledge: This course offers a comprehensive introduction to artificial intelligence, covering its fundamental concepts, development history, and the key characteristics of the three major concepts of AI. Students will explore primary research areas and application domains of AI, including computer vision, speech recognition, and natural language processing. Essential AI technologies relevant to the field will also be discussed, such as knowledge representation, expert systems, knowledge graphs, search algorithms, machine learning, artificial neural networks, deep learning, robotics, and intelligent driving. The course aims to help students understand how AI technologies can enhance the intelligent and information-driven operation of urban transportation systems. **Skills:** Students will be able to: 1) Learn the basic concepts and development history of Artificial Intelligence (AI), mastering the three major concepts of AI and their application fields. 2) Acquire proficiency key AI technologies, including knowledge representation, machine learning, and neural networks, thereby enhancing practical applications in intelligent transportation and autonomous driving. 3) Apply AI techniques to address real-world problems in the transportation sector, particularly in the design and optimization of intelligent transportation systems and autonomous vehicles. **Competences:** Upon completion of this course, students will have developed: 1) The ability to use acquired AI foundational knowledge to analyze and solve problems in intelligent transportation systems, particularly in areas such as intelligent scheduling, autonomous driving, and traffic flow prediction. 2) The competency to use AI techniques for traffic system optimization and automated management, and the ability to independently model and simulate intelligent transportation systems. 3) An understanding of AI applications across various transportation scenarios, with the ability to combine theory with practice, preparing students to tackle future challenges and developmental demands in the transportation industry. 4) The capacity to critically evaluate and make innovative contributions to the design and implementation of intelligent transportation systems, driving the advancement of intelligence in the transportation field.
Contents	**Part A Theoretical Teaching** (27 contact hours; 24 self-study hours) **Chapter 1: Overview of Artificial Intelligence** (2 contact hours; 2 self-study hours) ● Concept, origin, and development of Artificial Intelligence (AI) ● Different schools of thought in AI research ● Fifth-generation computers ● Research and application fields of AI, with a focus on Intelligent Transportation **Chapter 2: Learning from Nature: Intelligent Search Algorithms** (2 contact hours; 2 self-study hours) ● Overview of search algorithms

	● Genetic algorithms ● Ant colony algorithms ● Particle swarm optimization algorithms **Chapter 3: Deterministic Knowledge Systems** (2 contact hours; 2 self-study hours) ● Overview of deterministic knowledge systems ● Methods of deterministic knowledge representation ● Deterministic knowledge inference methods ● Simple examples of deterministic knowledge systems **Chapter 4: Uncertainty Knowledge Systems** (2 contact hours; 2 self-study hours) ● Overview of uncertainty reasoning ● Credibility reasoning ● Subjective Bayesian methods ● Fuzzy reasoning methods ● Probabilistic reasoning methods **Chapter 5: Machine Learning** (3 contact hours; 3 self-study hours) ● Overview of machine learning ● Linear regression ● Statistical learning ● Clustering algorithms **Chapter 6: Weak AI: Neural Networks** (3 contact hours; 2 self-study hours) ● Basic concepts and classifications of neural networks ● Perceptron concept ● BP neural networks ● Deep learning **Chapter 7: Natural Language Processing and Image Processing** (3 contact hours; 3 self-study hours) **Teaching Content:** ● Syntax analysis in natural language ● Question answering systems ● Recurrent neural networks ● Convolutional neural networks **Chapter 8: Distributed Intelligence** (3 contact hours; 2 self-study hours) ● Overview of distributed intelligence ● Agent structures and mechanisms ● Multi-agent systems ● Mobile agent systems **Chapter 9: Autonomous Driving and Vehicle-road Collaboration** (3 contact hours; 2 self-study hours)

	● Key technologies of vehicle-road collaboration ● Key technologies of autonomous vehicles **Chapter 10: AI and Fully Autonomous Subway Systems** (2 contact hours; 2 self-study hours) ● Driverless subway trains ● Fully automatic operation systems ● Intelligent scheduling ● Smart depots and stations ● Intelligent maintenance **Chapter 11: The Evolution of AI: Strong AI and Superintelligence** (2 contact hours; 2 self-study hours) ● The next generation of artificial intelligence ● The evolution of intelligence ● Strong AI ● Superintelligence **Part B Practical Teaching** (27 contact Hours; 12 self-Study Hours) **Project 1 Genetic Algorithm** (4 contact hours; 2 self-study hours) ● The principles of genetic algorithms and code implementation. **Project 2 Clustering Algorithms** (7 contact hours; 3 self-study hours) ● Understanding the concept of machine learning, and the principles and processes of unsupervised clustering algorithms. **Project 3 BP Neural Network** (6 contact hours; 2 self-study hours) ● Understanding the basic concepts, mathematical processes, and implementation mechanisms of BP neural networks. **Project 4 Convolutional Neural Networks** (6 contact hours; 3 self-study hours) ● Understanding the basic concepts, mathematical processes, and implementation mechanisms of convolutional neural networks. **Project 5 Application of A* Algorithm in Traffic** (4 contact hours; 2 self-Study hours) ● Understanding the basic concepts, mathematical processes, and implementation mechanisms of the A* algorithm.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10%

	• Homework 10% • Presentation 10% • Exercise report 20% • Final Exam 50%
Reading list	**Required books** [1] Wang, W. (2018). Principles of Artificial Intelligence and Its Applications (4th ed.). Electronic Industry Press. ISBN: 9787121344435. **Reference books** [1] Zhao, G. (2019). Redefining Transportation: How Artificial Intelligence Leads the Revolution in Transportation. Mechanical Industry Press. ISBN: 9787111640196. [2] Liu, S., & Gaudiot, Q. L. (2018). Autonomous Driving: How Artificial Intelligence Disrupts the Automotive Industry. Mechanical Industry Press. ISBN: 9787111611172.

Module 6 Mathematics and Physics

6.1 Advanced Mathematics A1

Competence field	Foreign Language
Module designation	College English A1
Semester(s) in which the module is taught	1st semester
Person responsible for the module	College English Teaching and Research Office
Language	English
Relation to curriculum	College English A1 is a core course within the General Education curriculum at Shenzhen Technology University, designed to enhance students' comprehensive English language proficiency. It aligns with the university's educational philosophy by integrating classroom instruction with practical applications. The course consists of six main chapters, covering various aspects of college life, relationships, holidays, leisure, language learning, and food culture.
Teaching methods	lecture-based teaching; blended learning; flipped classroom
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: Theoretical teaching Contact hours: 72 hours Size of class: No more than 60 students for theoretical teaching
Workload	Total Workload = 120 hours Contact Hours = 72 hours Self-study Hours = 48 hours
Credit points	4.0
Recommended prerequisites	High School English
Module objectives/intended learning outcomes	College English A1 is a core course within the General Education curriculum at Shenzhen Technology University, designed to enhance students' comprehensive English language proficiency. It aligns with the university's educational philosophy by integrating classroom instruction with practical applications. The course consists of six main chapters, covering various aspects of college life, relationships, holidays, leisure, language learning, and food culture, providing students with a solid foundation in both language skills and cultural understanding. Specific objectives include: **Knowledge:** 1) Expand students' English vocabulary and comprehension skills to read articles of moderate difficulty and depth. 2) Understand cultural nuances and social contexts relevant to English-speaking countries. **Skills:** Students will be able to 1) Develop students' abilities in English communication, both in writing and speaking.

	2) Enhance students' capabilities in cross-cultural interactions and formal written communication in English. **Competences:** Upon completion of this course, students will have developed: 1) Cultivate a habit of lifelong learning in English and the ability to integrate English learning into daily life. 2) Strengthen students' public speaking skills and their capacity to participate in English competitions or activities organized by the university.
Contents	**Part A: Theoretical Teaching** (72 contact hours; 48 self-study hours) **Chapter 1: College Life** (13 contact hours; 9 self-study hours) • English reading and writing skills development. • Introduction to college experiences and personal growth. **Chapter 2: People and Relationships** (12 contact hours; 8 self-study hours) • Understanding the impact of relationships and communication skills. **Chapter 3: Holidays and Traditions** (11 contact hours; 8 self-study hours) • Exploring the cultural significance of holidays and traditions. **Chapter 4: Leisure** (12 contact hours; 8 self-study hours) • Discussing the importance of leisure activities and their role in society. **Chapter 5: Language Learning** (13 contact hours; 8 self-study hours) • Motivations for learning languages and personal development. **Chapter 6: Food and Culture** (11 contact hours; 7 self-study hours) • The relationship between food and cultural identity.
Examination forms	Final Exam
Study and examination requirements	1) Students must achieve a minimum attendance requirement and complete all assigned tasks to be eligible for the final exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance and classroom performance 15% • Homework 10% • Autonomous listening study 15% • Listening and speaking group work 10% • Final exam 50%
Reading list	**Required Book** [1] Liu, J. *Pioneer College English: Integrated Course 1* [M]. Shanghai Foreign Language Education Press. [2] Zheng, S. *New Horizon College English: Writing, Listening, and Speaking 1 (Political Wisdom Edition)* [M]. Foreign Language Teaching and Research Press.

6.2 College English A2

Competence field	Foreign Language
Module designation	College English A2
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	College English Teaching and Research Office
Language	English
Relation to curriculum	University English A2 is a fundamental component of the 2024 undergraduate talent training program for the Transportation discipline. It is an integral part of the overall curriculum, aiming to develop students' comprehensive English application abilities through a blend of classroom and practical learning modes. This course aligns with the educational philosophy of Shenzhen Technology University, focusing on enhancing students' English proficiency and integrating moral education within the English learning process. The course consists of several chapters, including Orientation, The Influence of Mind over Body, The Teen Years, and Body Language.
Teaching methods	lecture-based teaching; blended learning; flipped classroom
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: Theoretical teaching Contact hours: 72 hours Size of class: No more than 60 students for theoretical teaching
Workload	Workload = 120 hours Contact Hours = 72 hours Self-study Hours = 48 hours
Credit points	4.0
Recommended prerequisites	University English A1
Module objectives/intended learning outcomes	University English A2 is a fundamental part of the 2024 undergraduate talent training program for the Transportation discipline. It is designed to develop students' comprehensive English application abilities through a combination of classroom learning and practical experiences. The course aligns with Shenzhen Technology University's educational philosophy by focusing on enhancing English proficiency and integrating moral education into the learning process. The course covers several chapters, including Orientation, The Influence of Mind over Body, The Teen Years, and Body Language, helping students build a well-rounded foundation in both language skills and personal development. Specific objectives include: **Knowledge:** 1) By the end of the course, students will have expanded their English vocabulary and be able to read articles of moderate difficulty and depth. They will also gain the ability to use English for cross-cultural communication and formal written communication. **Skills:** Students will be able to

	1) evelop their English listening and speaking skills through systematic training. They will be able to engage in interactive sessions with teachers during classes and improve their ability to communicate in English. **Competences:** Upon completion of this course, students will have developed: 1) practical abilities and innovative thinking in the field of English language application. They will be able to apply their knowledge to real-world scenarios, demonstrating competence in the practical aspects of English communication. Additionally, students will gain an understanding of the trends in English language development and the ability to critically evaluate and contribute to the ongoing evolution of English communication practices.
Contents	**Part A In-class Teaching** (48 contact hours; 15 self-study hours) *Chapter 1: Orientation and Course Introduction Chapter 2: The Influence of Mind over Body Chapter 3: The Teen Years Chapter 4: Body Language* **Part B In-class Practice** (18 contact hours; 12 self-study hours) *Moral Education Content from "New Horizon College English: Writing, Listening and Speaking 2"* **Part C Off-class Practice** (6 contact hours; 21 self-study hours) *Student Online Self-study through Unipus Platform*
Examination forms	Final Exam
Study and examination requirements	1) Students must achieve a minimum attendance requirement and complete all assigned tasks to be eligible for the final exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance and classroom performance 15% • Homework 10% • Autonomous listening study 15% • Mid-term exam 10% • Final exam 50%
Reading list	**Required Books** [1] Yang, H. Academic Encounters: Life in Society - Reading & Writing II [M]. Shanghai Foreign Language Education Press. [2] Yang, H. Academic Encounters: Life in Society - Watching, Listening & Speaking II [M]. Shanghai Foreign Language Education Press. [3] Zheng, S. New Horizon College English: Writing, Listening and Speaking 2 (New Political and ideological education Wisdom Edition) [M]. Foreign Language Teaching and Research Press. **Reference Books** [1] Chin, Y., Koizumi, Y., Reid, S., Wray, S., & Yamazaki, Y. Academic Writing Skills [M]. Cambridge University Press & Shanghai Foreign Language Education Press, 2017. [2] Smallwood, I., & Li, P. College English Creative Communication [M]. Macmillan Education & Shanghai Foreign Language Education Press, 2016. [3] Williams, I. English for Business [M]. Shanghai Foreign Language Education Press, 2013.

6.3 German for Beginners I

Competence field	Foreign Language
Module designation	German for Beginners I
Semester(s) in which the module is taught	3rd semester
Person responsible for the module	Prof. XIAN Peixin, Associate Professor
Language	German
Relation to curriculum	Elementary German I+ is an integral part of the 2024 undergraduate talent training program for the Transportation discipline at Shenzhen Technology University. This course aligns with the program's goals of producing high-quality composite talents and specialized applied talents by equipping students with basic German language skills, which is essential for their future engagements in international communication and collaboration within the field of transportation. The course is structured into six main units, covering topics such as German phonetics, basic communication, introduction to German-speaking countries, daily life, work, and leisure activities, all aimed at reaching the AI.1 level of the Common European Framework of Reference for Languages.
Teaching methods	lecture-based teaching; blended learning; flipped classroom
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: Theoretical teaching Contact hours: 72 hours Size of class: No more than 60 students for theoretical teaching
Workload	Workload = 120 hours Contact Hours = 72 hours Self-study Hours = 48 hours
Credit points	4.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	Elementary German I+ is a key component of the 2024 undergraduate talent training program for the Transportation discipline at Shenzhen Technology University. This course aims to develop high-quality, well-rounded talents and specialized applied professionals by providing students with basic German language skills. These skills are essential for their future participation in international communication and collaboration within the transportation sector. The course covers six main units, including German phonetics, basic communication, an introduction to German-speaking countries, and topics related to daily life, work, and leisure activities, with the goal of reaching the A1.1 level of the Common European Framework of Reference for Languages (CEFR). Specific objectives include: **Knowledge:** 1) Students will acquire basic German language knowledge, including the alphabet, pronunciation rules, and fundamental vocabulary and grammar to understand and use simple German in everyday

	situations. **Skills:** Students will be able to 1) develop listening, speaking, reading, and writing skills in German, with the ability to engage in basic conversations, understand simple texts, and write short personal reports. **Competences:** Upon completion of this course, students will have developed: 1) Understand simple questions, instructions, and announcements in daily life situations. 2) Extract important information from brief written notices, public signs, and small announcements. 3) Comprehend and articulate numbers, quantities, time, and prices. 4) Fill out simple personal information forms. 5) Write simple personal reports. 6) Introduce themselves and answer simple personal questions in conversations. 7) Express common daily issues, requests, and respond to questions and requests posed by others.
Contents	**Part A: In-class Teaching** (72 contact hours; 48 self-study hours) **Chapter 1: Voice** (9 contact hours; 6 self-study hours) • German alphabet and pronunciation rules. • Objective: Master the basic pronunciation of German. **Chapter 2: Willkommen!** (10 contact hours; 7 self-study hours) • Topics and Texts: Postcards from D-A-CH; the alphabet, seeing and hearing German; first contacts. • Vocabulary Fields: International words; Greetings: Introduction; Objects in the classroom. • Grammar: W-questions. • Pronunciation: Word accent in city names. • Objective: Master language actions such as greeting and introducing oneself; compare German with other languages; spell names; language in the classroom. **Chapter 3: Lektion 1 Sommerkurs in Leipzig** (10 contact hours; 7 self-study hours) • Topics and Texts: A German course in Leipzig; Neighboring countries of Germany; Registration; Languages in Switzerland. • Vocabulary Fields: Introduction: Places; Countries and languages. • Grammar: Personal pronouns in the nominative, verbs in the present tense; W-questions and sentence questions. • Pronunciation: Word accent and sentence accent. • Objective: Master language actions such as introducing oneself and others; state one's origin; state which languages one speaks. **Chapter 4: Lektion 2 Müller oder Miller?** (9 contact hours; 6 self-study hours) • Topics and Texts: Comic: Understanding and paying with numbers; Addresses and telephone numbers; Magazine article; Family names in German and internationally. • Vocabulary Fields: Post; Numbers from 1-1000: International

	numbers. • Grammar: Articles and nouns in singular and plural; W-questions. • Pronunciation: Umlauts; Sentence accent in W-questions. • Objective: Master language actions such as reading and stating addresses; stating telephone numbers; asking for names; asking follow-up questions; counting and paying. **Chapter 5: Lektion 3 Arbeit im Caf é** (8 contact hours; 5 self-study hours) • Topics and Texts: Workplace Café; Beverages; Bills, Short messages. • Vocabulary Fields: Café; ordering and paying. • Grammar: Definite and indefinite articles; the verb "sein". • Pronunciation: The sound of "e". • Objective: Master language actions such as ordering and paying in a caf é; understanding and writing messages; making appointments. **Chapter 6: Lektion 4 Lecker essen!** (8 contact hours; 5 self-study hours) • Topics and Texts: Short messages; Menu; Specialties from D-A-CH: Eating internationally; Food-Blog. • Vocabulary Fields: Food; Menu. • Grammar: Definite and indefinite articles in the accusative: not and no. • Pronunciation: Long and short vowels; Word accent. • Objective: Master language actions such as talking about food; stating likes and dislikes; describing how something tastes. **Chapter 7: Lektion 5 Hast du Zeit?** (9 contact hours; 6 self-study hours) • Topics and Texts: Newspaper articles; Quiz; Timetable; Times; Schedule; Daily routines; Invitations. • Vocabulary Fields: Time indications; Days of the week; Times of the day. • Grammar: Separable verbs; Word and sentence questions. • Pronunciation: Word accent in separable verbs; Long and short vowels. • Objective: Master language actions such as understanding time indications; making appointments; talking about daily routines; asking about departure times; responding to an invitation. **Chapter 8: Lektion 6 Meine Stadt** (9 contact hours; 6 self-study hours) • Topics and Texts: Travel journal; Flyers, timetable information in an app; on the way in Berlin Navigation. • Vocabulary Fields: Means of transport; Orientation in the city; Route description. • Grammar: Possessive in the nominative; Preterite of "sein". • Pronunciation: The sounds of "ts", "tz", and "z". • Objective: Master language actions such as talking about sights; understanding timetable information; naming means of transport, describing routes; talking about one's own things.
Examination forms	Final Exam
Study and examination requirements	1) Students must attend at least two-thirds of the classes and complete at least two-thirds of the assignments to be eligible for the final exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10%

	• Homework 10%; • Class participation 10%; • Mid-term oral exam 20% • National culture 10% • Final exam 40%
Reading list	**Required Book** [1] Funk, H., & Kuhn, C. *Kommunikation Deutsch - Lehrbuch* (3rd Edition) [M]. Shanghai Foreign Language Education Press, 2024. ISBN: 9787544679305. **Reference books** [1] Akin, B., & Lang, C. *Kommunikation Deutsch - Lehrerhandbuch* (3rd Edition) [M]. Shanghai Foreign Language Education Press, 2024. ISBN: 9787544679299. [2] Pasemann, N., & Weimann, G. *Kommunikation Deutsch - Testheft* (3rd Edition) [M]. Shanghai Foreign Language Education Press, 2024. ISBN: 9787544678803. [3] Huang, H. *Kommunikation Deutsch - Wortschatzheft* (3rd Edition) [M]. Shanghai Foreign Language Education Press, 2023. ISBN: 9787544678797.

6.4 Technical English and Thesis Writing

Competence field	Foreign Language
Module designation	Technical English and Thesis Writing
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Prof. LI Baicheng, Associate Professor
Language	Primarily English, supplemented with Chinese explanations
Relation to curriculum	This course is designed in alignment with the curriculum's goal of cultivating both technical expertise and strong communication skills among students, enabling them to succeed in the field of transportation engineering. As outlined in the curriculum, students are expected to master both the technical knowledge and the communication tools necessary for effective academic research and professional practice. The course supports these objectives by focusing on essential aspects of technical English and academic writing. Through the Fundamentals of Technical English module, students will gain a deep understanding of specialized vocabulary and sentence structures used in transportation engineering, essential for clear and precise communication. The Academic Reading and Analysis section equips students with the skills to critically evaluate and interpret technical research, fostering their ability to engage with existing literature. The Thesis and Technical Report Writing module directly addresses the skills required to write high-quality academic theses and professional reports, a key component of their academic development. In the Oral Communication and Presentation Skills module, students will refine their ability to present research findings clearly and confidently, preparing them for real-world professional interactions. Additionally, the Advanced Topics in Transportation Research module engages students with the latest research trends, allowing them to explore emerging topics and contribute to ongoing conversations in the field. These modules collectively support the research goals of the program, which aim to advance students' ability to conduct independent research, contribute to the development of the transportation sector, and communicate their findings effectively to both academic and professional audiences. This course directly contributes to achieving these research objectives by integrating technical writing skills, research analysis, and presentation competencies in a comprehensive manner.
Teaching methods	lecture-based teaching; blended learning; flipped classroom
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, practical teaching Contact hours: 54 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 54 hours Self-study hours = 36 hours
Credit points	3.0
Recommended prerequisites	None

Module objectives/intended learning outcomes	This course is designed to equip students with the technical expertise and communication skills necessary for success in transportation engineering. It focuses on key aspects of technical English, academic writing, and professional communication, providing students with specialized vocabulary, research analysis skills, and presentation competencies. Modules such as Fundamentals of Technical English, Academic Reading and Analysis, Thesis and Technical Report Writing, and Oral Communication and Presentation Skills support students in mastering the skills required for academic research, professional practice, and effective communication in the transportation field. Additionally, the course includes Advanced Topics in Transportation Research, which encourages students to engage with emerging trends and contribute to the development of the sector. Specific objectives include: **Knowledge:** 1) Acquire a solid understanding of technical English vocabulary and concepts specific to transportation engineering. 2) Understand the structure and content of academic papers, including key sections such as the introduction, methods, results, and conclusion. 3) Familiarize with academic writing principles, citation styles (e.g., APA, IEEE), and strategies for clear communication. **Skills:** Students will be able to 1) Effectively translate technical terms and sentences between English and Chinese. 2) Analyze, summarize, and critique academic articles and technical reports. 3) Write coherent and structured academic papers, technical reports, and essays. 4) Prepare and deliver professional oral presentations with well-designed visual aids. 5) Revise and proofread written work for grammar, clarity, and coherence. **Competences:** Upon completion of this course, students will have developed: 1) Develop the ability to conduct independent research, synthesize information, and present findings effectively. 2) Communicate complex transportation engineering concepts to both technical and non-technical audiences. 3) Collaborate in group settings, providing constructive feedback during peer reviews. 4) Engage in academic discussions and defend arguments with confidence and professionalism.
Contents	**Part 1: Technical English in Transportation Engineering** (32 contact hours; 21 self-study hours) This section is based on the textbook and introduces core technical English concepts relevant to transportation systems and logistics. **Chapter 1: Transportation System Introduction** (6 contact hours, 4 self-study hours) • Overview of transportation systems • Modes of transportation

	• Fundamentals of transportation planning and management **Chapter 2: Road Transportation** (6 contact hours, 4 self-study hours) • Road vehicles and their requirements • Road traffic safety and management **Chapter 3: Rail Transportation System** (8 contact hours; 5 self-study hours) • Public transportation systems and their characteristics • High-speed rail and urban rail systems • Maglev technology and rapid transit systems **Chapter 4: Public Transit and Logistics** (6 contact hours;4 self-study hours) • Bus transit and bus rapid transit systems • Public transport priority strategies • Introduction to logistics, supply chain management, and reverse logistics **Chapter 5: Case Studies and Applications** (6 contact hours;5 self-study hours) • Examples of transportation systems worldwide • Analysis of real-world logistics and urban mobility challenges **Part 2: Academic Writing and Professional Communication (22 contact hours; 15 self-study hours)** This section introduces students to academic writing principles, focusing on thesis and technical report preparation, alongside oral presentation skills. **Chapter 6: Fundamentals of Academic Writing** (6 contact hours; 3 self-study hours) • Structure of academic papers: Abstract, introduction, methodology, results, discussion. • Writing technical reports: Clarity, coherence, and conciseness • Common errors in academic writing and strategies for improvement **Chapter 7: Thesis Writing Skills** (8 contact hours, 4 self-study hours) • Drafting thesis sections: Introduction, literature review, methodology, and conclusions • Writing citations and references in APA and IEEE formats • Peer review and editing techniques **Chapter 8: Oral Communication and Presentation Skill** (4 contact hours; 4 self-study hours) • Preparing and delivering effective research presentations • Designing impactful visual aids (e.g., PowerPoint slides, posters) • Handling Q&A sessions during academic discussions **Chapter 9: Final Project and Assessment** (4 contact hours, 4 self-study hours) • Writing and revising a complete academic thesis or technical report • Oral presentation of the thesis findings
Examination forms	Final Exam

Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Class participation and discussions 10% • Vocabulary and translation exercises 10% • Writing assignments and peer review tasks 10% • Oral presentations 10% • Final written thesis or technical report 60%
Reading list	**Required books** [1] Yan, C., & Huang, X. Professional English for Transportation Engineering [M]. 2018. [2] Day, R. A. How to Write and Publish a Scientific Paper [M]. 2011. **Other materials** [1] Online journals and platforms: Elsevier, Springer, ResearchGate. [2] Multimedia content: TED Talks, YouTube technical discussions. [3] Transportation-focused blogs and industry reports.

Module 7 General Courses

7.1 Chinese Modern and Contemporary History

Competence field	General Courses
Module designation	Chinese Modern and Contemporary History
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Mr. GU Yaobao, Lecturer
Language	Chinese
Relation to curriculum	Outline of Modern and Contemporary Chinese History is a core component of the 2024 undergraduate talent training program at Shenzhen Technology University. This course serves as a public compulsory course for level 2024 undergraduate students, aiming to provide a comprehensive understanding of the development processes of modern Chinese revolutions, constructions, and reforms. It deepens the students' understanding of the historical laws of modern China, enhances their knowledge of the Party's history, the country's history, and the national conditions, and strengthens their ability to analyze historical issues and discern the direction of social development with a scientific historical view and methodology.
Teaching methods	lecture-based teaching; blended learning
Type of teaching, contact hours	Targeted Students: students of Transportation Program Type of Teaching: Theoretical Teaching、Practical Teaching Contact Hours: 54 hours Size of Class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact Hours = 54 hours Self-study Hours = 36 hours
Credit points	3.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	The course "Outline of Modern and Contemporary Chinese History" is a core component of the 2024 undergraduate program at Shenzhen Technology University. It provides a comprehensive understanding of the modern Chinese revolutions, constructions, and reforms, enhancing students' knowledge of the Party's history, the country's history, and national conditions. The course aims to develop students' ability to analyze historical issues and understand the direction of social development through a scientific historical perspective and methodology. Specific objectives include: **Knowledge:** 1) Students will gain a comprehensive understanding of the historical development of modern China, including the revolution, construction, and reform periods. They will learn about the historical patterns of China's modern development, the history of the Communist Party, and the national conditions.

	Skills: Students will be able to 1) develop the ability to analyze historical issues, discern historical right and wrong, and understand the direction of social development using scientific historical perspectives and methodologies. **Competences:** Upon completion of this course, students will have developed: 1) Understand the historical and political evolution of China from a scientific perspective. 2) Apply a scientific historical view and methodology to analyze historical issues. 3) Enhance their patriotic beliefs and commitment to the leadership of the Communist Party of China and the socialist path.
Contents	**Part A: In-class Teaching** (54 contact hours; 36 self-study hours) **Introduction** (4 hours contact; 2 hours self-study) • Overview of modern and contemporary Chinese history • Purpose and requirements of studying Chinese modern and contemporary history **Chapter 1: The Tribulations and Resistance of the Chinese Nation in Modern Times** (5 hours contact; 4 hours self-study) • The Opium Wars and Western aggression against China • The struggle against foreign armed invasion **Chapter 2: Early Explorations by Different Social Forces for the Country's Path** (5 hours contact; 4 hours self-study) • The Taiping Rebellion, Self-Strengthening Movement, and Hundred Days' Reform **Chapter 3: The Xinhai Revolution and the End of Monarchical Autocracy** (4 hours contact; 3 hours self-study) • The background, significance, and failure of the Xinhai Revolution **Chapter 4: The Establishment of the Communist Party of China and a New Phase of the Chinese Revolution** (4 hours contact; 3 hours self-study) • The spread of Marxism in China and the birth of the Communist Party **Chapter 5: The New Path of the Chinese Revolution** (5 hours contact; 3 hours self-study) • The establishment of the Nationalist government and armed resistance **Chapter 6: The Chinese Nation's War of Resistance Against Japan** (5 hours contact; 3 hours self-study) • The Japanese invasion and the Chinese resistance **Chapter 7: Struggle for the Establishment of New China**

	(4 hours contact; 3 hours self-study) • The historical choice of the people's republic and the second front of the war **Chapter 8: The Founding of the People's Republic of China and the Exploration of the Socialist Construction Path** (4 hours contact; 3 hours self-study) • The consolidation of the new people's government and the exploration of the socialist path **Chapter 9: Reform, Opening Up, and the Initiation and Development of Socialism with Chinese Characteristics** (4 hours contact; 3 hours self-study) • The historical great turn and the start of reform and opening up **Chapter 10: Socialism with Chinese Characteristics Enters a New Era** (4 hours contact; 3 hours self-study) • Broadening the prospects of socialism with Chinese characteristics and advancing into a new era **Part B: In-class Practice** (8 contact hours) **Chapter 11 Historical Moment Presentations** (3 hours contact) • Student presentations on historically touching moments **Chapter 12 Interactive Classroom Activities** (3 hours contact) • Classroom discussions, PPT presentations, and other interactive activities
Examination forms	Final Exam
Study and examination requirements	1) Students must maintain an attendance rate of at least two-thirds and complete the required practical activities to be eligible for the final exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 30% • Class Activities 20% • Classroom Interaction 10% • Final Exam 40%
Reading list	**Required Books** [1] Outline of Modern and Contemporary Chinese History (2023 Edition), Higher Education Press, February 2023. **Reference Books** [1] A Brief History of the Communist Party of China, Party School of the Central Committee of the Communist Party of China Press & People's Daily Press, 2021 Edition. [2] Selected Works of Mao Zedong (Volumes 1-4), People's Publishing House, 1991 Edition. [3] Selected Works of Deng Xiaoping (Volumes 1-3), People's Publishing House, 1994 Edition. [4] Selected Readings of Xi Jinping's Works (Volumes 1-2), People's Publishing House, 2023 Edition. [5] He Qin (Ed.), History of the People's Republic of China, Higher

	Education Press, 2009 Edition. [6] Hu Sheng, From the Opium War to the May Fourth Movement, People's Publishing House, 1998 Edition. [7] Hu Sheng, Seventy Years of the Communist Party of China, Central Party School Press, 1991 Edition.

7.2 Ideology Morality and Rule under the Law

Competence field	General Courses
Module designation	Ideology Morality and Rule under the Law
Semester(s) in which the module is taught	1st semester
Person responsible for the module	All Teachers in the Teaching and Research Department
Language	Chinese
Relation to curriculum	Ideology, Morality, and Rule of Law is a compulsory course for undergraduate students at Shenzhen Technology University, designed to integrate ideological, political, scientific, theoretical, and practical elements. It aligns with the university's talent training program by fostering students' understanding of socialist core values, legal concepts, and moral traditions, thereby preparing them to become responsible contributors to the nation's development. The course is structured into six chapters, covering the essence of life, ideals and beliefs, traditional virtues, Chinese spirit, value requirements, and legal concepts.
Teaching methods	lecture-based teaching; blended learning; seminar-based teaching
Type of teaching, contact hours	Targeted Students: students of Transportation Program Type of Teaching: Theoretical Teaching Contact Hours: 54 hours Size of Class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact Hours = 54 hours Self-study Hours = 36 hours
Credit points	3.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	"Ideology, Morality, and Rule of Law" is a compulsory course at Shenzhen Technology University aimed at integrating ideological, political, scientific, theoretical, and practical elements. It fosters students' understanding of socialist core values, legal principles, and moral traditions, preparing them to become responsible contributors to national development by cultivating a strong sense of social responsibility and civic duty. **Knowledge** 1) Students will understand and grasp the theoretical knowledge related to lofty ideals, moral foundations, professional ethics, and the core values of socialism, as well as a series of relevant theoretical knowledge. 2) Students will establish a Marxist perspective on career and morality. **Skill:** Through theoretical and practical teaching, students will 1) enhance their moral cultivation and develop into individuals with good professional ethics. 2) Students will be prepared to become educators with solid knowledge, moral integrity, and a passion for teaching, capable of

	guiding the intellectual and moral growth of their students. **Competences:** Upon completion of this course, students will have developed: 1) inherit and promote the excellent traditional culture of China, laying a solid foundation in humanities and science, and cultivating a spirit of scientific innovation. 2) Students will develop a serious, rigorous, and truthful attitude towards work and learning, as well as a cooperative spirit and professional ethics of mutual benefit and self-discipline.
Contents	**Part A: In-class Teaching** (54 contact hours; 36 self-study hours) **Introduction: Taking on the Mission of National Revival and Becoming Young People of the Era** (8 hours contact; 5 hours self-study) • Understanding the new era of socialism with Chinese characteristics. • The call for young people to take on the mission of national revival. • Enhancing ideological and moral quality and legal literacy. **Chapter 1: Comprehending the Essence of Life and Grasping Life Direction** (8 hours contact; 5hours self-study) • Worldview, outlook on life, and values. • The pursuit of a meaningful life. • Dealing with life's contradictions and opposing erroneous views on life. **Chapter 2: Pursuing Noble Ideals and Firm Beliefs** (8 hours contact; 6 hours self-study) • The connotation and significance of ideals and beliefs. • Strengthening faith, conviction, and confidence. • Realizing the Chinese Dream and youth aspirations. **Chapter 3: Inheriting Fine Traditions and Promoting the Chinese Spirit** (8 hours contact; 5 hours self-study) • The soul of the nation and the spirit of the times. • Patriotism in the new era. • Innovation and reform as driving forces for youth. **Chapter 4: Clarifying Value Demands and Practicing Value Standards** (8 hours contact; 5 hours self-study) • The common value pursuits of all people. • The distinctive features of socialist core values. • Actively practicing socialist core values. **Chapter 5: Adhering to Moral Norms and Tempering Moral Character** (8 hours contact; 5 hours self-study) • The core and principles of socialist morality. • Absorbing and drawing on excellent moral achievements. • Engaging in moral practices towards goodness. **Chapter 6: Learning Legal Concepts and Enhancing Legal Literacy** (6 hours contact; 5 hours self-study)

	• Characteristics and operation of socialist law. • Upholding comprehensive governance according to law. • Safeguarding constitutional authority and consciously abiding by the law.
Examination forms	Final Exam
Study and examination requirements	1) Students must maintain attendance and actively participate in class discussions and activities to be eligible for the final exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 20% • Active speech in class 10% • Off-class practice report and Presentation 20% • Excellent student • Extra score 10% • Final Exam 40%
Reading list	**Required books** [1] "Thought and Morality with Rule of Law" [M]. Higher Education Press, 2023. **Reference books** [1] "Thought and Moral Cultivation and Legal Basis" (Revised Edition 2018) [M]. Higher Education Press, 2018.

Competence field	General Courses
Module designation	Basic Principles of Marxism
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Dr. LAI Mingming, Professor
Language	Chinese
Relation to curriculum	This module, Principles of Marxism (MA00015), is a compulsory course for second-year undergraduate students. It is designed to provide a systematic education in Marxist theory, enabling students to understand and apply Marxist principles to analyze and solve contemporary social issues. The course is structured into eight chapters: Introduction to Marxism, World Diversity and Material Unity, Practice and Knowledge Development, Human Society and Its Development Laws, Capitalism's Essence and Laws, Capitalism's Development and Trends, Socialism's Development and Laws, and Communism's Lofty Ideal and Ultimate Realization.
Teaching methods	lecture-based teaching; blended learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: Theoretical teaching Contact Hours = 54 hours Size of class: No more than 60 students for theoretical teaching
Workload	Total Workload = 90 hours Contact Hours = 54 hours Self-study Hours = 36 hours
Credit points	3.0
Recommended prerequisites	Thought Morality and Rule of Law, Outline of Modern Chinese History
Module objectives/intended learning outcomes	"Principles of Marxism" (MA00015) aims to provide a comprehensive understanding of Marxist theory. It equips students with the ability to analyze and address contemporary social issues using Marxist principles, fostering critical thinking and theoretical application in real-world contexts. Specific objectives include: **Knowledge:** 1) Students will gain a comprehensive understanding of Marxist theory, including the principles of dialectical materialism, historical materialism, and the critique of capitalism. They will learn about the development of Marxist thought and its application to contemporary society. **Skills:** Students will be able to 1) apply Marxist theoretical frameworks to analyze social, economic, and political issues. They will also improve their critical thinking and problem-solving skills through the examination of various case studies and theoretical applications. **Competences:** Upon completion of this course, students will have developed: 1) a critical understanding of Marxist theory and its implications for social change. They will be able to engage with complex social theories and contribute to discussions on the development of

	socialist societies.
Contents	**Part A Theoretical teaching**(54 contact hours; 36 self-study hours) **Chapter 1. Introduction** (7 contact hours; 4 self-study hours) • What is Marxism • The Origin and Development of Marxism • The Basic Characteristics of Marxism • The Contemporary Value of Marxism • Conscious Learning and Application of Marxism **Chapter 2. The Materiality and Development Laws of the World** (7 contact hours; 4 self-study hours) • The Diversity of the World and the Unity of Matter • The Dialectical Relationship between Matter and Consciousness • The Dialectical Unity of Subjective Initiative and Objective Laws • The Basic Laws and Links of Connection and Development • The Scientific Method of Understanding **Chapter 3. Practice and Knowledge and Their Development Laws** (7 contact hours; 5 self-study hours) • Scientific View of Practice and Its Significance • The Essence and Basic Structure of Practice • The Essence and Development Laws of Knowledge • The Objectivity, Absoluteness, and Relativity of Truth • The Dialectical Unity of Truth and Value • Epistemology and Ideological Line • Achieving a Positive Interaction between Theoretical Innovation and Practical Innovation **Chapter 4. Human Society and Its Development Laws** (7 contact hours; 5 self-study hours) • The Dialectical Relationship between Social Existence and Social Consciousness • The Role of the Mode of Material Production in Social Existence and Development • The Basic Contradictions of Society and Their Laws of Motion • The Formation and Development of World History • The Driving Forces of the Development of Society and History • The Role of the People and Individuals in Social History • The Relationship between the Masses, Classes, Political Parties, and Leaders **Chapter 5. The Essence and Laws of Capitalism** (6 contact hours; 4 self-study hours) • The Basic Contradiction of the Commodity Economy on the Basis of Private Ownership • The Theory of Labor Value and Its Significance • The Theory of Surplus Value and Its Significance • The Basic Contradiction of Capitalism and Economic Crises • The Political System of Capitalism and Its Essence • The Ideology of Capitalism and Its Essence **Chapter 6. The Development and Trends of Capitalism** (7 contact hours; 5 self-study hours) • The Formation and Characteristics of Private Monopoly Capitalism

	• The Characteristics and Essence of State Monopoly Capitalism • The Manifestations and Impacts of Economic Globalization • The Changes in Capitalism after World War II and Their Essence • The Contradictions and Conflicts of Capitalism since the International Financial Crisis of 2008 • The Historical Status of Capitalism and Its Historical Necessity to Be Replaced by Socialism **Chapter 7. The Development and Laws of Socialism** (7 contact hours; 5 self-study hours) • The Historical Process of Five Hundred Years of Socialism • The Basic Principles of Scientific Socialism • The Basic Principles of Scientific Socialism and Socialism with Chinese Characteristics • The Long-Term Nature of Building Socialism in Economically and Culturally Backward Countries • The Diversity of Socialist Development Paths • Socialism Advances in Practice **Chapter 8. The Noble Ideal of Communism and Its Ultimate Realization** (6 contact hours; 4 self-study hours) • The Scientific Methodological Principles for Foreseeing Future Society • The Basic Characteristics of Communist Society • The Necessity and Long-Term Nature of the Realization of Communist Ideals • The Relationship between the Communist Ideal and the Common Ideal of Socialism with Chinese Characteristics
Examination forms	Final Exam
Study and examination requirements	1) Students must achieve at least 2/3 attendance and complete more than 2/3 of the assignments to be eligible to sit for the final exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 20% • Homework 10% • Presentation 20% • Active speech in class 10% • Final Exam 40%
Reading list	**Required Books** [1] "Principles of Marxism" [M]. Higher Education Press, 2023. **Reference Books** [1] Zhang, M., & Wang, Q. "Essentials of Marx and Engels' Doctrine" [M]. People's Publishing House, 2018. [2] Dong, Z. "The Dao of Marx" [M]. Guangxi People's Publishing House, 2021. [3] Tan, P. "Dialogue between Marxist Texts and Reality" [M]. People's Publishing House, 2018.

7.3 Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era

Competence field	General Courses
Module designation	Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era
Semester(s) in which the module is taught	3rd semester
Person responsible for the module	Mr. ZHONG Biao, Lecturer
Language	Chinese
Relation to curriculum	Aligned with the curriculum's goal of fostering ideological and moral development, this course systematically explores the core essence, spiritual significance, rich connotations, and practical requirements of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era. By integrating theoretical instruction with its vivid application in China's practices, the course aims to help students comprehensively understand its historical, theoretical, practical, and global significance. Through a deep grasp of the Marxist perspectives, stances, and methods underpinning this thought, students will enhance their "Four Consciousnesses," strengthen their "Four Confidences," and achieve the "Two Upholds." Ultimately, the course seeks to cultivate a new generation ready to shoulder the great responsibility of national rejuvenation.
Teaching methods	lecture-based teaching; blended learning; seminar-based teaching
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: Theoretical teaching Contact hours: 54 hours Size of class: No more than 60 students for theoretical teaching
Workload	Total Workload = 90 hours Contact Hours = 54 hours Self-study Hours = 36 hours
Credit points	3.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	This course systematically examines the core essence, spiritual significance, and practical applications of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era. By integrating theory with real-world practice, it aims to enhance students' understanding of its historical, theoretical, practical, and global importance, fostering a sense of responsibility for national rejuvenation. Specific objectives include: **Knowledge:** 1) Understand that the core essence of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era is upholding and developing socialism with Chinese characteristics. 2) Grasp the "Ten Clarifications" and "Fourteen Upholds" as the central content, which are organically integrated and unified. 3) Recognize that the pursuit of people's happiness, national

	rejuvenation, and global harmony is the key to comprehending this thought. 4) Appreciate the essence of this thought: emancipating the mind, seeking truth from facts, and adapting to the times. **Skills:** Students will be able to 1) Analyze the profound changes in the world today, described as unprecedented in a century. 2) Explain the significance of China's entry into a new era of socialism with Chinese characteristics and its position as the most favorable period of development in modern history. 3) Interpret the revitalization of scientific socialism in 21st-century China and the Chinese Communist Party's leadership in theory and practice. 4) Recognize Xi Jinping as the principal creator of this thought and evaluate the theoretical innovations of the Chinese Communist Party. **Competence:** 1) Understand that Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era serves as the ideological guide for the Chinese Communist Party and the fundamental directive for national political and social life. 2) Appreciate its role as Marxism for contemporary China and the 21st century. 3) Critically evaluate its original contributions to the development of Marxism and its significance as the ideological banner of the era.
Contents	**Section 1: Direction Determines the Path, and the Path Determines Destiny** (18 contact hours; 12 self-study hours) **Chapter 1 Socialism with Chinese Characteristics is the choice of history and the people.** (6 contact hours; 4 self-study hours) • Discuss the historical roots and evolution of socialism with Chinese characteristics and its alignment with the needs of the people. **Chapter 2 Socialism with Chinese Characteristics is fundamentally socialism, not any other ideology.** (6 contact hours; 4 self-study hours) • Define socialism with Chinese characteristics in contrast to other ideological frameworks and its fundamental principles. **Chapter 3 Strengthening confidence in the path, theory, system, and culture of socialism with Chinese characteristics.** (6 contact hours; 4 self-study hours) • Explore the significance of strengthening confidence in the ideology and practice of socialism with Chinese characteristics. **Section 2: Socialism with Chinese Characteristics Enters a New Era** **(18 contact hours; 12 self-study hours)** **Chapter 4 The New Era represents a new historical position in China's development.** (6 contact hours; 4 self-study hours)

	• Analyze the key characteristics of the New Era and its implications for China's global role and domestic development. **Chapter 5 The transformation of China's principal social contradiction is a historic change with broad implications.** (6 contact hours; 4 self-study hours) • Examine the transformation of China's social contradictions and its impact on social, economic, and political structures. **Chapter 6 The great transformations of the New Era and their milestone significance.** (6 contact hours; 4 self-study hours) • Investigate the major transformations in the New Era and their historical importance for China's future. **Section 3: Persistently Advancing and Developing Socialism with Chinese Characteristics in the New Era** (18 contact hours; 12 self-study hours) **Chapter 7 Fully implementing the Party's fundamental theories, lines, and strategies.** (6 contact hours; 4 self-study hours) • Focus on the implementation of key Party theories and strategies in governance and development. **Chapter 8 Coordinating the "Five-Sphere Integrated Plan" and advancing the "Four-Pronged Comprehensive Strategy."** (6 contact hours; 4 self-study hours) • Discuss the Five-Sphere Integrated Plan and Four-Pronged Comprehensive Strategy, and their roles in the development of socialism with Chinese characteristics. **Chapter 9 Continuously driving forward the development of socialism with Chinese characteristics.** (6 contact hours; 4 self-study hours) • Explore the ongoing efforts to advance socialism with Chinese characteristics and the challenges faced.
Examination forms	Final Exam
Study and examination requirements	1) Students must maintain an attendance rate of at least two-thirds and complete the required practical activities to be eligible for the final exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 18% • Classroom performance 12% • Social practice report 20% • Presentation and discussion 10% • Final exam 40%
Reading list	**Required Books** [1] "Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era" [M]. Higher Education Press, 1st Edition, August 28, 2023. **Additional Reading Materials** [1] "Outline for Learning Xi Jinping Thought on Socialism with

	Chinese Characteristics for a New Era" [M]. Learning Press and People's Publishing House, April 2023. [2] "Thirty Lectures on Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era" [M]. Central Propaganda Group, Learning Press, February 2022. [3] "Basic Issues of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era" [M]. Central Party School, People's Publishing House, August 2020. [4] "Outline for Learning Xi Jinping Economic Thought" [M]. Central Publicity Department and National Development and Reform Commission, People's Publishing House and Learning Press, June 2022.

7.4 Introduction to Maoism and Socialist Theoretical System with Chinese Characteristics

Competence field	General Courses
Module designation	Introduction to Maoism and Socialist Theoretical System with Chinese Characteristics
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Mr. ZHONG Biao, Lecturer
Language	Chinese
Relation to curriculum	The course "Mao Zedong Thought and the Theoretical System of Socialism with Chinese Characteristics" is a compulsory political theory course for undergraduate students in ordinary universities in China. It is designed to provide a comprehensive understanding of the scientific connotations, formation, development, scientific system, historical status, guiding significance, basic viewpoints, and the lines, principles, and policies of socialist construction with Chinese characteristics. This course is integral to the overall curriculum plan as it equips contemporary college students with an understanding of the process of sinicization of Marxism, the theoretical quality of Marxism that keeps pace with the times, and fosters a firm belief in building socialism with Chinese characteristics.
Teaching methods	lecture-based teaching; blended learning; seminar-based teaching
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: Theoretical lectures, practical teaching, and interactive sessions Contact hours: 54 hours Size of class: No more than 60 students for theoretical teaching
Workload	Total Workload = 90 hours Contact Hours = 54 hours Self-study Hours = 36 hours
Credit points	3.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	This course provides an in-depth exploration of Mao Zedong Thought and the theoretical system of socialism with Chinese characteristics, covering their scientific connotations, development, and practical significance. It aims to help students understand the sinicization of Marxism, the evolving nature of Marxist theory, and foster a firm belief in building socialism with Chinese characteristics. Specific objectives include: **Knowledge:** 1) Students will gain a comprehensive understanding of the scientific connotations, historical development, and guiding significance of Mao Zedong Thought and the theoretical system of socialism with Chinese characteristics. **Skills:** 1) Students will be able to Students will develop the ability to apply

	Marxist standpoints, viewpoints, and methods to analyze and solve problems, enhancing their capacity to execute the Party's basic line and program with awareness and firmness. **Competences:** 1) The course aims to strengthen students' confidence in the path, theory, system, and culture of socialism with Chinese characteristics, and to foster their ability to contribute to the comprehensive construction of a modern socialist country.
Contents	**Introduction: Historical Process and Theoretical Achievements of the Sinicization of Marxism** (Total: 10 contact hours; 6 self-study hours) Introduction to the historical process and key theoretical achievements of the Sinicization of Marxism, focusing on how Marxist theory was adapted and applied in China. **Chapter 1: Mao Zedong Thought and Its Historical Status** (Total: 12 contact hours; 8 self-study hours) • **Formation and Development of Mao Zedong Thought** (4 contact hours; 2 self-study hours) Discuss the development of Mao Zedong Thought, including its philosophical roots and historical context. • **Main Content and Essence of Mao Zedong Thought** (4 contact hours; 3 self-study hours) Detailed examination of the core ideas, principles, and practical applications of Mao Zedong Thought. • **Historical Position of Mao Zedong Thought** (4 contact hours; 3 self-study hours) Explore the historical significance of Mao Zedong Thought in the context of Chinese revolution and socialist construction. **Chapter 2: Theory of New Democratic Revolution** (Total: 12 contact hours; 8 self-study hours) • **Basis for the Formation of New Democratic Revolution Theory** (4 contact hours; 2 self-study hours) Explore the theoretical foundations and political context that led to the formation of the New Democratic Revolution Theory. • **General Line and Basic Program of New Democratic Revolution** (4 contact hours; 3 self-study hours) Focus on the key strategies, programs, and political line guiding the New Democratic Revolution. • **Path and Basic Experience of New Democratic Revolution** (4 contact hours; 3 self-study hours) Analyze the practical experience and lessons learned from the implementation of the New Democratic Revolution. **Chapter 3: Theory of Socialist Transformation** (Total: 12 contact hours; 8 self-study hours) • **Transition from New Democracy to Socialism** (4 contact hours; 3 self-study hours) Study the transition from New Democracy to socialism, including the political, social, and economic challenges faced. • **Path and Historical Experience of Socialist Transformation** (4 contact hours; 3 self-study hours) Examine the historical process and practical lessons of socialist

	transformation in China. • **Establishment of Socialist System in China** (4 contact hours; 2 self-study hours) Analyze the establishment and consolidation of the socialist system in China, focusing on its key achievements. **Chapter 4: Preliminary Exploration of the Socialist Construction Path** (Total: 8 contact hours; 6 self-study hours) • **Important Theoretical Achievements of Preliminary Exploration** (4 contact hours; 3 self-study hours) Review the key theoretical achievements of China's early exploration into socialist construction. • **Significance and Lessons from Preliminary Exploration** (4 contact hours; 3 self-study hours) Analyze the significance of these explorations and the lessons learned, particularly in shaping China's development path.
Examination forms	Final Exam
Study and examination requirements	1) Students must maintain an attendance rate of at least two-thirds and complete the required practical activities to be eligible for the final exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 18% • Classroom performance 12% • Social practice report 20% • Presentation and discussion 10% • Final exam 40%
Reading list	**Required Books** [1] "Introduction to Mao Zedong Thought and the Theoretical System of Socialism with Chinese Characteristics" [M]. Higher Education Press, 2023, 8th Edition. **Additional Reading Materials** [1] "Introduction to Mao Zedong Thought and the Theoretical System of Socialism with Chinese Characteristics" [M]. Higher Education Press, 2021, 7th Edition.

7.5 Situation and Policy Education 1

Competence field	General Courses
Module designation	Situation and Policy Education 1
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Mr. WANG Hongyue, Lecturer
Language	Chinese
Relation to curriculum	Aligned with the curriculum's objective of fostering ideological and moral development, Situation and Policy is a compulsory public foundational course in ideological and political education for higher education institutions. Guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, this course helps students understand major domestic and international current events, the Party and state's principles and policies, and the concept of overall national security. The course cultivates an awareness of national security, transforms this awareness into conscious action, and enhances patriotism, social responsibility, and the ability to discern political and policy matters. It enables students to analyze and address issues based on an understanding of China's principles and responses to domestic and global challenges, while fostering comprehensive development and a strong sense of duty to contribute to a prosperous nation.
Teaching methods	lecture-based teaching; blended learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching Contact hours: 9 hours Size of class: no more than 60 students for theoretical teaching
Workload	Total Workload: 15 hours Contact Hours: 9 hours Self-study Hours: 6 hours
Credit points	0.5
Recommended prerequisites	None
Module objectives/intended learning outcomes	This course provides students with an understanding of major domestic and global events, national policies, and the concept of overall national security, guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era. It aims to cultivate national security awareness, enhance patriotism, social responsibility, and foster the ability to analyze and address political and policy issues effectively. Specific objectives include: **Knowledge:** 1) Students will understand the significance of the Party's 20th Central Committee's 3rd Plenary Session. 2) Students will grasp the concept of high-quality economic development and its implications. 3) Students will learn about the "One Country, Two Systems" framework and its impact on Shenzhen-Hong Kong cooperation. 4) Students will recognize the challenges and prospects of Chinese modernization in the global trade environment.

	Skills: Students will be able to 1) develop the ability to analyze current political and economic situations. 2) Students will enhance their skills in understanding and interpreting national policies and strategies. **Competences:** Upon completion of this course, students will have developed: 1) foster a sense of national security and patriotism. 2) Students will improve their political sensitivity and policy judgment capabilities.
Contents	**Chapter 1. In-depth Study and Implementation of the Spirit of the 3rd Plenary Session of the 20th Central Committee** (3 contact hours; 2 self-study hours) • Understand the significance, implications, and key takeaways from the 3rd Plenary Session, focusing on how it shapes China's policies and development strategies. **Chapter 2. Promoting High-Quality Economic Development** (2 contact hours; 2 self-study hours) • Explore the concept of high-quality economic development, its importance, and how it contributes to China's modernization and sustainable growth. **Chapter 3. Shenzhen-Hong Kong Cooperation under the Framework of 'One Country, Two Systems'** (2 contact hours; 1 self-study hours) • Review the history, current status, and future prospects of Shenzhen-Hong Kong cooperation, emphasizing its role in regional economic development and integration. **Chapter 4. Chinese Modernization and the Global Trade Environment amidst Century-Old Changes** (2 contact hours; 1 self-study hour) • Analyze the challenges and opportunities faced by China's modernization in the context of the global trade environment, focusing on how China navigates international relations and adapts to global economic shifts.
Examination forms	Final Exam
Study and examination requirements	1) Students must maintain an attendance rate of at least two-thirds and complete the required practical activities to be eligible for the final exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance and Classroom performance 50% • Final grade 50%
Reading list	**Required books** [1] "Current Affairs Report: College Student Edition 2024-2025 Upper Volume", Current Affairs Publishing House, 2024 edition.

7.6 Situation and Policy Education 2

Competence field	General Courses
Module designation	Situation and Policy Education 2
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Prof. LI Zhongwei, Mr. ZHONG Biao, Mr. HU Xueying, Mr. ZHANG Pengju
Language	Chinese
Relation to curriculum	This module, Situation and Policy 2, is a compulsory course for students to understand the current national and international political landscape, economic trends, and the policies of the Party and the state. It aligns with the overall curriculum by providing insights into four main chapters: In-depth Study of the Party's Central Committee's Decisions, Domestic Economic and Social Situation, Hong Kong, Macao, and Taiwan Affairs, and International Situation and Policy.
Teaching methods	lecture-based teaching; blended learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: Theoretical teaching Contact hours: 9 hours Size of class: No more than 60 students for theoretical teaching
Workload	Total Workload: 15 hours Contact Hours: 9 hours Self-study Hours: 6 hours
Credit points	0.5
Recommended prerequisites	Situation and Policy Education 1
Module objectives/intended learning outcomes	This course equips students with a comprehensive understanding of domestic and international political dynamics, economic trends, and the Party and state policies. Guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, it cultivates national security awareness, enhances patriotism and social responsibility, and develops the ability to analyze and address political and policy issues. Specific objectives include: **Knowledge:** 1) Students will gain an understanding of the major domestic and international current affairs, the guidelines and policies of the Party and the state. 2) Students will learn the principles and positions of China's government in response to economic, political situations, and hotspots both domestically and internationally. **Skills:** 1) Students will develop the ability to analyze and solve problems related to political, economic, and social issues. 2) Students will enhance their critical thinking and policy discrimination skills through the study of current events and policies. **Competences:**

	Upon completion of this course, students will have developed: 1) Students will strengthen their political acumen and sense of responsibility, fostering a spirit of patriotism and social responsibility. 2) Students will improve them to contribute to the nation's development and to engage with global issues with confidence and competence.
Contents	**Chapter 1. In-depth Study of the 20th Central Committee's 3rd Plenary Session** (2 contact hours; 1 self-study hours) • Overview and in-depth discussion of the decisions made during the 3rd Plenary Session, focusing on its implications for China's governance and future development. **Chapter 2. Economic Development and Quality Growth** (2 contact hours; 1 self-study hours) • Focus on the new development concepts and economic strategies introduced by the government to foster high-quality growth and achieve modernization. **Chapter 3. Shenzhen-Hong Kong Cooperation under 'One Country, Two Systems'** (3 contact hours; 2 self-study hours) • Historical review of the cooperation between Shenzhen and Hong Kong, exploring its achievements and future prospects within the framework of 'One Country, Two Systems'. **Chapter 4. China's Modernization and Global Trade Environment** (2 contact hours; 2 self-study hours) • Analysis of China’s modernization process in the context of the evolving global trade environment, highlighting China's shifting role in global politics and economics.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3 are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 20% • Homework 30% • Final paper 50%
Reading list	**Required Books** [1] "Current Affairs Report for College Students" [M]. Current Affairs Publishing, 2024.

7.7 Situation and Policy Education 3

Competence field	General Courses
Module designation	Situation and Policy Education 3
Semester(s) in which the module is taught	3rd 、4^{th}、5^{th}、6^{th}、7^{th}、8^{th} semester
Person responsible for the module	Mr. WANG Hongyue
Language	Chinese
Relation to curriculum	This module, "Situation and Policy 3," is a compulsory course for the undergraduate program, designed to provide students with a comprehensive understanding of the current political landscape, both domestically and internationally. It aligns with the curriculum by covering four main topics: Strengthening Party Construction, Domestic Economic and Social Issues, Hong Kong, Macao, and Taiwan Affairs, and International Situation and Policy.
Teaching methods	lecture-based teaching; blended learning; seminar-based teaching
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: Theoretical teaching Contact hours: 18 hours Size of class: No more than 60 students for theoretical teaching
Workload	Total Workload: 30 hours Contact Hours: 18 hours Self-study Hours: 12 hours
Credit points	1.0
Recommended prerequisites	Situation and Policy Education 1 (MA00003) Situation and Policy Education 2 (MA00004)
Module objectives/intended learning outcomes	This course provides students with a comprehensive understanding of domestic and international political landscapes, emphasizing key topics such as Party construction, economic and social issues, Hong Kong, Macao, and Taiwan affairs, and global policies. It fosters students' analytical abilities, national security awareness, and social responsibility to address contemporary challenges. Specific objectives include: **Knowledge:** 1) Students will understand the current political, economic, and social issues within the context of China's development and its role in global affairs. **Skills:** Students will be able to 1) develop analytical skills to evaluate national policies and their impact on domestic and international scenarios. **Competences:** Upon completion of this course, students will have developed: 1) enhance their ability to critically assess political events and articulate a nuanced understanding of national security and international relations.
Contents	**Chapter 1: Strengthening Party Construction**

	(4 contact hours; 3 self-study hours) • An in-depth discussion on the importance of strengthening the Party's leadership, ideological foundation, organizational structure, and ethical discipline. This includes the Party's role in guiding the development of socialist society and its influence on political stability and governance. **Chapter 2: Domestic Economic and Social Issues** (4 contact hours; 3 self-study hours) • Examination of China's domestic economic challenges and social issues. This includes topics such as income inequality, rural-urban disparities, social welfare systems, and the policies needed to address these issues in the context of sustainable development. **Chapter 3: Hong Kong, Macao, and Taiwan Affairs** (5 contact hours; 3 self-study hours) • Study of the political, economic, and social dynamics surrounding Hong Kong, Macao, and Taiwan, including the "One Country, Two Systems" framework, the development of cross-strait relations, and the importance of national sovereignty in these areas. **Chapter 4: International Situation and Policy** (5 contact hours; 3 self-study hours) • Analysis of China's foreign relations, including its role in international organizations, global economic diplomacy, and the shifting geopolitical landscape. This section will focus on China's policy priorities, global trade strategies, and diplomatic relations with key international partners.
Examination forms	Practical Report
Study and examination requirements	1) Only students with class attendance rate over 2/3 are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Process performance 50% • Final paper 50%
Reading list	**Required Books** [1] "Current Affairs Report: College Student Edition" [M]. Current Affairs Publishing, 2024.

7.8 Sports Club I~IV

Competence field	General Courses
Module designation	Sports Club I~IV
Semester(s) in which the module is taught	1st , 2nd, 3rd, 4th semester
Person responsible for the module	
Language	Chinese
Relation to curriculum	This module is designed to complement the 2024 undergraduate talent training program at Shenzhen Technology University by offering a range of physical activities that enhance students' physical fitness, coordination, and overall health. It aligns with the curriculum's goals of fostering well-rounded individuals with a strong foundation in physical education and sports. The course is structured into several chapters, each focusing on different aspects of physical education: 1) Basketball, 2) Volleyball, 3) Aerobics (Zumba), 4) Table Tennis, 5) Pilates, 6) Badminton, 7) Swimming, and 8) Aerobics (Aerobic Latin). Each chapter is tailored to develop specific skills and knowledge within the context of physical education.
Teaching methods	practical training
Type of teaching, contact hours	Targeted Students: students of Transportation Program Type of Teaching: Theoretical teaching, practical teaching Contact Hours: 60 hours Size of Class: No more than 60 students for theoretical teaching
Workload	Workload = 60 hours Contact hours = 60 hours Self-study hours = 0 hours
Credit points	2.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	This course aims to enhance students' physical fitness, coordination, and overall health through diverse physical activities, fostering well-rounded development. It emphasizes building a solid foundation in physical education, aligning with the curriculum's focus on holistic growth. Specific objectives include: **Knowledge:** 1) Understanding of the historical development and cultural significance of various sports. 2) Comprehensive knowledge of the rules, techniques, and strategies of different sports. 3) Awareness of the physical and mental benefits of engaging in regular physical activities. **Skills:** Students will be able to 1) skills in basketball, volleyball, aerobics, table tennis, pilates, badminton, and swimming. 2) Ability to apply theoretical knowledge to practical sports activities, focusing on technique and strategy implementation.

	Competences: Upon completion of this course, students will have developed: 1) practical abilities and innovative thinking in the field of sports and physical education. 2) Capacity to apply learned knowledge to real-world sports scenarios, demonstrating competence in the practical aspects of sports performance and training. 3) Understanding of the trends in sports development, the requirements of various sports for physical fitness, and the trends in team formation and competition.
Contents	**Week 1** • Learn group step movement • Review footwork movement • Physical fitness training **Week 2** • Review footwork movement • Learn single-handed layup • Physical fitness training **Week 3** • Review footwork movement, single-handed layup • Learn basic dribbling • Physical fitness training **Week 4** • Review footwork movement, single-handed layup, dribbling • Learn chest pass • Physical fitness training **Week 5** • Review footwork movement, single-handed layup, dribbling, chest pass • Learn running layup • Physical fitness training **Week 6** • Review footwork movement, single-handed layup, dribbling, chest pass, running layup • Teaching match • Physical fitness training **Week 7** • Review footwork movement, single-handed layup, dribbling, chest pass, running layup • Teaching match • Physical fitness training **Week 8** • Review footwork movement, single-handed layup, dribbling, chest pass, running layup • Teaching match • Physical fitness training

	Week 9 • Review footwork movement, single-handed layup, dribbling, chest pass, running layup • Learn running layup in motion • Process assessment: Teaching match • Physical fitness training **Week 10** • Basketball viewing • Basketball refereeing method • Classroom theory class **Week 11** • Review footwork movement, single-handed layup, dribbling, chest pass, running layup • Teaching match • Physical fitness training **Week 12** • Review footwork movement, single-handed layup, dribbling, chest pass, running layup • Teaching match • Physical fitness training **Week 13** • Review footwork movement, single-handed layup, dribbling, chest pass, running layup • Teaching match • Physical fitness training **Week 14** • Review footwork movement, single-handed layup, dribbling, chest pass, running layup • Process assessment: Teaching match • Physical fitness training **Week 15** • Review footwork movement, single-handed layup, dribbling, chest pass, running layup • Teaching match • Physical fitness training **Week 16** • Review footwork movement, single-handed layup, dribbling, chest pass, running layup • Teaching match • Physical fitness training **Week 17** • Basketball basic skills examination • Classroom practice class **Week 18** • Basketball basic skills makeup exam • Classroom practice class

Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3 are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance constitutes 20% • Technical and tactical skills account 60% • Physical fitness test 30%
Reading list	**Required Books** [1] Sun, M. (Ed.). "Advanced Basketball Course" [M]. People's Sports Publishing House, 2002. **Reference Books** [1] Ma, W., Huo, Z., & Mou, H. (Eds.). "University Sports Course" [M]. Beijing Sport University Publishing House, 2013.

7.9 Military Theory

Competence field	General Courses
Module designation	Military Theory
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Department of International Cooperation and Student Work
Language	Chinese
Relation to curriculum	This course aligns with the undergraduate training program by fostering students' understanding of national defense and security, which are integral to developing well-rounded individuals with strong social responsibility, national pride, and a commitment to safeguarding the nation's interests. It aims to equip students with a foundational understanding of contemporary military principles and practices, alongside an appreciation of the evolving challenges in national and international security. The course is structured into five chapters: 1) National Defense, 2) National Security, 3) Military Thought, 4) Modern Warfare, 5) Information-Based Equipment.
Teaching methods	lecture-based teaching; blended learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: Theoretical teaching Contact hours: 36 hours Size of class: No more than 60 students for theoretical teaching
Workload	Workload = 60 hours Contact Hours = 36 hours Self-study Hours = 24 hours
Credit points	2.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	This course fosters students' understanding of national defense and security, emphasizing their importance in cultivating socially responsible individuals with strong national pride and a commitment to safeguarding national interests. It provides foundational knowledge of military principles, modern warfare, and evolving security challenges. Specific objectives include: **Knowledge:** 1) Understanding of military and skills 2) Familiarity with national defense concepts, history, policies, and achievements 3) Comprehension of national security situation and international strategic trends 4) Knowledge of military thought, both ancient and contemporary **Skills:** Students will be able to 1) Ability to analyze and discuss military and security-related issues 2) Development of critical thinking skills in the context of national defense and security **Competences:**

	Upon completion of this course, students will have developed: 1) Enhanced national defense awareness and patriotic spirit 2) Fostering a sense of social responsibility and national pride
Contents	**Chapter 1: National Defense** (8 contact hours; 4 self-study hours) • Overview of national defense strategies, objectives, and policies. Topics may include defense modernization, military reform, and the strategic role of national defense in protecting sovereignty, security, and national interests. **Chapter 2: National Security** (8 contact hours; 5 self-study hours) • Exploration of national security as a multidimensional concept, covering political, economic, social, and cultural security. Discussion of the importance of safeguarding national interests in the global context and integrating internal and external security policies. **Chapter 3: Military Thought** (6 contact hours; 5 self-study hours) • Study of the evolution of military thought, from classical military strategies to contemporary concepts, and the integration of political and military strategies in modern statecraft. Key figures and theories in military thought will be covered. **Chapter 4: Modern Warfare** (8 contact hours; 6 self-study hours) • In-depth analysis of modern warfare tactics, technology, and strategies. This section will focus on the impact of new technologies (such as cyber warfare, AI, and drones) on military operations and the changing nature of conflict in the 21st century. **Chapter 5: Informationalized Equipment** (6 contact hours; 4 self-study hours) • Study of informationalized military equipment, focusing on the integration of information technology with military hardware and software. Topics include the development of smart weapons, command and control systems, and the role of big data and artificial intelligence in military operations.
Examination forms	Report
Study and examination requirements	1) Only students with class attendance rate over 2/3 are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 20% • Final Exam 80%
Study and examination requirements and forms of examination	• Attendance 20%; • Final Exam 80%.
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks
Reading list	**Required books** [1] "New Era, New Syllabus, Military Course Tutorial for General Colleges and Universities" edited by Fan Shuangli and Liu Bing, published by South China University of Technology Press, 2019.

7.10 Mental Health for College Students

Competence field	General Courses
Module designation	Mental Health for College Students
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Ms. YAO Shuangyan, Lecturer
Language	Chinese
Relation to curriculum	This module, Psychological Health of College Students, is designed to complement the overall curriculum by providing students with essential knowledge and skills in psychological health. It covers various chapters including basic knowledge, self-awareness, personality development, learning psychology, interpersonal communication, sexual and romantic psychology, emotional management, stress and frustration coping, career planning, and life education. The module aligns with the university's goal of fostering well-rounded individuals with a strong foundation in mental health. The module structure includes: 1) Basic Knowledge of College Student Psychological Health, 2) Self-Awareness in College Students, 3) Personality Development of College Students, 4) Learning Psychology of College Students, 5) Interpersonal Communication of College Students, 6) Sexual and Romantic Psychology of College Students, 7) Emotional Management of College Students, 8) Stress Management and Frustration Coping of College Students, 9) Career Planning of College Students, 10) Life Education of College Students.
Teaching methods	lecture-based teaching; blended learning; seminar-based teaching
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: Theoretical teaching Contact hours: 36 hours Size of class: No more than 60 students for theoretical teaching
Workload	Workload = 60 hours Contact hours = 36 hours Self-study hours = 24 hours
Credit points	2.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	This module, Psychological Health of College Students, is designed to equip students with essential knowledge and skills in psychological health. It covers a wide range of topics including self-awareness, personality development, learning psychology, interpersonal communication, emotional management, stress coping, career planning, and life education. The module aligns with the university's goal of fostering well-rounded individuals with a solid foundation in mental health. Specific objectives include: **Knowledge:** 1) Students will understand the standards of psychological health, the concept of psychological counseling, and the importance of self-awareness and personality development.

	Skills: 1) Students will be able to Students will acquire skills in managing emotions, dealing with stress and frustration, and enhancing interpersonal communication. **Competences:** 1) Students will develop the ability to plan their careers, appreciate life, and handle psychological crises.
Contents	**Chapter 1 Basic Knowledge of College Student Psychological Health** (3 contact hours; 2 self-study hours) • Introduction to psychological health concepts and standards for college students. • Understanding the role of psychological counseling and common psychological confusions among students. **Chapter 2 Self-Awareness in College Students** (3contact hours; 3 self-study hours) • Exploring the development of self-awareness and identifying personal biases and reasons behind them. • Techniques for self-adjustment and building self-esteem and confidence. **Chapter 3 Personality Development of College Students** (4 contact hours; 2 self-study hours) • Understanding the concept of personality and recognizing personal traits. • Adjusting learning and life goals based on personality characteristics and cultivating positive qualities. **Chapter 4 Learning Psychology of College Students** (4 contact hours; 2 self-study hours) • Characteristics of learning activities and psychological features in university. • Overcoming learning psychological barriers and managing study time effectively. **Chapter 5 Interpersonal Communication of College Students** (4 contact hours; 2 self-study hours) • The significance, characteristics, and types of interpersonal communication. • Enhancing communication skills and building interpersonal networks. **Chapter 6 Sexual and Romantic Psychology of College Students** (4 contact hours; 3self-study hours) • Development of sexual physiology and psychology, and characteristics of romantic relationships in college students. • Addressing issues related to sexual and romantic psychology and forming correct understandings. **Chapter 7 Emotional Management of College Students** (4 contact hours; 3 self-study hours)

	• Understanding emotional characteristics and learning methods for emotional regulation. • Managing emotions to maintain a positive emotional state. **Chapter 8 Stress Management and Frustration Coping of College Students** (4 contact hours; 2 self-study hours) • Overview of stress and frustration, their sources, and impact on college students. • Strategies for stress management and coping with setbacks. **Chapter 9 Career Planning of College Students** (3 contact hours; 2 self-study hours) • Understanding the importance of career planning and setting capability goals during university. • Techniques for career planning and practical job-seeking skills. **Chapter 10 Life Education of College Students** (3 contact hours; 3 self-study hours) • Recognizing and valuing life, and understanding the significance of life education. • Identifying signals of psychological crises and learning preliminary intervention methods.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3 are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Regular grades (growth majors/attendance/practical activities) 50%; • Final Exam 50%
Reading list	**Required Books** [1] Qiu, H. College Student Psychological Health Education [M]. Guangdong Higher Education Press, 2018.9. [2] Qin, X. College Student Psychological Health Education / 'Twelfth Five-Year Plan' General Higher Education Planning Textbook [M]. Beijing Normal University Press, 2015.2. **Reference Books** [1] Zhang, J., & Zeng, Q. College Student Psychological Health Education [M]. Jinan University Press, 2013.8.

7.11 National Security Education for College Students

Competence field	General Courses
Module designation	National Security Education for College Students
Semester(s) in which the module is taught	1st semester
Person responsible for the module	None
Language	Chinese
Relation to curriculum	This course is a compulsory course offered by the Security and Protection Center of Shenzhen Technology University, targeted at first-year full-time undergraduate students. It aims to provide national security education and public safety education for college students in the new era, enhance their national security awareness and self-protection capabilities, and subtly strengthen their ideals and beliefs, cultivate patriotic sentiments, improve moral character, expand knowledge and horizons, foster a spirit of hard work, and comprehensively enhance their overall quality. By learning this course, students can deeply understand and accurately grasp the overall national security concept, firmly establish the concept of national interests first, enhance the awareness of consciously safeguarding national security, and acquire the ability to safeguard national security, which is of great significance for cultivating qualified builders and reliable successors of socialism with Chinese characteristics.
Teaching methods	lecture-based teaching
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: Online independent learning (theoretical learning mainly through video courses) Contact hours: Total 18 hours
Workload	Workload = 30 hours Contact hours = 18 hours Self-study hours = 12 hours
Credit points	1.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	The overall goal of the course is to enable students to deeply understand and accurately grasp the overall national security concept through national security education, firmly establish the concept of national interests first, enhance the awareness of consciously safeguarding national security, and acquire the ability to safeguard national security. It focuses on understanding the relationship between the destiny of the Chinese nation and the country, and practicing the overall national security concept. College students should systematically master the connotation and spiritual essence of the overall national security concept, understand the national security system with Chinese characteristics, establish a bottom-line thinking on national security, transform national security awareness into conscious actions, and strengthen their sense of responsibility. **Knowledge:** 1) Master the basic connotation, importance, threats and challenges, and related education methods of various fields of national security in the new era, including national security situation and characteristics,

	political security, territorial security, military security, economic security, cultural security, social security, scientific and technological security, cyber security, ecological security, resource security, nuclear security, overseas interests security, and new fields such as space, deep sea, polar regions and biology. 2) Understand General Secretary Xi Jinping's important expositions on the overall national security concept, the requirements of the 20th National Congress of the Communist Party of China on national security, the provisions of the National Security Law of the People's Republic of China on new fields of security, and the important role of national security in national stability and people's well-being. 3) Know about the current situation of China's national security in related fields (e.g., Internet cyber security), the historical orientation of national security development, and the institutional advantages, development advantages and opportunity advantages of realizing national security. **Skills:** Students will be able to 1) Independently complete online video learning, course quizzes and online exams within the specified time, and master the learning methods of online independent courses. 2) Analyze the threats and challenges faced by national security in related fields, and initially propose ideas for safeguarding national security based on the learned knowledge. 3) Transform national security awareness into conscious actions, such as abiding by national security-related laws and regulations, keeping national secrets, resisting the erosion of bad online culture, and daring to fight against illegal and criminal acts that harm social security. **Competences:** Upon completion of this course, students will have developed: 1) Establish a firm overall national security concept, firmly establish the concept of national interests first, and enhance the sense of responsibility and mission of safeguarding national security. 2) Cultivate patriotic sentiments and cultural confidence, recognize the historical mission of contemporary college students in safeguarding national security, and become loyal defenders and disseminators of national security. 3) Improve the ability to identify and respond to national security risks, and form the awareness of abiding by national security laws and regulations and consciously safeguarding national security. 4) Enhance comprehensive quality, including moral cultivation, knowledge reserve and logical thinking, and lay a solid foundation for growing into a qualified builder and reliable successor of socialism with Chinese characteristics.
Contents	**Part A: Online Theoretical Learning** (18 contact hours; 12 self-study hours) **Chapter 1: Situation and Characteristics of National Security in the New Era** (1 contact hour; 0 self-study hour) • Teaching Content: General Secretary Xi Jinping's important expositions on the overall national security concept; Firmly establishing the overall national security concept, improving the national security system, and enhancing national security capabilities; College students in the new era should correctly view

	the national security situation. • Learning Outcomes: Understand the basic connotation and practical significance of national security in the new era, learn General Secretary Xi Jinping's expositions on the overall national security concept, and firmly establish the overall national security concept; improve the basic cognition of the overall national security concept, enhance the awareness of national security vigilance, and become builders and successors of socialism with Chinese characteristics who love the Party and the country. **Chapter 2: National Political Security Education in the New Era** (2 contact hours; 0 self-study hour) • Teaching Content: Important requirements of the 20th National Congress of the Communist Party of China on national political security in the new era; Threats and challenges faced by national political security in the new era; Ways and methods of national political security education in the new era; College students in the new era should firmly safeguard national political security. • Learning Outcomes: Systematically master the basic connotation, importance, threats and challenges, and education methods of national political security in the new era; deeply understand that political security is the foundation of national security, master the ways and methods of safeguarding political security, and establish a bottom-line thinking on political security. **Chapter 3:National Territorial Security Education in the New Era** (1 contact hour; 1 self-study hour) • Teaching Content: Basic connotation and main contents of national territorial security in the new era; Importance of national territorial security in the new era; Threats and challenges faced by national territorial security in the new era; Ways and methods of national territorial security education in the new era; College students in the new era should firmly safeguard national territorial security. • Learning Outcomes: Master the basic connotation, importance, threats and challenges of national territorial security in the new era, and the ways and methods of territorial security education; improve territorial security literacy, cultivate correct territorial security values, and integrate territorial security awareness into daily study and life. **Chapter 4: National Military Security Education in the New Era** (1 contact hour; 1 self-study hour) • Teaching Content: Basic connotation and main contents of national military security in the new era; Importance of national military security in the new era; Threats and challenges faced by national military security in the new era; Ways and methods of safeguarding national military security in the new era; College students in the new era should firmly safeguard national military security. • Learning Outcomes: Understand the importance of national military security in the new era, master the connotation and contents of military security; cultivate military security awareness, strengthen the sense of responsibility and mission, and become active practitioners and disseminators of military security. **Chapter 5:National Economic Security Education in the New Era** (1 contact hour; 1 self-study hour)

	• Teaching Content: Basic connotation of national economic security in the new era; Importance of national economic security in the new era; Threats and challenges faced by economic security in the new era; College students in the new era should firmly safeguard national economic security. • Learning Outcomes: Understand and master the connotation of economic security, know that economic security is the foundation of China's overall security; establish economic security awareness, enrich economic security knowledge, and improve the ability to safeguard economic security. **Chapter 6:ational Cultural Security Education in the New Era** (1 contact hour; 1 self-study hour) • Teaching Content: Basic connotation and important significance of national cultural security; Threats and challenges faced by national cultural security in the new era; Ways and methods of national cultural security education in the new era; College students in the new era should firmly safeguard national cultural security. • Learning Outcomes: Understand the basic connotation, importance, threats and challenges of national cultural security in the new era; love Chinese excellent traditional culture, revolutionary culture and advanced socialist culture, achieve cultural confidence, cultural consciousness and cultural self-improvement, and consciously resist the erosion of bad online culture. **Chapter 7:National Social Security Education in the New Era** (1 contact hour; 1 self-study hour) • Teaching Content: Overview of social security; Threats and challenges faced by social security; College students in the new era should be practitioners of safeguarding social security. • Learning Outcomes: Master the connotation of social security and its importance to national security and people's happy life; understand the ways and methods of safeguarding social security, enhance social security awareness, and improve the ability to respond to social security hazards. **Chapter 8:National Scientific and Technological Security Education in the New Era** (1 contact hour; 1 self-study hour) • Teaching Content: Basic connotation of national scientific and technological security in the new era; 2) Important significance of the national scientific and technological security strategy in the new era; 3) Problems and challenges faced by national scientific and technological security in the new era; 4) Ways and methods of national scientific and technological security education in the new era. • Learning Outcomes: Understand General Secretary Xi Jinping's important speeches on national scientific and technological security, enhance the strategic awareness that science and technology are the country's sharp weapons; establish scientific and technological security awareness, enrich scientific and technological security knowledge, and recognize the important role of scientific and technological security in national security. **Chapter 9:ational Cyber Security Education in the New Era** (1 contact hour; 1 self-study hour) • Teaching Content: Meaning and important role of national cyber

	security in the new era; Threats and challenges faced by national cyber security in the new era; Ways and methods of national cyber security education in the new era; Current situation of China's Internet cyber security; College students in the new era should firmly safeguard national cyber security. • Learning Outcomes: Master the importance and basic connotation of national cyber security in the new era; cultivate cyber security literacy and good cyber security awareness, and abide by cyber security-related laws and regulations. **Chapter 10:National Ecological Security Education in the New Era** (1 contact hour; 1 self-study hour) • Teaching Content: asic connotation of national ecological security in the new era; Importance of national ecological security in the new era; Threats and challenges faced by national ecological security; Ways and methods of national ecological security education in the new era. • Learning Outcomes: Systematically recognize the connotation and importance of national ecological security, deeply understand the threats and challenges faced by national ecology; cultivate good national ecological security awareness, and recognize the important significance of building national ecological security in the new era. **Chapter 11:National Resource Security Education in the New Era** (1 contact hour; 1 self-study hour) • Teaching Content: Basic connotation of national resource security in the new era; Importance of national resource security in the new era; Threats and challenges faced by national resource security in the new era; Ways and methods of national resource security education in the new era; College students in the new era should firmly safeguard national resource security. • Learning Outcomes: Understand the concept, classification, utilization and protection of national resource security; establish a correct outlook on values and thinking methods for safeguarding national resource security, and enhance the awareness of loving and protecting national resources. **Chapter 12:National Nuclear Security Education in the New Era** (2 contact hours; 1 self-study hour) • Teaching Content: Basic connotation of national nuclear security in the new era; Importance of national nuclear security in the new era; Threats and challenges faced by national nuclear security in the new era; College students in the new era should firmly safeguard national nuclear security; Ways and methods of national nuclear security education in the new era. • Learning Outcomes: Master the connotation of nuclear security and the importance of strengthening national nuclear security education; establish nuclear security awareness, enrich nuclear security knowledge, and improve the ability to safeguard nuclear security. **Chapter 13:National Overseas Interests Security Education in the New Era** (2 contact hours; 1 self-study hour) • Teaching Content: Basic contents and characteristics of national overseas interests security in the new era; Importance of national overseas interests security in the new era; Threats and challenges faced by national overseas interests security in the new era; College

	students in the new era should firmly safeguard national overseas interests security. • Learning Outcomes: Systematically master the basic connotation, importance, threats and challenges of national overseas interests security in the new era; deeply understand the spiritual essence of national overseas interests security education, and transform the awareness of safeguarding overseas interests security into conscious actions. **Chapter 14:National Security Education in New Fields such as Space, Deep Sea, Polar Regions and Biology in the New Era** (2 contact hours; 1 self-study hour) • Teaching Content: Basic connotation of national security education in new fields such as space, deep sea, polar regions and biology in the new era; Importance of national security education in new fields such as space, deep sea, polar regions and biology in the new era; Threats and challenges faced by national security education in new fields such as space, deep sea, polar regions and biology in the new era; Ways and methods of national security education in new fields such as space, deep sea, polar regions and biology in the new era. • Learning Outcomes: Understand the basic connotation and importance of national security in new fields such as space, deep sea, polar regions and biology in the new era; master the ways and methods of safeguarding security in new fields, and establish the awareness of taking national security interests as the top priority.
Examination forms	1. Usual assessment: (1) Video learning (10% of the total score, assessed based on the completion of online video courses); (2) Course quizzes (10% of the total score, assessed based on the results of online course quizzes). 2. Final assessment: Online final exam (80% of the total score, students can participate in the online exam only after completing all video learning and course quizzes).
Study and examination requirements	1. Learning requirements: Students must adopt the online independent learning method, and complete all online video learning and course quizzes within the specified open period; no unified learning location and time are arranged, and students need to reasonably arrange their own learning schedules. 2. Examination requirements: Only students who have completed all video learning and course quizzes are allowed to participate in the online final exam. 3. Grade assessment requirements: The composition of the overall grade (minimum passing score: 60) is as follows: • Usual Grades 20% (Video Learning 10%, Course Quizzes 10%); • Final Exam 80%. Students who successfully complete all links of online learning and exams on the online learning platform and whose total score reaches 60 or above will obtain the corresponding credits.
Reading list	**Required Textbook:** National Security Education for College Students in the New Era, National Defense Industry Press, January 2024. **Reference Books:** None

Module 8 Practical Training

8.1 Industry Cognition

Competence field	Practical Training
Module designation	Industry Cognition
Semester(s) in which the module is taught	1th semester
Person responsible for the module	Dr. LIU Xiaozhou, Associate Professor
Language	Chinese
Relation to curriculum	This course integrates industry awareness education and career planning education to help transportation students to interpret and recognize their majors and future positions, career planning, guiding students to understand the professional background and development of the forefront of the initial mastery of the basic knowledge and common methods of career planning, which will help to improve the recognition and interest in the profession, set up a correct concept of career and career aspirations combined with the social development prospects, talent demand and their own conditions of the profession, the initial formulation of personal career planning, and thus regulate and adjust their learning direction and behavior for successful employment, entrepreneurship conditions. Combined with the development prospects of the profession, the demand for talents and their own conditions, the students will initially formulate their personal career planning, and in this way regulate and adjust their own learning direction and behavior, and create conditions for smooth employment and entrepreneurship.
Teaching methods	lecture-based teaching; blended learning; case-based learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching Contact hours: 36 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 60 hours Contact hours = 36 hours Self-study hours = 24 hours
Credit points	2.0
Recommended prerequisites	None
Module objectives/intended learning outcomes	This course aims to according to the requirements of the direction setting, development frontiers and career planning of this major, in accordance with the form of thematic lectures, a number of professional teachers and experts outside the university to explain the relevant thematic content, to help students to have a preliminary understanding of the development of the industry, to sort out the correct view of the career, and to lay the foundation for improving students' professional interests, aspiring to better professional learning, and more effective career planning and management. . The topic is divided into two parts: industry awareness and career planning. Specific objectives include: **Knowledge:**

	This course will systematically introduce the current status and trends in urban rail transit development and networked operations in China and Shenzhen, the evolution and applications of artificial intelligence and intelligent vehicles, and the technologies and methodologies for information collection in intelligent transportation systems. It will also cover the concept and characteristics of big data in the context of traffic planning and management, and the application of big data in the Japanese transportation sector. Additionally, the course will explore the comparison of Chinese and German higher education systems, the organization and construction of college student innovation and entrepreneurship teams, and the concepts of self-awareness, interest exploration, and value exploration in the context of career planning. **Skills:** Students will be able to: 1) Students will understand the development and trends in urban rail transit and networked operations, and be able to apply knowledge of new methods and technologies in these fields. 2) Students will master the theoretical and practical aspects of artificial intelligence and intelligent vehicles, including the technical aspects of autonomous driving. 3) Students will be able to identify and utilize various sensors and information collection technologies within intelligent transportation systems. 4) Students will grasp the role of big data in transforming traffic planning and management and understand how to apply big data in these contexts. 5) Students will understand the comparative education systems and be able to analyze the implications for professional development. 6) Students will develop the skills to organize and build innovation and entrepreneurship teams and navigate the policies and practices related to innovation and entrepreneurship. **Competences:** Upon completion of this course, students will have developed: 1) Students will acquire practical abilities and innovative thinking regarding urban rail transit, intelligent vehicles, and intelligent transportation systems, as well as knowledge of engineering technology in these areas. 2) Students will develop the ability to critically assess the advancements and future directions of urban rail transit and intelligent vehicle technologies, and engage in discussions on the integration of artificial intelligence in transportation. 3) Students will demonstrate an understanding of the importance of data-driven decision-making in traffic planning and management, and be able to analyze and apply big data in transportation-related projects. 4) Students will foster an innovative mindset and practical skills necessary for contributing to the advancement of intelligent transportation systems and for career development in the industry. 5) Students will develop self-awareness and the ability to explore their interests and values, which are crucial for making informed career decisions and planning their professional paths.
Contents	**Part A Practical teaching** (36 contact hours; 24 self-study hours) **Chapter 1 Industry Knowledge** (20 contact hours; 14 self-study hours) • Urban Rail Transit Development and Networked Operations • Artificial Intelligence and New Generation Smart Cars

	• Information Collection Technologies in Intelligent Transportation Systems • Transport Planning and Management in the Era of Big Data • Application of Big Data in the Japanese Transportation Sector **Chapter 2 Career Planning** (16 contact hours; 10 self-study hours) • Comparison of Chinese-German University Student Training • Organization and Construction of College Student Innovation and Entrepreneurship Teams • Time Bottle, College Life, and Career Planning • Self-Awareness and Interest Exploration • Skill Exploration and Value Exploration
Examination forms	Practical Report
Study and examination requirements	1) Students should write course reports. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 15% • Lecture notes 25% • Report 60%
Reading list	**Reference books** [1] Luo, Q. City Rail Transit Introduction [M]. Southwest University Press, 2017. [2] Hu, S. Transportation Science [M]. People's Traffic Press, 2018. [3] Wang, X., & Sun, F. Intelligent Transportation Systems [M]. Southwest Jiaotong University Press, 2018. [4] Wu, J., & Zheng, C. Career Planning and University Life [M]. Economic Science Press. **Other materials** [1] PPT courseware (self-compiled)

8.2 Engineering Survey Practice and Labor

Competence field	Practical Training
Module designation	Engineering Survey Practice and Labor
Semester(s) in which the module is taught	3th semester
Person responsible for the module	Dr. JIN Meihan, Assistant Professor
Language	Chinese
Relation to curriculum	The Engineering Measuring Practice starts from the practical needs of traffic engineering surveys, deepening students' understanding, mastery, and comprehensive application of traffic data collection knowledge. It serves as an important teaching component for developing students' abilities to integrate theory with practice, conduct comprehensive analysis, and solve problems. The practice course, combined with practical work, enables each student to become familiar with the entire process of digital mapping, both in the field and in the office. Students will acquire fundamental methods and skills for setting up control networks, data collection, and topographic mapping in accordance with measurement standards using various tools and techniques.
Teaching methods	practical training; project-based learning; cooperative learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching Contact hours: 10 hours Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 90 hours Contact hours = 10 hours Self-study hours = 80 hours
Credit points	3.0
Recommended prerequisites	Linear Algebra, Engineering Drawing and CAD
Module objectives/intended learning outcomes	This course aims to enable students to understand with the measuring and cartography theories and familiar with manipulation of the tools for modern measurement, as well as using software to draw and visualize the measured data. Specific objectives include: **Knowledge:** This course will provide a fundamental knowledge of engineering measurement and cartography. The students will learn about 1) basic theories of measurement, including its purpose, and coordinates; 2) mechanism of electronic total station; 3) the precision control and requirements of engineering measuring; 4) the cartography methods and standards of real field measuring. **Skills:** Students will be able to: 1) Measure roads around the campus buildings. 2) Accurately mapping all fixed objects and topographic features. 3) Use cartography software to produce large-scale digital topographic maps. **Competences:**

	Upon completion of this course, students will have developed: 1) Improving hands-on abilities and independence. 2) Gain experience in completing real engineering measuring and survey tasks, improving organizational and management abilities. 3) Cultivate professional qualities and ethics, contributing to the comprehensive development of students' competencies.
Contents	**Theoretical teaching** (10 contact hours; 6 self-study hours) **Introductions of Survey and Measurement theories** (10 contact hours; 6 self-study hours) • Basic knowledge of measuring and coordinate systems **Part B Practical teaching** (0 contact hours; 74 self-study hours) Surveying roads around the campus building, mapping physical and topographic features, creating 1:500 scale topographic maps, conducting quality checks, and writing an internship report. Accurately mapping all fixed objects and topographic features surrounding the Shenzhen Technology University's D1 building, including its surrounding roads and courtyard. • 1) Residential Areas and Associated Facilities: Represent each building in layers, annotating the structure and number of floors. Specific elements such as overhead buildings and colonnades must be depicted accurately. • 2) Road Facilities: Precisely map all roads and their associated facilities. Main campus roads are marked using "main street" symbols. Secondary campus roads are marked with "secondary street" symbols. Pedestrian walkways are marked with "internal road" symbols. Road surface materials (e.g., "concrete," "asphalt," "soil," "gravel," "brick") must be noted, and boundary lines should distinguish different material junctions. • 3) Vegetation: Accurately map the outer boundaries of vegetation, using appropriate symbols and text to indicate different types of plants. Represent tree rows by marking their start, end, and turning points. Significant standalone trees are highlighted individually with appropriate symbols and text annotations for tree names. • 4) Topographic Mapping (Optional): Represent the area's terrain using contours or slopes. Reinforced slopes should be labeled as "solid slopes," while unreinforced ones are noted as "earthen slopes." • 5) Generalization of Features: When features are too numerous and complex, prioritize mapping important features and omitting less significant ones due to map space constraints. Principles include: (1) Retaining significant features and omitting less critical ones (e.g., prioritize roads over flower beds). (2) Fixing important features and shifting less critical ones. (3) Ensuring the map remains accurate, clear, and easy to read. • 6) Text Annotations: Following standards, annotate key facilities such as government buildings, schools, and other significant landmarks. For unmappable features, use text annotations to clarify their presence (e.g., annotate names of teaching buildings, dormitories, road materials, and vegetation). • 7) Topographic Map Refinement: Refine map details, including: Smoothing feature lines and topographic elements. Annotating major features. Removing unnecessary elevation and control points, or repositioning them to avoid overlapping with mapped features. • 8) Writing the Internship Report: At the end of the internship, each student must prepare an internship report. The report should meet the following requirements: (1) The content must be

	comprehensive. (2) Concepts must be accurate and correct. (3) Sentences should be fluent and coherent. (4) The writing style should be concise. (5) Handwriting or formatting must be neat and tidy. (6) Illustrations and tables should be clear and visually appealing.
Examination forms	Final Exam
Study and examination requirements	1) Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • In-class report 50% • Internship materials 40% • Instrument storage 10%
Reading list	**Required books** [5] "Surveying (Fourth Edition)" by Guan Dahua, China Agricultural Press, 2018. [6] "Engineering Surveying" by Li Shaoyuan and Liang Jianchang, Mechanical Industry Press, 2021.

8.3 Innovate Practice Project L1

Competence field	Practical Training
Module designation	Innovate Practice Project L1
Semester(s) in which the module is taught	3th semester
Person responsible for the module	Ms. TANG Ruixue, Senior Engineer
Language	Chinese
Relation to curriculum	This course is a professional practical course. In response to the problems of centralized education and training, closed and rigid training, disconnection between goals and content and actual needs, and disconnection between theory and engineering application and innovative practice in the traditional talent cultivation model, based on the "diversified industry university research cooperation education mechanism, driven by 'innovation+', the 'creative innovation creation (innovation and intelligence) entrepreneurship' (hereinafter referred to as the 'four creations'), the integrated collaborative education model led by the school, with the full participation of all subjects of industry university research application and full process division of labor and cooperation," aims to expand and enhance students' theoretical knowledge and technology, professional and vocational skills, learning methods, ability to solve practical problems, engineering application ability, innovation and entrepreneurship ability, enhance students' craftsmanship spirit, scientific literacy and comprehensive competitiveness in the workplace, and cultivate students who truly meet their own needs. Development needs Innovative and entrepreneurial talents who can promote the improvement of enterprise innovation and competitiveness, as well as high-quality and efficient development. The four innovation talent cultivation model will take "innovation+" as the driving force, that is, using creativity as the trigger and starting point, innovation as the connotation and process, creativity (creative intelligence) as the manifestation and form, entrepreneurship as the content and goal, and actual scientific research and engineering projects as the driving force. It will cultivate students' innovation consciousness, spirit, thinking and ability in stages, themes, directions, and advanced ways throughout the entire process of undergraduate talent cultivation. The division of labor and cooperation between industry, academia, research, and application, as well as integrated collaboration, will cultivate applied, engineering, and innovative talents that meet the actual needs of modern rail transit and related industries driven by it.
Teaching methods	project
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: practical teaching Contact hours: 18 hours
Workload	Workload = 60 hours Contact hours = 18 hours Self-study hours = 42 hours
Credit points	2.0
Recommended prerequisites	Industry Cognition Practice and Career Planning, College Physics, Advanced Mathematics, Engineering Drawing and CAD, Fundamentals of Programming," etc.

Module objectives/intended learning outcomes	This course is the first stage of the special series of four innovation practice projects in the transportation major. During this stage, through the study of literature search methods, literature citation methods, programming basics, project system management, patent writing methods, English paper writing methods, etc., basic knowledge is prepared for the subsequent stages of practical activities in the special series of four innovation practice projects. **Knowledge objective**: ➢ Targeting undergraduate students majoring in transportation, we will release introductions and guidelines on relevant practical project topics through various themed workshops. With students' cognition, experience, construction, and improvement as the starting point and main line, we aim to enable them to understand, learn, and think about the industry development background, current situation, trends, hotspots, and pain points in their professional field. We will also provide guidance on employment status and prospects, career requirements and development, job responsibilities and skills, corporate culture and social responsibility, especially guiding students on how to combine their own actual situation for career planning, academic planning, innovation and entrepreneurship planning, as well as implementation roadmaps; ➢ Organize students to visit the workshop, experience and recognize the achievements and works of senior students in the workshop, and communicate and discuss with senior students in an experiential and immersive manner to fully stimulate and guide students' interest, enthusiasm, and planning in learning. **Skill objective:** ➢ Understand the writing methods for documents related to scientific research projects; ➢ Understand the basic methods for conducting scientific research projects; ➢ Understand the introduction technology of transportation profession; **Ability objective:** After completing this course, students are expected to possess ➢ Proficient in writing documents related to scientific research projects; ➢ Enhance the basic methods for conducting scientific research projects; ➢ Cultivate students' innovative thinking.
Contents	**Week 1:** Course Introduction, Schedule, and Requirements; Introduction to Practical Report Writing Requirements, Paper Writing Methods, etc. (1 contact hour; 2 self-study hours) **Week 2:** Introduction to Relevant Academic Competitions (1 contact hour; 2 self-study hours) **Week 3:** Methods of Literature Search and Citation (1 contact hour; 2 self-study hours)

	Week 4: Research on Urban Road Traffic Safety Hazards (1 contact hour; 2 self-study hours) **Week 5:** Project System Management (1 contact hour; 2 self-study hours) **Week 6:** Introduction to Ongoing Projects (1 contact hour; 2 self-study hours) **Week 7:** Methods of Writing English Papers (1 contact hour; 2 self-study hours) **Week 8:** Introduction to Ongoing Projects (1 contact hour; 2 self-study hours) **Week 9:** Methods of Patent Writing (1 contact hour; 2 self-study hours) **Week 10:** Project Group Exchange (1 contact hour; 2 self-study hours) **Week 11:** Fundamentals of Programming (1 contact hour; 2 self-study hours) **Week 12:** Introduction to Ongoing Project (1 contact hour; 2 self-study hours) **Week 13:** Introduction to the Frontiers of Science and Technology (1 contact hour; 3 self-study hours) **Week 14:** Project Group Exchange (1 contact hour; 3 self-study hours) **Week 15:** Project Topic Cognition Education (1 contact hour; 3 self-study hours) **Week 16:** Project Topic Cognition Education (1 contact hour; 3 self-study hours) **Week 17:** Introduction to Innovation Practice Workshops and Main Project Topics, Release of "Four Innovations" Project Topic Guidelines. (1 contact hour; 3 self-study hours) **Week 18:** Guidance on Writing Practical Summary Reports (1 contact hour; 3 self-study hours)
Examination forms	Project Report
Study and examination requirements	1) Only students who have an attendance rate of over 2/3 and submit classroom notes and practical reports on time can earn credits.

	2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 15% • Class Notes 25% • Practical Report 60%
Reading list	**Reference books：** [1] Luo, Q. (Editor). Urban Rail Transit Introduction. Southwest University Press, 2017. [2] Wu, F. (Editor). Traffic Engineering. People's Traffic Press, 2014. [3] Wang, X., & Sun, F. (Editors). Intelligent Transportation Systems. Southwest Jiaotong University Press, 2018. [4] Zhang, Y., & Yao, D. A Framework for Vehicle-Infrastructure Cooperative Intelligent Transportation Systems. Publishing House of Electronics Industry, 2015.

8.4 Innovate Practice Project L2

Competence field	Practical Training
Module designation	Innovate Practice Project L2
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Ms. TANG Ruixue, Senior Engineer
Language	Chinese
Relation to curriculum	This course is a professional practical course. In response to the problems of centralized education and training, closed and rigid training, disconnection between goals and content and actual needs, and disconnection between theory and engineering application and innovative practice in the traditional talent cultivation model, based on the "diversified industry university research cooperation education mechanism, driven by 'innovation+', the 'creative innovation creation (innovation and intelligence) entrepreneurship' (hereinafter referred to as the 'four creations'), the integrated collaborative education model led by the school, with the full participation of all subjects of industry university research application and full process division of labor and cooperation," aims to expand and enhance students' theoretical knowledge and technology, professional and vocational skills, learning methods, ability to solve practical problems, engineering application ability, innovation and entrepreneurship ability, enhance students' craftsmanship spirit, scientific literacy and comprehensive competitiveness in the workplace, and cultivate students who truly meet their own needs. Development needs Innovative and entrepreneurial talents who can promote the improvement of enterprise innovation and competitiveness, as well as high-quality and efficient development. The four innovation talent cultivation model will take "innovation+" as the driving force, that is, using creativity as the trigger and starting point, innovation as the connotation and process, creativity (creative intelligence) as the manifestation and form, entrepreneurship as the content and goal, and actual scientific research and engineering projects as the driving force. It will cultivate students' innovation consciousness, spirit, thinking and ability in stages, themes, directions, and advanced ways throughout the entire process of undergraduate talent cultivation. The division of labor and cooperation between industry, academia, research, and application, as well as integrated collaboration, will cultivate applied, engineering, and innovative talents that meet the actual needs of modern rail transit and related industries driven by it.
Teaching methods	project-based learning; problem-based learning; cooperative learning; practical training
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: practical teaching Contact hours: 18 hours
Workload	Workload = 90 hours Contact hours = 18 hours Self-study hours = 72 hours
Credit points	3.0
Recommended prerequisites	Industry Cognition Practice and Career Planning, College Physics, Advanced Mathematics, Engineering Drawing and CAD, Fundamentals of Programming.

Module objectives/intended learning outcomes	This course is the second stage of the implementation of the four innovation talent training model, namely the "innovation" stage. This stage is the stage of formulating, demonstrating, optimizing, and evaluating technical solutions: organizing various research groups to design, demonstrate, modify, and optimize technical solutions based on demand analysis, creative and conceptual design, from functional performance, user roles and operational processes, data flow and data management, architecture and network structure, hardware and software structure and interfaces, control structure, core algorithms and key technologies, research methods and technical routes, system integration and testing and experimental plans, budget estimates, feasibility and risk analysis, task division and schedule arrangement, etc; At the same time, through various forms such as lectures on basic theoretical knowledge, thematic analysis and seminars, operation and use of instruments, equipment and tools, on-site experience operation, professional and experimental skills training, software programming training, enterprise visits and internships, engineering case analysis, team spirit and project team management training, students' essential theoretical knowledge, basic skills, scientific and engineering literacy, and teamwork quality for scientific research and technological development innovation are strengthened and expanded. **Knowledge objective:** ➢ Understand the basic connotations and particularities of innovation and entrepreneurship: Understand the basic concepts, connotations, and particularities of innovation and entrepreneurship in practical activities. ➢ Master the basic knowledge and requirements of innovation, innovation quality, innovation thinking, innovation methods, and innovation practice: deeply understand the theoretical knowledge and practical requirements related to innovation. ➢ Understand innovation opportunities and their identification elements: Learn how to identify and evaluate innovation opportunities. **Skill objective:** ➢ Learn to analyze data and achieve task objectives: possess data analysis skills to achieve specific business goals. ➢ Have good interpersonal communication and coordination skills: demonstrate efficient communication and coordination skills in teamwork. ➢ Mastering training methods for innovative thinking and methods: Learning and applying innovative thinking and methods to improve personal innovation level. **Ability objective:** After completing this course, students are expected to possess ➢ Ability to analyze and solve problems: able to analyze practical problems and propose solutions. ➢ Have good interpersonal communication and coordination skills: demonstrate efficient communication and coordination skills in team cooperation and communication. ➢ Enhance students' ability to utilize their learned innovative thinking, techniques, and search skills: strengthen students' practical skills in engineering innovation.

	➢ Cultivate students' innovation consciousness, entrepreneurial spirit, and entrepreneurial thinking: establish confidence and determination to build an innovative country, and cultivate students' scientific spirit of seeking truth, exploring innovation, and striving for excellence.
Contents	**Week 1-17: Each project team carries out project research and development** (16 contact hours; 64 self-study hours) Under the guidance of the supervising teacher, each project team carries out the research and development work of the first phase of the project. **Week 18: Submission of practical report, evaluation and defense** (2 contact hours; 8 self-study hours)
Examination forms	Project Report
Study and examination requirements	1) Only students who have an attendance rate of over 2/3 and submit classroom notes and practical reports on time can earn credits. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 40% • Practical Report 40% • Evaluation and Assessment 10%
Reading list	**Reference books：** [1] Luo, Q. (Editor). Urban Rail Transit Introduction. Southwest University Press, 2017. [2] Wu, F. (Editor). Traffic Engineering. People's Traffic Press, 2014. [3] Wang, X., & Sun, F. (Editors). Intelligent Transportation Systems. Southwest Jiaotong University Press, 2018. [4] Zhang, Y., & Yao, D. A Framework for Vehicle-Infrastructure Cooperative Intelligent Transportation Systems. Publishing House of Electronics Industry, 2015.

8.5 Innovate Practice Project L3

Competence field	Practical Training
Module designation	Innovate Practice Project L3
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Ms. Tang Ruixue, Senior Engineer
Language	Chinese
Relation to curriculum	This course is a professional practical course. In response to the problems of centralized education and training, closed and rigid training, disconnection between goals and content and actual needs, and disconnection between theory and engineering application and innovative practice in the traditional talent cultivation model, based on the "diversified industry university research cooperation education mechanism, driven by 'innovation+', the 'creative innovation creation (innovation and intelligence) entrepreneurship' (hereinafter referred to as the 'four creations'), the integrated collaborative education model led by the school, with the full participation of all subjects of industry university research application and full process division of labor and cooperation," aims to expand and enhance students' theoretical knowledge and technology, professional and vocational skills, learning methods, ability to solve practical problems, engineering application ability, innovation and entrepreneurship ability, enhance students' craftsmanship spirit, scientific literacy and comprehensive competitiveness in the workplace, and cultivate students who truly meet their own needs. Development needs Innovative and entrepreneurial talents who can promote the improvement of enterprise innovation and competitiveness, as well as high-quality and efficient development. The four innovation talent cultivation model will take "innovation+" as the driving force, that is, using creativity as the trigger and starting point, innovation as the connotation and process, creativity (creative intelligence) as the manifestation and form, entrepreneurship as the content and goal, and actual scientific research and engineering projects as the driving force. It will cultivate students' innovation consciousness, spirit, thinking and ability in stages, themes, directions, and advanced ways throughout the entire process of undergraduate talent cultivation. The division of labor and cooperation between industry, academia, research, and application, as well as integrated collaboration, will cultivate applied, engineering, and innovative talents that meet the actual needs of modern rail transit and related industries driven by it.
Teaching methods	project-based learning; problem-based learning; cooperative learning; practical training
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: practical teaching Contact hours: 18 hours
Workload	Workload = 90 hours Contact hours = 18 hours Self-study hours = 72 hours
Credit points	3.0
Recommended prerequisites	Industry Cognition Practice and Career Planning, College Physics, Advanced Mathematics, Engineering Drawing and CAD, Foundations

	of Programming
Module objectives/intended learning outcomes	This course is the third stage of the implementation of the Four Creativity Talent Training Model, namely the "Creativity (Intelligence)" stage. This stage is the research and development of key technologies and core algorithms, the implementation of creative (intelligent) development, and the integration and testing of systems. With the inspiration, guidance, and support of the innovation and entrepreneurship practice mentor team, and the transmission, assistance, and guidance of senior project research group students, each project research group carries out innovative research, development, and testing of relevant core algorithms and key technologies based on the main content and objectives, technical routes, and implementation plans formulated in the technical plan, as well as the processing, manufacturing, and testing of components, the writing and analysis of software programs, network architecture, system integration construction, testing, and optimization, in order to develop creative works; Hold the "Urban Rail Transit College 'Four Innovations' Innovation and Intelligence Creation Works Competition", where the jury will comment, guide and evaluate all innovative technologies and intelligence creation works, select excellent works and innovative technologies with good innovation, progressiveness and practical application value, especially those with broad market prospects for key funding, enter the stage of achievement transfer, transformation and industrialization, and participate in various domestic and foreign college students' science and technology innovation and entrepreneurship competitions; The research group for projects with average completion status and potential for improvement may not receive funding for the transfer and transformation of results, but they can proceed to the next stage and discuss and determine the direction and topic of their senior graduation project with the guidance teacher team. **Knowledge objective:** ➢ Understand the basic connotations and particularities of innovation and entrepreneurship: Understand the basic concepts, connotations, and particularities of innovation and entrepreneurship in practical activities. ➢ Master the basic knowledge and requirements of innovation, innovation quality, innovation thinking, innovation methods, and innovation practice: deeply understand the theoretical knowledge and practical requirements related to innovation. ➢ Understand innovation opportunities and their identification elements: Learn how to identify and evaluate innovation opportunities. **Skill objective:** ➢ Learn to analyze data and achieve task objectives: possess data analysis skills to achieve specific business goals. ➢ Have good interpersonal communication and coordination skills: demonstrate efficient communication and coordination skills in teamwork. ➢ Mastering training methods for innovative thinking and methods: Learning and applying innovative thinking and methods to improve personal innovation level. **Ability objective:**

	After completing this course, students are expected to possess ➢ Ability to analyze and solve problems: able to analyze practical problems and propose solutions. ➢ Have good interpersonal communication and coordination skills: demonstrate efficient communication and coordination skills in team cooperation and communication. ➢ Enhance students' ability to utilize their learned innovative thinking, techniques, and search skills: strengthen students' practical skills in engineering innovation. ➢ Cultivate students' innovation consciousness, entrepreneurial spirit, and entrepreneurial thinking: establish confidence and determination to build an innovative country, and cultivate students' scientific spirit of seeking truth, exploring innovation, and striving for excellence.
Contents	**Week 1-17: Each project team carries out project research and development** (16 contact hours; 64 self-study hours) Under the guidance of the supervising teacher, each project team carries out the research and development work of the second phase of the project. **Week 18: Submission of practical report, evaluation and defense** (2 contact hours; 8 self-study hours)
Examination forms	Project Report
Study and examination requirements	1) Only students who have an attendance rate of over 2/3 and submit classroom notes and practical reports on time can earn credits. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 40% • Practical Report 40% • Evaluation and Assessment 10%
Reading list	**Reference books：** [1] Luo, Q. (Editor). Urban Rail Transit Introduction. Southwest University Press, 2017. [2] Wu, F. (Editor). Traffic Engineering. People's Traffic Press, 2014. [3] Wang, X., & Sun, F. (Editors). Intelligent Transportation Systems. Southwest Jiaotong University Press, 2018. [4] Zhang, Y., & Yao, D. A Framework for Vehicle-Infrastructure Cooperative Intelligent Transportation Systems. Publishing House of Electronics Industry, 2015.

8.6 Innovate Practice Project L4

Competence field	Practical Training
Module designation	Innovate Practice Project L4
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Ms. TANG Ruixue, Senior Engineer
Language	Chinese
Relation to curriculum	This course is a professional practical course. In response to the problems of centralized education and training, closed and rigid training, disconnection between goals and content and actual needs, and disconnection between theory and engineering application and innovative practice in the traditional talent cultivation model, based on the "diversified industry university research cooperation education mechanism, driven by 'innovation+', the 'creative innovation creation (innovation and intelligence) entrepreneurship' (hereinafter referred to as the 'four creations'), the integrated collaborative education model led by the school, with the full participation of all subjects of industry university research application and full process division of labor and cooperation," aims to expand and enhance students' theoretical knowledge and technology, professional and vocational skills, learning methods, ability to solve practical problems, engineering application ability, innovation and entrepreneurship ability, enhance students' craftsmanship spirit, scientific literacy and comprehensive competitiveness in the workplace, and cultivate students who truly meet their own needs. Development needs Innovative and entrepreneurial talents who can promote the improvement of enterprise innovation and competitiveness, as well as high-quality and efficient development. The four innovation talent cultivation model will take "innovation+" as the driving force, that is, using creativity as the trigger and starting point, innovation as the connotation and process, creativity (creative intelligence) as the manifestation and form, entrepreneurship as the content and goal, and actual scientific research and engineering projects as the driving force. It will cultivate students' innovation consciousness, spirit, thinking and ability in stages, themes, directions, and advanced ways throughout the entire process of undergraduate talent cultivation. The division of labor and cooperation between industry, academia, research, and application, as well as integrated collaboration, will cultivate applied, engineering, and innovative talents that meet the actual needs of modern rail transit and related industries driven by it.
Teaching methods	project-based learning; problem-based learning; cooperative learning; practical training
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: practical teaching Contact hours: 18 hours
Workload	Workload = 90 hours Contact hours = 18 hours Self-study hours = 72 hours
Credit points	3.0
Recommended prerequisites	Industry Cognition Practice and Career Planning, College Physics, Advanced Mathematics, Engineering Drawing and CAD, Foundations of Programming, Four Innovations Practical Project Special Topics I-III, etc.

Module objectives/intended learning outcomes	This course is the fourth stage of the implementation of the four innovation talent training model, namely the "entrepreneurship" stage. This stage is the stage of innovation improvement and optimization, achievement transfer and transformation, establishment of start-up companies, and industrialization: Based on the evaluation opinions of stages L1-L3, with the guidance and strong support of the guiding teacher team, combined with the development of relevant college student innovation and entrepreneurship competitions, further improvement, enhancement, and optimization of their innovative technologies, products, etc. are carried out to meet the actual needs of the market and users. A plan for achievement transfer and transformation, industrialization, and commercial operation is formulated to prepare for application promotion, transfer and transformation, and industrialization; Organize the "Urban Rail Transit College '4 Innovations' Entrepreneurship Competition", where the judging panel selects project teams with significant industrialization potential and market application prospects, as well as their innovative technologies and products, to transfer and transform their achievements. The "4 Innovations" Foundation and/or other related enterprises, foundations, etc. will provide industrialization funding; At the same time, students can also participate in various domestic and international college student entrepreneurship competitions and receive relevant funding; Entering schools and other college student maker bases/spaces, college student entrepreneurship parks, etc., establishing relevant start-up companies, carrying out achievement transfer and transformation, promoting innovative products, industrialization, and commercial operations. **Knowledge objective:** ➢ Understand the basic connotations and particularities of innovation and entrepreneurship: Understand the basic concepts, connotations, and particularities of innovation and entrepreneurship in practical activities. ➢ Master the basic knowledge and requirements of innovation, innovation quality, innovation thinking, innovation methods, and innovation practice: deeply understand the theoretical knowledge and practical requirements related to innovation. ➢ Understand innovation opportunities and their identification elements: Learn how to identify and evaluate innovation opportunities. **Skill objective:** ➢ Learn to analyze data and achieve task objectives: possess data analysis skills to achieve specific business goals. ➢ Have good interpersonal communication and coordination skills: demonstrate efficient communication and coordination skills in teamwork. ➢ Mastering training methods for innovative thinking and methods: Learning and applying innovative thinking and methods to improve personal innovation level.

	Ability objective: After completing this course, students are expected to possess ➢ Ability to analyze and solve problems: able to analyze practical problems and propose solutions. ➢ Have good interpersonal communication and coordination skills: demonstrate efficient communication and coordination skills in team cooperation and communication. ➢ Enhance students' ability to utilize their learned innovative thinking, techniques, and search skills: strengthen students' practical skills in engineering innovation. ➢ Cultivate students' innovation consciousness, entrepreneurial spirit, and entrepreneurial thinking: establish confidence and determination to build an innovative country, and cultivate students' scientific spirit of seeking truth, exploring innovation, and striving for excellence.
Contents	**Week 1-17: Each project team carries out project research and development** (16 contact hours; 64 self-study hours) Under the guidance of the supervising teacher, each project team carries out the research and development work of the third phase of the project. **Week 18: Submission of practical report, evaluation and defense** (2 contact hours; 8 self-study hours)
Examination forms	Project Report
Study and examination requirements	1) Only students who have an attendance rate of over 2/3 and submit classroom notes and practical reports on time can earn credits. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Attendance 10% • Homework 40% • Practical Report 40% • Evaluation and Assessment 10%
Reading list	**Reference books：** [1] Luo, Q. (Editor). Urban Rail Transit Introduction. Southwest University Press, 2017. [2] Wu, F. (Editor). Traffic Engineering. People's Traffic Press, 2014. [3] Wang, X., & Sun, F. (Editors). Intelligent Transportation Systems. Southwest Jiaotong University Press, 2018. [4] Zhang, Y., & Yao, D. A Framework for Vehicle-Infrastructure Cooperative Intelligent Transportation Systems. Publishing House of Electronics Industry, 2015.

8.7 Internship in Enterprise

Competence field	Practical Training
Module designation	Internship in Enterprise
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Ms. TANG Ruixue , Senior Experimentalist
Language	Chinese
Relation to curriculum	This practical course is an important practical teaching link for transportation majors and an important way for students to connect theory with practice. Through enterprise internship courses, students will acquire practical abilities related to transportation in areas such as urban rail transit operation and management, intelligent transportation, etc., understand the basic systems, processes, and methods of urban rail transit operation and management, and develop professional practical skills in areas such as traffic signal acquisition and processing, traffic signal control, intelligent vehicle control, and intelligent public transportation, thereby increasing their intuitive understanding. Through practical learning, students can understand important knowledge points in theoretical courses, stimulate their interest in learning, cultivate their ability to learn independently, and highlight the teaching characteristics of emphasizing the cultivation of engineering practical abilities.
Teaching methods	internship; problem-based learning
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: practical teaching Practice time: no less than 16 weeks Size of class:: All students majoring in transportation
Workload	Workload = 630 hours Contact hours = 180 hours Self-study hours =450 hours
Credit points	21.0
Recommended prerequisites	Introduction to Transportation Engineering, Introduction to Rail Transit Systems, Electrical Engineering and Electronic Technology, Information Systems and Databases, Transportation Engineering, Fundamentals of Control Engineering, Transportation Planning, Transportation Economics, Traffic Safety Engineering, Transportation System Simulation, Rail Transit Vehicle Engineering, etc
Module objectives/intended learning outcomes	This practical course is an important practical teaching link for transportation majors and an important way for students to connect theory with practice. Through practical courses in enterprise internships, students will acquire practical abilities in areas such as intelligent transportation, transportation planning, and management. Integrating the teaching content of professional courses with engineering practice, deepening the understanding of theoretical knowledge, consolidating and enhancing the learned theoretical knowledge, and discovering and solving new problems in practice; Learning practical knowledge that is difficult to involve in classroom theoretical teaching; To lay a solid foundation for the study of subsequent courses and the work after graduation. Through practical learning, students can understand important knowledge points in theoretical courses, stimulate their interest in learning, and cultivate their ability to learn independently. Specific goals include:

	Knowledge objective: Through practical courses in enterprise internships, students will acquire practical abilities in areas such as intelligent transportation, transportation planning, and management. Through practical learning, students can understand important knowledge points in theoretical courses, stimulate their interest in learning, cultivate their ability to learn independently, and highlight the teaching characteristics of emphasizing the cultivation of engineering practical abilities. **Skill objective:** ➢ Understand the operational situation of the internship enterprise and learn about its research and development, production, organization, and management procedures. ➢ Understand rail transit equipment and its structure, operating principles, maintenance techniques, etc. ➢ Understand the processes, standards, and technologies involved in organizing and managing rail transit operations. ➢ Understand technologies related to intelligent transportation system engineering, traffic planning and management, and big data applications. ➢ Understand the technologies and procedures related to rail transit control and intelligent maintenance, rail transit facility design and operation management. ➢ Be able to integrate the professional courses learned and integrate them into production practice. **Ability objective:** After completing this course, students are expected to possess: ➢ Professional skills: Master practical operational skills related to the profession. Understand industry standards and best practices. Understand the latest technological trends and applications. ➢ Communication skills: Improve the ability to communicate with colleagues, superiors, and clients. Learn how to effectively engage in teamwork and collaboration. ➢ Problem solving ability: Learn how to identify problems and propose solutions in practical work. Enhance critical thinking and problem-solving skills. ➢ Time management and organizational skills: Learn how to manage time and priorities in a fast-paced work environment. Improve work efficiency and results. ➢ Adaptability: The ability to adapt to new environments and different work cultures. Flexibly respond to changes and challenges in the workplace. ➢ Self management: Enhance the ability to motivate and supervise oneself. Learn how to set personal career goals and strive towards them. ➢ Professional ethics and sense of responsibility: Understand the importance of professional ethics and reflect it in practical work. Cultivate a sense of responsibility towards work and the team. ➢ Project management: Participate in project planning, execution, and evaluation, and understand the entire process of project management. Learn how to coordinate resources and control project progress. ➢ Innovation and Creativity: Trying new ideas and methods in practical work. Cultivate innovative thinking and problem-solving creativity.

Contents	**Week 1: Safety education and pre job training** Understand the management system and organizational structure, security management system, and confidentiality regulations of the internship enterprise, and enhance security awareness; Understand the overall business situation of the internship enterprise, learn the procedures of production, organization, and management of the enterprise, and become familiar with the functions and structure of the internship department. Key point: Proficient in mastering safety production standards. **Week 2-17: Corporate Internship Training and Practice** The specific internship content will be arranged by the enterprise internship unit. **Week 18: Corporate Internship Defense and Summary**
Examination forms	Enterprise Practice
Study and examination requirements	1) Only students who complete the various internship tasks required by the professional internship outline and have no disciplinary violations can earn credits for enterprise internships. 2) Submit all internship materials for the company, with grades on a two-level system, passing or failing.
Reading list	Books related to Internship in Enterprise

Module 9 Bachelor Thesis

9.1 Bachelor Thesis

Competence field	Bachelor Thesis
Module designation	Bachelor Thesis
Semester(s) in which the module is taught	8th semester
Person responsible for the module	Dr. JIANG Shixiong, Assistant Professor
Language	Chinese
Relation to curriculum	Bachelor Thesis can train students how to apply the knowledge learned in the past four years to engineering design or research. They can independently complete the entire contents of graduation design under the guidance of the instructor. Students have the complex ability of research, gather information, make a proposal, analysis and calculation, drawing design (accordance with the national standard) or experimental test, calculation programming, translate foreign data, report writing (design manual or paper) and graduated reply capacity. The content is combined with the actual needs of the scientific research and engineering. Students should complete transportation related topics, research topics or experimental subjects.
Teaching methods	seminar
Type of teaching, contact hours	Targeted students: students of Transportation Program Type of teaching: theoretical teaching, experiment/ practice teaching and computer practice Contact hours: 180 hours Theoretical teaching, experiment/ practice teaching and computer practice are arranged by instructors on the basis of each student's specific project Size of class: each instructor teaches 3-5 students
Workload	Workload=600 hours Contact hours = 180 hours Self-study hours = 420 hours
Credit points	20.0
Recommended prerequisites	Complete all courses(1-8 Module)
Module objectives/intended learning outcomes	The goal and task of the graduation project is to enable students to integrate and apply their theoretical knowledge and skills to analyze and solve practical transportation related problems. Specific objectives include: **Knowledge:** Demonstrate understanding of knowledge learned from the program as well as methods of literature review and research. **Skill:** 1. Demonstrate the ability to conduct research and literature search and studies. 2. Demonstrate the ability to analyze theories and design/experiment protocols, and develop hardware and software.

	3. Demonstrate the ability to comprehensively process and analyze data. 4. Demonstrate the ability to write thesis, design specifications and abstracts (foreign language---English). **Competences:** Students shall acquire the ability to follow the development trend of professional and related fields, to study in depth, to acquire comprehensive interdisciplinary knowledge and skills related to the program, to apply the knowledge and modern engineering tools, to have a certain degree of innovation and engineering literacy in design, to consider economic, environmental, legal, safety, health, ethical and other factors, and to have teamwork and communication skills.
Contents	**Bachelor Thesis (18 weeks)** **Stage 1: Candidate topics and Undergraduate Thesis Assignment** Instructor of the graduation project must declare the topic one semester before commencement of the bachelor thesis and submit it to the faculty for approval. After that, students would choose the topics and instructors can select one students for each topic from students choosing the topic. On this basis, the "Undergraduate Thesis Assignment" shall be completed and issued to students at the beginning of the graduation project. Besides, according to the requirements of the Undergraduate Thesis Assignment, the students should finish the theses proposal with the approval of instructor and Dean of the Transportation Program. The proposal should contain the following contents: the meaning, literature review, the innovations, research contents, methods, basic theories, stages of implementation, references. **Stage 2: Implementation of the proposal**** **(7 weeks)** Implementation of the thesis plan marks the most important stage throughout the entire graduation project. It is implemented in stages according to the proposal which shall be continuously improved according to actual implementation. During this period, due to different sources and nature of the topic, the instructor shall give targeted guidance. For the graduation project of the program, special attention shall be paid to: theoretical research and engineering applications; rigorous evidence seeking and bold innovation, and enhancement of computer applications and hands-on laboratory skills. **Stage 3: Mid-term inspection** **(1 week)** Students' progress will be reviewed at mid-term. The instructors will give some advices to improve the quality of the research. **Stage 4: Improving the project** **(4 week)** The instructors would help students to improve their research. The instructor will focus on the theoretical research and engineering applications; rigorous evidence seeking and bold innovation. Besides, the instructor would discuss and help to deal with the existing problems in current versions. **Stage 5: Writing thesis for the graduation project***

	(4 weeks) The graduation thesis reflects outcome of the graduation project and should be completed independently by the student under guidance of instructor. The format of the thesis must be in strict accordance with the uniform format issued by the University. The bachelor thesis and its attachments shall be submitted in written and electronic version on time. **Stage 6: Review and defense of the bachelor thesis** **(2 weeks)** After completing the bachelor thesis, the instructor will review, revise and grade it. Once submitted, one or two faculty members will be appointed by the departmental thesis defense team to evaluate and grade the thesis. The defense will be organized and all students must attend the defense. The students failed in the first defense would have the opportunity to attend the second defense.
Examination forms	Thesis
Study and examination requirements	1) Students complete project tasks (experiment, design or calculation) required by instructor; through the interim check; complete thesis. 2) The composition of the overall grade (minimum passing score: 60) is as follows: • Instructor assessment (30%): Student's initiative and ability throughout the comprehensive design process will be assessed and the instructor will give the grade • Reviewer assessment (20%): The faculty members will review the design reports submitted by the student and give a grade accordingly. • Defense (50%): Student's graduation defense grade given by the defense group according to their theses and performances.

Note: In Contents,** for key knowledge points, * for important knowledge points,
and the rest for general information.