Appendix B - Syllabus - Engineering Fundamentals

Competence field	Engineering Fundamentals
Module designation	Introduction to Programme of Railway Transit
Module level, if applicable	
Code, if applicable	100842
Subtitle, if applicable	
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Professor YANG Jian
Lecturer	Professor YANG Jian Lecturer CHONG Lei Lecturer WEI Lili Associate Professor ZHU Haiyan Associate Professor LI Zaiwei
Language	Chinese
Relation to curriculum	The course of Introduction to Programme of Railway Transit covers the current and future development of rail transit program in four areas: railway vehicle, communication signals, operations management and maintenance management. It aims to enhance students' interest in the program, help them understand its features and prospects, and cultivate their awareness and ability to think globally and solve problems, which will prepare them for future studies and employment.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching: Contact hours: 16 hours Of which Theoretical teaching: 16 hours Experiment/practice teaching: 0 hours Size of class: up to 70 students for theoretical teaching

Workload	Workload = 30 hours Contact hours = 16 hours Self-study hours = 14 hours
Credit points	1.0
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	N/A
Module objectives/intended learning outcomes	By taking this course, students will be able to achieve the following outcomes: ● **Knowledge:** 1. Professional orientation, development prospects and employment; 2. Leading technologies of the discipline; 3. Program objectives and course offerings. ● **Skills:** 1. Ability to understand the objectives and professional development of Vehicle Engineering (Rail Transit Vehicle); 2. Ability to articulate the curriculums and key knowledge modules of Vehicle Engineering (Rail Transit Vehicle). ● **Competence:** Awareness and ability to think and solve problems from a holistic perspective that will positively contribute to future studies and employment.
Contents	**Part A Theoretical teaching** (16 contact hours; 14 self-study hours) **Chapter 1** Vehicle Engineering (Rail Transit Vehicle) (4 contact hours; 4 self-study hours) ● Professional orientation of Vehicle Engineering (Rail Transit Vehicle) ● Development prospects for Vehicle Engineering (Rail Transit Vehicle) ● Employment situation of Vehicle

	Engineering (Rail Transit Vehicle) ● Training goals of Vehicle Engineering (Rail Transit Vehicle)** ● Course offerings for Vehicle Engineering (Rail Transit Vehicle)* **Chapter 2** Urban Rail Transit Communication Signals (4 contact hours; 4 self-study hours) ● Professional orientation of Urban Rail Transit Communication Signals ● Development prospects for Urban Rail Transit Communication Signals ● Employment situation of Urban Rail Transit Communication Signals ● Training goals of Urban Rail Transit Communication Signals** ● Course offerings for Urban Rail Transit Communication Signals* **Chapter 3** Urban Rail Transit Operations and Management (4 contact hours; 3 self-study hours) ● Professional orientation of Urban Rail Transit Operations and Management ● Development prospects for Urban Rail Transit Operations and Management ● Employment situation of Urban Rail Transit Operations and Management ● Training goals of Urban Rail Transit Operations and Management** ● Course offerings for Urban Rail Transit Operations and Management* **Chapter 4** Railway Engineering (4 contact hours; 3 self-study hours) ● Professional orientation of Railway Engineering ● Development prospects for Railway Engineering ● Employment situation of Railway Engineering

	● Training goals of Railway Engineering** ● Course offerings for Railway Engineering* Part B: Experiment: (0 experiment hours; 0 self-study hours)
Study and examination requirements and forms of examination	Final score includes: 1. Attendance (40%): see class attendance 2. Final assessment (60%): see the paper related to rail transit
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1]TAN Fuxing, QIU Weihua, FANG Yu. *Overview of Urban Rail Transit System.* Beijing: China Water & Power Press. 2013 2. Reference books [1] HE Zonghua et al. *Urban Rail Transit Operation Organization.* Beijing: China Architecture and Building Press. 2003 [2] YE Xiafei. *Urban Rail Transit Planning and Design.* Beijing: China Railway Publishing House. 1999. [3] SUN Zhang. *Introduction to Urban Rail Transit.* Beijing: China Railway Publishing House. 2000.

Appendix B - Syllabus - Engineering Fundamentals

Competence field	Engineering Fundamentals
Module designation	Engineering Fluid Mechanics
Module level, if applicable	
Code, if applicable	011130
Subtitle, if applicable	
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Associate Professor SUN Yixia
Lecturer	Associate Professor SUN Yixia Lecturer YANG Fang Lecturer YE Xiao
Language	Chinese
Relation to curriculum	Engineering Fluid Mechanics is an essential foundation course for Vehicle Engineering (Rail Transit Vehicle). Through this course, students will master the basic concepts and principles of fluid balance and motion as well as calculation and experimental skills of engineering fluid mechanics, develop the ability to apply knowledge of engineering fluid mechanics to analyzing practical problems, and have adequate theoretical knowledge for subsequent studies as well as future scientific research and professional work.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching, experiment teaching Contact hours: 32 hours Of which Theoretical teaching: 30 hours Experiment/practice teaching: 2 hours Size of class: up to 60 students for theoretical teaching

Workload	Total workload = 60 hours Contact hours = 32 hours Self-study hours = 28 hours
Credit points	2.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	Engineering Mechanics (1); Physics (Mechanics); Unary Calculus (1); Unary Calculus (2)
Module objectives/intended learning outcomes	**Learning outcomes:** The mission of this course is to help students acquire expertise in solving stationary and flow of fluids in the field of vehicle engineering, whilst developing their integrated thinking, mathematical reasoning, and problem-solving skills for complex engineering problems in vehicle engineering. Specific objectives include: **Knowledge:** 1. Basic concepts of fluid mechanics, the laws of fluid at rest and in motion; 2. The continuity, momentum and Bernoulli's equation for fluid flow; 3. Basic experimental equipment and various measurement methods of fluid mechanics, including flow rate, volume and pressure. **Skills:** 1. Ability to develop basic hydrodynamic models; 2. Ability to solve the continuity, momentum and Bernoulli's equations for fluid flow. 3. Ability to use knowledge of engineering fluid mechanics to develop experimental

	protocols for measuring basic fluid parameters. **Competence:** Acquire a comprehensive knowledge of fluid stasis and flow and be able to apply the expertise and mathematical modeling methods to reasonably deduce, analyze, and evaluate fluid stasis and flow problems in real-world engineering and provide concrete solutions.
Contents	**Part A. Theoretical teaching (30 contact hours; 26 self-study hours)** **Chapter 1 Introduction (1 contact hour; 1 self-study hour)** ● Concepts of engineering fluid mechanics* ● Engineering fluid mechanics research* ● Research methods in engineering fluid dynamics **Chapter 2 Mechanical Properties of Fluids (3 contact hours; 2 self-study hours)** ● Fluid continuous media models** ● Force acting on fluid* ● Mechanical properties of fluids** ● Newtonian and non-Newtonian fluids **Chapter 3 Hydrostatics (7 contact hours; 7 self-study hours)** ● Hydrostatic pressure and its properties** ● Differential equations of fluid equilibrium* ● Equilibrium of fluids in a gravitational field** ● Liquid column manometers* ● Relative equilibrium of liquids ● Total pressure of a stationary liquid acting on flat and curved surfaces* ● Buoyancy of an object in a stationary liquid **Chapter 4 Basic Concepts of Fluid Flow (6 contact hours; 5 self-study hours)** ● Two methods of describing fluid movement* ● Lines and traces** ● Classification of flows **Chapter 5 Fundamentals of Fluid Flow (8 contact hours; 8 self-study hours)** ● Systems and controllers

	● Continuity equation** ● Differential equations for ideal fluid motion ● Bernoulli's equation for micro-flow bundles and total flow and its applications** ● Momentum equations and applications for steady-state total flow** **Chapter 6 Flow Resistance and Energy Loss (3 contact hours; 2 self-study hours)** ● Classification of resistance to flow and energy loss* ● Two flow states for viscous fluid motion** ● Laminar flow in horizontal circular tubes* ● Loss of energy along the turbulence in a circular tube ● Local energy loss of flow in a round tube **Chapter 7: Quantitative Analysis and the Analogy Principle (2 contact hours; 1 self-study hours)** ● Basic concepts and principles of quantitative analysis* ● Quantitative analysis and the analogy principle **Part B. Experiment teaching (2 contac hours; 2 self-study hours)** ● Reynold's experiment** (1 contact hour; 1 self-study hour) ● Bernoulli's equation experiment **(1 contact hour; 1 self-study hour)
Study and examination requirements and forms of examination	1. Basic requirements for class (no late arrivals, no early departures, and no unauthorized absences) 10%. 2. Assignments (including homework 50% and experiment reports 50%) 20%. 3. Final exam 70%.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] MO Nairong. *Engineering Fluid Mechanics*. Wuhan: Huazhong University of Science and Technology Press, 2015.

	2. Reference books [1] KONG Long. *Engineering Fluid Mechanics.* Beijing: China Electric Power Press, 2014. [2] HUANG Weixing et al. *Engineering Fluid Mechanics (2nd Edition).* Beijing: Chemical Industry Press, 2016. [3] LIU Qixia, YANG Xiaolin. *Engineering Fluid Mechanics.* Wuhan: Huazhong University of Science and Technology Press, 2016. [4] LONG Tianyu, CAI Zengji. *Fluid Mechanics (2nd Edition).* Beijing: China Architecture and Building Press, 2013

Appendix B - Syllabus - Engineering Fundamentals

Competence field	Engineering Fundamentals
Module designation	Engineering Mechanics (1)
Code, if applicable	019503
Subtitle, if applicable	
Semester(s) in which the module is taught	3rd semester
Person responsible for the module	Associate Professor LI Peichao
Lecturer	Associate Professor LI Peichao Associate Professor PAN Ying Associate Professor CAO Lijie Lecturer CHEN Xi Associate Professor ZHANG Ting Lecturer WU Yongxia Lecturer FAN Zhiyi Lecturer LIU Xiaomei
Language	Chinese
Relation to curriculum	Engineering Mechanics (1) is an important and fundamental course that enables students to master methods of force analysis of objects, simplify force systems, use the theory of equilibrium of force systems and equilibrium conditions to solve the binding force; understand methods of describing motion of objects and their geometric properties in motion, develop equations of motion of objects, calculate velocity (angular velocity) of objects in motion; use synthetic motion to analyze velocity of a moving point on an instantaneous mechanism; master the momentum theorem, kinetic energy theorem, momentum moment theorem; understand the concept of inertial force; master the simplified results of inertial force in the case of rigid body translation, fixed axis and plane motion; master the application of D'Alembert's principle; develop the ability to correctly establish mechanical models of simple engineering objects, and be able to conduct static, kinematic, kinetic (including) (instantaneous and process) analytical and computational skills.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: Using lecturing as a primary teaching method, in combination with classroom exercises and discussion Contact hour: 64 hours Of which

	Theoretical teaching: 64 hours Experiment/practice teaching: 0 hour Computer practice: 0 hour Size of class: 60-90 students
Workload	Total workload = 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	Unary Calculus (1), Unary Calculus (2), Physics (Mechanics)
Module objectives/intended learning outcomes	Leaning outcomes: ● **Knowledge:** 1. Statics: The axioms of statics, analysis of forces on objects, point-to-point moment of force, plane couples, moment of spatial force on axes, the concept of friction, planar concurrent force system, analysis and equilibrium of coplanar forces system, equilibrium of three-dimensional forces; 2. Kinematics: Calculation of velocity and acceleration of the synthetic motion of points and rigid plane motion; 3. Dynamics: Calculation of momentum, kinetic energy, moment of momentum and inertial forces; application of the universal theorems of dynamics (momentum theorem, moment of momentum theorem, kinetic energy theorem, D'Alembert's principle). ● **Skills:** 1. Ability to analyze forces on objects and calculate binding force by force balance; 2. Ability to calculate velocity and acceleration of the synthetic motion of points and rigid plane motion; 3. Ability to apply the universal theorem of dynamics in a comprehensive way to solve problems of mass and mass point system; ● **Competence:** Having the ability to apply principles and methods of engineering mechanics to solving engineering problems, and to build corresponding mechanical models for analysis and

	problem-solving. Through the study of engineering mechanics, students will be able to improve their logical and abstract thinking skills.
Contents	**Part A. Theoretical teaching (64 contact hours; 56 self-study hours)** **Chapter 1 Introduction** (2 contact hours, 2 self-study hours) ● The study object and content of Engineering Mechanics (1); ● Research methods for Engineering Mechanics (1); ● Learning objectives, methods and notes of Engineering Mechanics (1). **Chapter 2 Axioms of Statics and Analysis of Forces on Objects** (4 contact hours, 4 self-study hours) ● The concept of rigid body and force;** ● The axioms of statics;** ● Constraint and constraining forces;** ● Analysis of forces on object and diagrams drawing.** **Chapter 3 Plane Force Systems** (12 contact hours, 10 self-study hours) ● Resultant and equilibrium condition of planar concurrent force system: geometrical and analytical methods; ** ● Concepts of force couples, planar force-couple system synthesis and equilibrium;** ● Simplification of coplanar forces system to a point in the plane of action and discussion of the results of the simplification; * ● Equations of equilibrium for coplanar forces system and their applications; * ● Truss force analysis and solution; ** ● Friction angle and self-locking concepts and their engineering applications. ** **Chapter 4 Spatial Force System** (3 contact hours, 3 self-study hours) ● Spatial force on the axis projection and moment to

	the axis; ** ● Equations of equilibrium for spatial force system and its applications; * ● The center of gravity method. * **Chapter 5 Kinematics of A Point Particle** (3 contact hours, 3 self-study hours) ● Method of describing the motion of a point; ** ● Using sagittal, Cartesian, and natural coordinate methods to establish the equations of motion of points. ** **Chapter 6 Basic Motion of Rigid Bodies** (3 contact hours, 3 self-study hours) ● The concept of parallel movement of rigid bodies; ** ● Equations of fixed-axis rotation of rigid bodies, velocity and acceleration analysis; ** Chapter 7 **Synthetic Motion of a Point Particle** (11 contact hours, 10 self-study hours) ● Concepts of relative, implicated, and absolute motion; ** ● The velocity synthesis theorem for points; ** ● The synthesis theorem for the acceleration of a point when the implicated motion is a flat motion; ** ● The synthesis theorem for the acceleration of a point when the implicated motion is a fixed-axis rotation. * **Chapter 8 Planar Kinematics of Rigid Bodies** (12 contact hours, 8 self-study hours) ● Concept of planar kinematics of rigid bodies; ** ● Using the base point method and velocity projection method to calculate velocity of a point on a plane graph; ** ● Applying the concept of instantaneous center of velocity to calculate velocity of a point on a plane graph; ** ● Using the base point method to calculate the acceleration of a point on a plane graph. *

	Chapter 9 Fundamental Theorems of Dynamics (10 contact hours, 9 self-study hours) ● Differential equations of particle motion; ** ● Moment theorem; ** ● Momentum theorem, kinetic energy theorem. ** **Chapter 10 D'Alembert's Principle** (4 contact hours, 4 self-study hours) ● The concept of inertial forces and the simplified results of inertial forces in the case of a rigid body in translational, fixed-axis, and planar motion. The application of D'Alembert's principle. * **Part B. Experiment/practice teaching: 0 hour.**
Study and examination requirements and forms of examination	After-class assignment shall be done independently by students after each class. Usual performance accounts for 30%, including assignments (20%), in-class performance and attendance (10%): no late arrivals, no early departures, and no unauthorized absences; final assessment (closed-book written exam) accounts for 70%.
Media employed	PPT courseware, multimedia computers, projectors, laser pointers, blackboards, etc.
Reading list	1. Required books LI Peichao, FAN Zhiyi, LIU Xiaomei. *Concise Engineering Mechanics (2nd Edition).* Beijing: Tsinghua University Press, 2016. 2. Reference books [1] Teaching Research Center of Basic Mechanics, School of Aerospace Engineering and Applied Mechanics, Tongji University. *Theoretical Mechanics.* Shanghai: Tongji University Press, 2005. [2] LIU Yanzhu, ZHU Benhua, YANG Haixing. *Theoretical Mechanics (3rd Edition).* Higher Education Press, 2009. [3] MEI Fengxiang, ZHOU Jiping, SHUI Xiaoping. *Engineering Mechanics.* Beijing: Higher Education Press, 2003. [4] LI Junfeng. *Theoretical Mechanics (2nd Edition).* Beijing: Tsinghua University Press, 2007.

Appendix B - Syllabus - Engineering Fundamentals

Competence field	Engineering Fundamentals
Module designation	Engineering Mechanics (2)
Code, if applicable	019504
Subtitle, if applicable	
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Associate Professor CAO Lijie
Lecturer	Associate Professor CAO Lijie Professor PAN Yingfu Associate Professor LI Peichao Associate Professor ZHANG Ting Lecturer WU Yongxia Lecturer JIAN Qiwei Lecturer CHEN Xi Lecturer FAN Zhiyi Lecturer LIU Xiaomei
Language	Chinese
Relation to curriculum	Engineering Mechanics (2) is an important foundation course for engineering programs. Students will learn the basic principles and methods of the distribution laws of internal force, stress and deformation of rods, familiarize with the calculation of strength and stiffness of components under four basic deformations of materials: axial tension, shear, torsion and bending, grasp the concept of stress state of points, commonly used strength theory, the concept of stability and calculation method of rod stability, master the analysis and design methods of components under combined deformation, and learn to operate experiment equipment and instruments for structural analysis and performance testing of general mechanical parts. The course will enable students to apply knowledge and engineering concepts to propose solutions to complex engineering problems, and improve their capability of teamwork, independent learning and innovation.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching, experiment teaching Contact hour: 48 hours Of which Theoretical teaching: 42 hours Experiment teaching: 6 hours Computer practice: 0 hour

	Size of class: 80-90 students
Workload	Total workload = 90 hours Contact hours = 48 hours Self-study hours = 42 hours
Credit points	3.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	Unary Calculus (1); Unary Calculus (2); Multivariate Calculus (1); Multivariate Calculus (2); Physics (Mechanics); Engineering Mechanics (1)
Module objectives/intended learning outcomes	Leaning outcomes: **Knowledge:** Concepts of internal forces, stresses, strains, strength, and stiffness; methods of analysis and calculation of strength and stiffness in rod axial tensile and compression, shear, torsion, and bending deformation. 2. The concept of stress state at a point, common strength theories, the use of combined deformations; 3. The concept of stability and the method of calculating pressure bar stability; **Skills:** 1. The ability to simplify simple members into mechanical models, and to skillfully calculate strength and stiffness of members under various basic deformations; 2.Ability to apply strength theory to calculate strength and stiffness under complex stress states, and to analyze the stability of pressure bars; 3. Able to synthesize and apply the basic theories in the course to solve complex strength, stiffness and stability problems in engineering. **Competence:** Able to independently analyze and solve problems related to strength, stiffness and stability in engineering practice, adopt abstract thinking to specific physical structures and mechanical phenomena from a mechanical perspective, and use experiment methods to study mechanical properties of components.
Contents	**Part A. Theoretical teaching (42 contact hours; 36 self-study hours)**

	Chapter 1. Introduction (1.5 contact hours, 1.5 self-study hours) ● Basic content and methods of Engineering Mechanics (2); ● The tasks of Engineering Mechanics (2); ● The basic assumptions of deformed solids;** ● The basic forms of rod deformations; ● Mechanical properties of materials;** ● The concept of stress concentration; **Chapter 2. Axial Tension and Compression** (8 contact hours, 7 self-study hours) ● Concepts, examples and force characteristics of rods in axial tensile compression; ● Methods of determining internal forces - cross-sectional method;** ● Axial forces, axial diagrams;** ● Stress calculations and strength conditions in axial tensile and compression;** ● Axial tensile deformation, concept of strain, Hooke's law formula;* ● A simple pull-pressure static variable solution. **Chapter 3. Shearing and Extrusion** (1.5 contact hours 1.5 self-study hours) ● The concepts of shearing and extrusion; ● Calculation of the area of shear and extruded surfaces; ● Shear stress, extrusion stress, strength calculations of joints; **Chapter 4. Torsion** (4 contact hours, 3 self-study hours) ● The concept of torsion; ● Hooke's law, the reciprocal theorem of shear and stress;** ● Internal forces, stresses and deformations in torsion of an axis of circular cross-section;** ● Torsional strength and stiffness conditions;** **Chapter 5. Bending** (10 contact hours, 9 self-study hours) ● Internal forces in bending of beams, internal force diagrams;** ● Positive bending stresses in beams of symmetrical section, calculation of positive stress strength of beams;** ● Shear stresses in beams of rectangular section; ● Calculation of the displacement of the beam using

	the integration and superposition methods;** ● Calibration of beam stiffness;** **Chapter 6. Stress States and Strength Theory** (7 contact hours, 6 self-study hours) ● The concept of stress state at a point, the concept of principal and maximum shear stresses;** ● Analytical analysis of in-plane stress states;** ● Graphical determination of the stress state in a plane; ● The concepts of strength theory, commonly used strength theories and their applications;* **Chapter 7. Combinatorial Deformation** (6 contact hours, 5 self-study hours) ● Concepts and examples of combinatorial deformation. ● Calculation of strength in the combination of oblique bending, tension (compression) and bending;** ● Calculation of strength in combination with bending and torsion** **Chapter 8. Pressure Bar Stability** (4 contact hours, 3 self-study hours) ● The concept of pressure bar stability;* ● Calculation of critical forces and critical stresses using the Euler formula for critical loads on slender bars;** ● The scope of application of the Euler formula;** ● Measures to improve pressure bar stability. * **Part B. Experiment teaching: (6 contact hours, 6 self-study hours)** 1. Tensile and compression experiments (2 experiment hours, 2 self-study hours) 2. Torsion experiments (2 experiment hours, 2 self-study hours) **3.** Positive bending stress experiment (2 experiment hours, 2 self-study hours)
Study and examination requirements and forms of examination	After-class assignment shall be done independently by students after each class. 1. In-class performance (20%): basic requirements (no late arrivals, no early departures, and no unauthorized absences) and experiment performance. 2. Assignments (20%): homework, experiment prep, notes and reports, self-regulated learning.

	3. Final assessment (60%): final exam.
Media employed	PPT courseware, multimedia computers, projectors, laser pointers, blackboards, etc.
Reading list	1. Required books [1] LI Peichao, FAN Zhiyi, LIU Xiaomei. *Concise Engineering Mechanics (1st Edition).* Beijing: Tsinghua University Press, 2013. 2. Reference books [1] LIU Hongwen. *Concise Material Mechanics (2nd Edition).* Beijing: Higher Education Press, 2008. [2] SHAN Huizu. *Mechanics of Materials Tutorial*. Beijing: Higher Education Press, 2004. [3] Department of Applied Mechanics and Engineering, Southwest Jiaotong University. *Engineering Mechanics Tutorial.* Beijing: Higher Education Press, 2004. [4] ZHAO Guankang, ZHANG Guoming. *A Concise Course on Engineering Mechanics (3rd Edition).* Beijing: Machinery Industry Press, 2007

Appendix B - Syllabus - Engineering Fundamentals

Competence field	Engineering Fundamentals
Module designation	Foundation of Manufacturing Technology
Module level, if applicable	
Code, if applicable	249101
Subtitle, if applicable	
Semester(s) in which the module is taught	3rd semester
Person responsible for the module	Associate Professor SONG Fang
Lecturer	Associate Professor SONG Fang Associate Professor ZHANG Fan Lecturer TAN Xiaoxiao Lecturer HUANG Dacheng Associate Professor ZHAO Zhonghua
Language	Chinese
Relation to curriculum	This course will provide students with knowledge of common metallic materials and processes, which constitutes a necessary foundation for further studies and work in the field of mechanical engineering or materials processing engineering.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 64 hours Of which Theoretical teaching: 64 hours Experiment/practice teaching: 0 hour Size of class: up to 70 students for theoretical teaching
Workload	Total workload = 120 hours Contact hours = 64 hours Self-study hours = 56 hours

Credit points	4.0
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	Practice on foundation of manufacturing technology; Fundamentals of Drawing
Module objectives/intended learning outcomes	Module objectives: This course covers common metallic materials and their processes. Specific objectives include: ● **Knowledge:** 1. Basic concepts, characteristics, classifications and applications of fundamental manufacturing technology; 2. Basic principles and processes of fundamental manufacturing technology; 3. The requirements of fundamental manufacturing technology for the structural manufacturability of parts; 4. Processing methods for typical parts. ● **Skills:** 1. Basic knowledge of the principles and processes of manufacturing technology; ability to select blanks, processing methods and conduct process analysis. 2. Ability to design and execute basic engineering experiments and analyze the results. 3. Ability to design fundamental metalworking processes. **Competence:** Able to apply knowledge and skills of the basic theories and techniques of manufacturing technology to analyze manufacturing problems in practical engineering, with consideration of economic, environmental, legal, safety, health and ethical factors.

Contents	**Theoretical teaching** (64 contact hours; 56 self-study hours) **Chapter 1 Introduction** (4 contact hours; 2 self-study hours) ● Classification of engineering materials; ● Principal properties of metallic materials;** ● Basic process of common heat treatment. ** **Chapter 2 Liquid Metal Forming (Casting)** (16 contact hours; 14 self-study hours) ● Factors affecting metal casting filling capacity;** ● Types, grades, organization, performance characteristics and applications of cast iron;** ● The three modes of solidification and the three stages of shrinkage, measures to prevent shrinkage and reduce internal stresses;** ● Processes for steel, copper and aluminum alloy castings; ● Principles for the selection of pouring locations and parting surfaces;** ● Development of casting process drawings for typical castings. ** **Chapter 3 Metal Plastic Forming (Forging)** (12 contact hours; 11 self-study hours) ● Organizational changes after plastic deformation, factors influencing the malleability of metals;** ● The free forging process, the range of billet heating and forging temperatures, development of the free forging process on hammers, the technicalities of free forging structures;* ● Development of die-forging drawings, structural manufacturability of die-forged parts;** ● Development of process regulations for deep-drawing parts,

	stamping parts structure processability;** ● The production and application of precision die forging, parts extrusion, parts rolling, powder forging, and CNC stamping. **Chapter 4 Metal Joint Forming (Welding)** (12 contact hours; 11 self-study hours) ● Familiarity with the organization and properties of welded joints;* ● Knowledge of welding crack prevention measures and repair methods;** ● Methods and principles for the rational selection of stick electrodes;** ● Welding equipment, commonly used welding tools; ● Processes, characteristics and applications of manual electric arc welding, submerged arc welding and gas-shielded welding;** ● The process and characteristics of plasma arc welding;* ● Methods of estimating the weldability of metallic materials, methods of welding and repair of carbon steel, alloy structural steel and cast iron parts;** ● Method and principle of selecting materials for welding parts, process design of welded joints. ** **Chapter 5 Metalworking** (20 contact hours; 18 self-study hours) ● Method of calculating cutting volume; ** ● Differences in the properties of commonly used tool;** ● Tool geometric-angle marking and measurement methods;** ● Determining tool durability;** ● The principle of rational selection of the amount of cutting; ** ● Lathe feeding drive systems;** ● Surface machining methods, surface milling machining and milling elements, cylindrical milling cutters, face milling cutters, methods and characteristics of surface milling;* ● Method of processing holes* ● Common surface machining solutions and process procedures for typical parts;**

Study and examination requirements and forms of examination	Final score includes: 1. Attendance (20%): no late arrivals, no early departures, and no unauthorized absences; 2. In-class performance (20%): classroom participation, discussion 3. Assignments (10%): homework; 4. Final assessment (60%): written examination results
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	Reading list [1] ZHAO Zhonghua. *Fundamentals of Manufacturing Technology (Excellent Engineer Education and Training Program Textbooks - Basic Engineering Series).* Beijing: Tsinghua University Press, 2013. Reference books: [1] ZHOU Guilian, FU Ping, YANG Hualin. *Foundation of Manufacturing Technology.* Beijing: Machinery Industry Press, 2014. [2] NI Xiaodan, YANG Jirong, XIONG Yunchang. *Fundamentals of Mechanical Manufacturing Technology.* Beijing: Tsinghua University Press, 2014. [3] LI Zhijiang. *Foundation of Mechanical Manufacturing Technology.* Beijing: Science Press, 2014. [4] LI Changhe, YANG Jianjun. *Metals Technology.* Beijing: Science Press, 2014. [5] BIAN Hongyuan. *Metalworking (3rd Edition).* Beijing: Beijing Institute of Technology Press, 2013.

Competence field	Engineering Fundamentals
Module designation	Engineering Thermodynamics
Module level, if applicable	
Code, if applicable	011131
Subtitle, if applicable	
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Professor CAI Yingling
Lecturer	Professor CAI Yingling Associate Professor HUANG Xinghua Lecturer XIAO Lanlan
Language	Chinese
Relation to curriculum	This course is a foundation elective course for senior engineering undergraduate students. Through this course, students will learn about the importance of energy conservation under the increasingly serious energy crisis, acquire knowledge and laws of energy conversion and heat transfer, explore the working principles of a variety of thermal equipment, including new energy thermal equipment, as well as technical measures to improve thermal efficiency. Students will be able to use models of engineering thermodynamics and heat transfer for quantitative analysis and decision-making in engineering, and effectively implement energy-saving retrofits in their future jobs. The course aims to cultivate engineering and technical personnel with science literacy.

Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching, experiment teaching Contact hours: 32 hours Of which Theoretical teaching: 30 hours. Experiment/practice teaching: 2 hours Size of class: up to 90 students for theoretical teaching
Workload	Total workload = 60 hours Contact hours = 32 hours Self-study hours = 28 hours
Credit points	2.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	Unary Calculus (1); Unary Calculus (2); Multivariate Calculus (1); Multivariate Calculus (2); Physics (Mechanics); Heat and Modern Physics
Module objectives/intended learning outcomes	**Learning outcomes:** The main task of the course is to acquire a comprehensive and systematic understanding of engineering thermodynamics with respect to the thermal properties of matter, efficient use of heat energy, and basic laws governing the conversion of heat energy to other energy sources. Students will establish the right view of energy use, develop analytical and problem-solving skills and use thermodynamic models for quantitative analysis and decision-making in engineering. Specific objectives include: ● **Knowledge:** 1. Basic theory of energy conversion laws and effective utilization of energy.

	2. Basic knowledge of the thermodynamics laws and their application. 3. Physical properties of commonly used engineering materials, simple power cycles and refrigeration cycles. ● **Skills:** 1. Specialized knowledge of analyzing and solving problems of various thermodynamic processes and cycles, and the ability to use formulas and diagrams to calculate and analyze various thermodynamic processes and cycles. 2. Able to transform complex thermodynamic problems into concrete thermodynamic models. 3. Able to perform quantitative analysis of basic thermodynamic systems. **Competence:** Having theoretical knowledge of conservation of energy and conversion laws in thermodynamics; able to abstract engineering problems, analyze and make engineering decisions, and conserve energy and reduce emission in engineering design.
Contents	**Part A. Theoretical teaching** (30 contact hours; 26 self-study hours) **Introduction** (1 contact hour) ● Energy and thermal energy use ● Characteristics of energy conversion* ● The study object and content of engineering thermodynamics ● Research methods for thermodynamics* **Chapter I Basic Concepts** (4 contact hours; 3 self-study hours) ● Thermal systems* ● Thermal state of the substance and its basic state parameters* ● Equilibrium, axioms of state and equation of state** ● Quasi-static and reversible processes** ● Heat and power** ● Thermal cycle* **Chapter II Thermal Properties of Gases** (3 contact hours; 2 self-study hours)

	● Ideal versus actual gases* ● Specific heat capacity of ideal gas* ● Nature of gas mixture* ● Compression factor and the van der Waals equation **Chapter III The First Law of Thermodynamics** (5 contact hours; 6 self-study hours) ● Thermodynamic energy and total energy* ● Closed system energy equation** ● Open system energy equation* ● Steady-state, steady-state flow energy equations for open system** ● Application of the steady-state, steady-flow energy equation **Chapter IV Thermal Processes of Ideal Gas and Gas Compression** (5 contact hours; 5 self-study hours) ● Thermal process analysis and steps* ● Thermal insulation process** ● Comprehensive analysis of the variable process** ● Theoretical compressed shaft power of the compressor* ● Remaining gap impact of piston compressor **Chapter V The Second Law of Thermodynamics** (7 contact hours; 8 self-study hours) ● The substance and formulation of the second law of thermodynamics* ● The Carnot's Cycle and Carnot's Theorem** ● State parameter entropy and entropy equations** ● Principle of entropy growth and loss of work capacity in isolated systems* **Chapter VI Water Vapor and Moist Air** (3 contact hours; 1 self-study hours) ● Water phase change and phase diagram ● Pressurization process of water vapor* ● Nature of moist air* **Chapter VII Internal Combustion Engine Cycles and Air Compression Refrigeration Cycles** (2 contact hours; 1 self-study hours) ● Internal combustion engine cycle

	● Air compression refrigeration cycle **Part B. Experiment teaching: (2 experiment hours; 2 self-study hours)** 1. Determination of air specific heat capacity (1 experiment hour;1 self-study hour) 2. Determination of indoor ambient meteorological parameters (1 experiment hour;1 self-study hour)
Study and examination requirements and forms of examination	1. Basic requirements for class (no late arrivals, no early departures, and no unauthorized absences) 10%. 2. Assignments (including homework 20% and experiment reports 10%) 30%. 3. Final exam 60%.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks, etc.
Reading list	1. Required books [1] Edited by LIAN Leming. *Engineering Thermodynamics (6th Edition).* Beijing: China Architecture and Building Press, 2016. 2. Reference books [1] Edited by SHEN Weidao, TONG Jungeng. *Engineering Thermodynamics (4th Edition).* Beijing: Higher Education Press, 2010. [2] Edited by TONG Jungeng, WANG Pingyang, SU Yongkang. *Fundamentals of Thermodynamics (2nd Edition).* Shanghai: Shanghai Jiao Tong University Press, 2008. [3] M.J. Moran, H.N. Shapiro, D.D. Boettner, M. B. Bailey. *Fundamentals of Engineering Thermodynamics*, 7th Ed., JOHN WILEY & SONS, 2010. [4] HE Yaling. *Analysis, Typical Questions and Answers of Engineering Thermodynamics.* Xi'an Jiaotong University Press, 2008.

Competence field	Engineering Fundamentals
Module designation	Measurement and Sensor Technology
Module level, if applicable	
Code, if applicable	109139
Subtitle, if applicable	
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Professor ZHENG Shubin
Lecturer	Professor ZHENG Shubin Lecturer PENG Lele Lecturer ZHONG Qianwen
Language	Chinese & English
Relation to curriculum	This course is a foundation course for Vehicle Engineering (Rail Transit Vehicle). Students will learn the measurement and sensor system, master the description method for time and frequency domain of signal, understand the concept of signal spectral structure, basic principles and methods of spectral analysis and correlation analysis, as well as the basic concepts of digital signal analysis and processing. Students will also learn the commonly used sensors, signal adjustment circuitry and recording; understand working principle and performance of display instrumentation; master the evaluation method of basic characteristics of detection devices and distortion-free test conditions, and first-order and second-order linear system; understand problems of dynamic measurement and engineering measurement of rail vehicles and their corresponding descriptions in English. Students will acquire the basic principles and methods of engineering measurement technology and apply it to solve measurement problems related to urban rail transit.

Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching, experiment teaching Contact hours: 32 hours Of which Theoretical teaching: 30 hours Experiment/practice teaching: 2 hours Size of class: up to 50 students for theoretical teaching
Workload	Total workload = 60 hours Contact hours = 32 hours Self-study hours = 28 hours
Credit points	2.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	Electrical Technology, Electronic Technology,
Module objectives/intended learning outcomes	**Learning outcomes:** The purpose and mission of this course is to enable students to understand the basic issues and content of dynamic measurement in engineering, master the basic principles and methods of engineering measurement techniques and their corresponding descriptions in English, and apply them to practical measurement tasks in the engineering field. Specific objectives include: ● **Knowledge:** 1. Methods of describing the time and frequency domains of signals; concepts of the spectral structure of signals, basic principles and methods of spectral analysis

	and correlation analysis, and their corresponding English descriptions; 2. Commonly used sensors, commonly used signal conditioning circuits and records, working principle and performance of instruments, and their corresponding descriptions in English; 3. Evaluation methods of basic characteristics of measurement devices and distortion-free conditions, first- and second-order linear system characteristics, basic issues of dynamic measurement and engineering measurement of rail vehicles, and their corresponding descriptions in English. ● **Skills:** 1. Ability to describe variables and parameters related to measurement systems and sensors, and to classify engineering signals; 2. Ability to perform basic transformations, analysis and calculations on engineering signals; 3. Ability to understand the basic sensing transformation principles and subsequent processing aspects of engineering measurement, and to configure engineering test systems. ● **Competence:** Able to apply principles of measuring and sensing technology to test scheme design and data analysis for engineering problems; perform basic signal analysis for specific measurement purposes; solve problems from different perspectives; understand various measurement, testing and sensing technologies; and to continuously expand and acquire new knowledge.

Contents	**Part A Theoretical teaching** (30 contact hours; 26 self-study hours) **Chapter I Overview of Measurement and Sensor Technology** (2 contact hours; 2 self-study hours) ● An overview of the development of measurement and sensor technology; ● Basic concepts of measurement, testing, sensing**. ● Basic components of the measurement system*. **Chapter II Signals and their description** (8 contact hours; 6 self-study hours) ● Types of signals and their characteristics**; ● The concept of signal spectrum**; ● Fourier series trigonometric expansion of the periodic signal*; ● Fourier transform of acyclic signals*; ● Basic concepts of random signals. **Chapter III Basic Characteristics of Measurement Device** (6 contact hours; 6 self-study hours) ● Static characteristics and errors of measurement device**; ● Static characteristic parameters of measurement device*, ● Dynamic characteristics of measurement device **, ● Dynamic characteristics of first- and second-order measurement device*, ● Distortion-free measurement condition*; ● Dynamic measurement characteristics of measurement device. **Chapter IV Signal Conditioning, Processing** (6 contact hours; 6 self-study hours) ● The principle of electric axle measurement**; ● Principles and methods of measurement

	of DC electric axle*; ● Principles and methods of modulation and demodulation of signals; ● Basic concepts of filters; ● The concept of filter design parameters*. **Chapter V Common Sensing Technologies** (4 contact hours; 3 self-study hours) ● Sensor technologies and classifications*; ● Principles and applications of strain sensors*; ● Principles and applications of piezoelectric sensors*; ● Principles of sensor selection**. **Chapter VI Vibration Measurement and Engineering Applications** (4 contact hours; 3 self-study hours) ● Vibration measurement methods*; ● Application of vibration measurement technologies in vehicle engineering**. **Part B Experiment teaching** (2 experiment hours; 2 self-study hours) First-order system dynamic characteristic measurement
Study and examination requirements and forms of examination	Final score includes: attendance (10%), performance (30%) and final exam (60%). Specific requirements are as follows: 1. Attendance (10%): no late arrivals, no early departures, and no unauthorized absences; 2. Assignments (30%): homework, experiment reports; 3. Final assessment (60%): final exam.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] XIONG Shibo, HUANG Changyi. *Fundamentals of Mechanical Engineering Testing Technology* . Beijing: Machinery

	Industry Press, 2007. 2. Reference books [1] ZHANG Youyun. *Modern Mechanical Testing Technology.* Beijing: Science Press, 2005. [2] CHEN Hualing. *Mechanical Engineering Testing Technology.* Beijing: Machinery Industry Press, 2006. [3] SHEN Yan, GUO Bing, YANG Ping. *Testing and Sensing Technology.* Beijing: Tsinghua University Press, 2011.

Competence field	Engineering Fundamentals
Module designation	Mechanical Principle
Module level, if applicable	
Code, if applicable	019310
Subtitle, if applicable	
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Professor ZHANG Liqiang
Lecturer	Professor ZHANG Liqiang Associate Professor LU Chenhui Associate Professor ZHANG Chunyan Lecturer TENG Bing
Language	Chinese
Relation to curriculum	Mechanical Principle is a foundation course for mechanics-related programs. It is closer to engineering practice than a typical foundation course. It has a broader field of study and adaptability than a core course. It describes general principles of operation, construction features, basic design theories and calculation methods, with a focus on the analysis of degrees of freedom and velocity of planar mechanisms, planar connecting rod mechanisms, cam mechanisms, and gear mechanisms. The course will help students develop the ability to innovatively design mechanical products and improve the use of existing machinery.

Type of teaching, contact hours	Target students: sophomores of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching + experiment teaching Exercise time: 48 hours Of which Theoretical teaching: 44 hours Experiment/practice teaching: 4 hours Size of class: up to 90 students for theoretical teaching
Workload	Total workload = 90 hours Contact hours = 48 hours Self-study hours = 42 hours
Credit points	3.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	Unary Calculus (1); Unary Calculus (2); Multivariate Calculus (1); Multivariate Calculus (2); Fundamentals of Drawing; Physics (Mechanics); Physics (Electromagnetism); Engineering Mechanics (1)
Module objectives/intended learning outcomes	**Learning outcomes:** The course aims to equip students with general mechanical design skills and the ability to adapt and handle creative mechanical and technical work. Specific objectives include: ● **Knowledge:** 1. Basic knowledge of structural, kinematic and dynamic analysis of general planar mechanisms; 2. Graphical methods for the analysis and design of mechanical motion and dynamics; 3. Basics of analyzing and designing mechanisms according to known dynamic conditions. ● **Skills:**

	1. Able to apply basic theoretical knowledge of mechanics and mechanical dynamics for fundamental design and modeling of mechanisms; 2. Able to consult technical data, and make calculations and drawings. 3. Able to use experiments to analyze the characteristics of mechanisms in motion. ● **Competence:** Ability to formulate mechanical motion schemes, analyze and design mechanisms, and to expand knowledge of mechanical design to solve practical problems.
Contents	**Part A. Theoretical teaching** (44 contact hours; 38 self-study hours) **Chapter I Introduction** (2 contact hours; 2 self-study hours) ● The concept of machines, mechanisms, components and parts* ● The content, nature and characteristics of the course and learning methods ● General process of mechanical design ● Basic requirements for the design of machines and mechanical parts* **Chapter II Structural Analysis of Planar Mechanisms** (7 contact hours; 5 self-study hours) ● Composition of mechanism** ● Sketching movement of mechanisms ● Mechanisms with conditions to determine movement * ● Calculation of degrees of freedom of mechanisms* **Chapter III Movement Analysis of Mechanisms** (4 contact hours; 4 self-study hours) ● Purpose and methodology of mechanism motion analysis ● The concept of velocity transients and the determination of their location * ● Velocity analysis of mechanisms using velocity transients * **Chapter IV Planar connecting rod**

	mechanism (5 contact hours; 5 self-study hours) ● Features and applications of planar connecting rod mechanism ● Basic type and development of planar connecting rod mechanism ● Basic characteristics of planar connecting rod mechanism* ● Design of planar connecting rod mechanism* **Chapter V Cam Mechanism** (5 contact hours; 5 self-study hours) ● Applications and types of cam mechanism ● Common laws of motion of the follower * ● Pressure angle of the cam mechanism* ● Diagrammatic design of cam contours * **Chapter VI Gear Mechanism** (9 contact hours; 7 self-study hours) ● Characteristics and types of gear mechanism ● Basic laws of tooth profile engagement* ● Formation of involutes and their properties* ● Engagement characteristics of involute tooth profiles* ● Basic parameters and geometry of involute standard gears* ● Transmission properties of involute straight-tooth cylindrical gears* ● Reason for correction, cutting method, geometry, transmission type and design procedure of the gearboxes ● Engagement characteristics, basic parameters and geometry of helical cylindrical gear drive* **Chapter VII Wheel System** (6 contact hours; 6 self-study hours) ● Classification and application of the wheel system ● Calculation of the transmission ratio of the fixed axle wheel train * ● Calculation of the transmission ratio of the rotating wheel system and hybrid

	wheel system * **Chapter VIII Regulation of Fluctuations in Mechanical Running Speed** (4 contact hours; 2 self-study hours) ● Objectives and methods of mechanical operation speed fluctuation adjustment and flywheel design approximation ** ● Determination of the main dimensions of the flywheel* **Chapter IX Mechanical Balance** (2 contact hours; 2 self-study hours) ● Purpose and content of mechanical balancing ● Conditions and calculations of static and dynamic equilibrium of rigid rotors* ● Experimental principle and method of equilibrium of rigid rotors **Part B. Experiment/practice teaching (4 experiment hours; 4 self-study hours)** 1. Mechanism motion sketching (2 experiment hours; 2 self-study hours) 2. Involute tooth contour drawing (2 experiment hours; 2 self-study hours)
Study and examination requirements and forms of examination	1. Basic requirements for class (no late arrivals, no early departures, and no unauthorized absences) 10%. 2. Assignments (including homework 50% and experiment reports 50%) 20%. 3. Final exam 70%.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] LU Ning, FAN Jiangling et al. *Mechanical Principle (2nd Edition)*, Beijing: Tsinghua University Press. 2012; 2. Reference books [1] Edited by SHEN Yongsheng, *A Course on Mechanical Principle (3rd edition)*. Beijing: Tsinghua University Press, 2019;

	[2] SUN Heng, CHEN Zuomo, GE Wenjie. *Mechanical Principle (8th Edition).* Beijing: Higher Education Press. 2013; [3] Guo Weidong. *Mechanical Principle (Digital Cloud Textbook).* Xi'an: Xi'an Jiaotong University Press. 2016

Competence field	Engineering Fundamentals
Module designation	Mechanical Design
Module level, if applicable	
Code, if applicable	019302
Subtitle, if applicable	
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Professor ZHANG Liqiang
Lecturer	Professor ZHANG Liqiang Professor HANG Lubin Associate Professor ZHANG Chunyan Lecturer TENG Bing
Language	Chinese
Relation to curriculum	Machinery Design is a foundation course for mechanics related programs. It briefly introduces the basic knowledge of machine design with a focus on the basic design theory and methods of general parts. The content includes general theory (the basic principles of machine and component design, design calculation theory, material selection, structural requirements, etc.), coupling (screw connection, pin connection, etc.), transmission (gear drive, belt drive, worm drive, spiral drive, etc.), shaft system (sliding bearings, rolling bearings, shafts, etc.) and others (spring, box, housing, reducer etc.).
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching + experiment teaching Contact hours: 80 hours Of which Theoretical teaching: 76 hours Experiment/practice teaching: 4 hours Size of class: up to 90 students for theoretical teaching

Workload	Total workload = 150 hours Contact hours = 80 hours Self-study hours = 70 hours
Credit points	5.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	Mechanical Principle; Engineering Mechanics (1); Engineering Mechanics (2); Interchangeability and Technical Measurement
Module objectives/intended learning outcomes	**Learning outcomes:** The course aims to equip students with design skills of general parts and the ability to adapt and handle creative mechanical and technical work. Specific objectives include: ● **Knowledge:** 1. Characteristics, working principle and design method of general mechanical parts. 2. Design and calculation method for thread drive, belt drive, gear drive, rolling bearings and shafts and other general parts. 3. Experimental methods of typical mechanical parts. ● **Skills:** 1. Ability to design reasonable structure, material and heat treatment for parts according to the actual working conditions. 2. Ability to study and analyze the influence of structure, materials, machining and heat treatment parameters on the performance of parts. 3. Ability to apply experiments to study structure and performance of general parts. ● **Competence:**

	Understand the design principles, methods and general design rules of general mechanical parts, and have the ability to design and innovate at mechanical transmission devices and simple machines.
Contents	**Part A. Theoretical teaching** (76 contact hours; 66 self-study hours) **Chapter 1 Introduction** (2 contact hours; 2 self-study hours) ● The content, nature and tasks of the course. **Chapter 2 General Introduction to Mechanical Design** (2 contact hours; 4 self-study hours) ● Design principles and methods of common parts;** ● Ability to access and use relevant technical data;** ● Experimental methods for typical parts;** ● New developments in mechanical design. **Chapter 3 Strength of Mechanical Parts** (8 contact hours; 8 self-study hours) ● Calculation of the strength of parts under static stress** ● Calculation of the strength of parts under variable stress** ● Calculation of the strength of parts under unstable stress; ● Contact strength concepts and calculations for parts. ** **Chapter 4 Threaded and Keyed Connections** (10 contact hours; 8 self-study hours) ● Basic types of threaded couplings** ● Calculation of threaded couplings** ● Measures to increase the load capacity of threaded couplings* **Chapter 5 Belt Drive** (6 contact hours; 6 self-study hours) ● Force analysis of drive belts (initial tension, effective tension, Euler formula)

	and stress analysis of drive belts (tensile, bending, centrifugal force);** ● Elastic sliding and slippage of belt drives;* ● Failure modes and calculation criteria for belt drives, basic power rating of a single V-belt. ● Design calculations for V-belt drives. ** **Chapter 6 Gearing** (10 contact hours; 8 self-study hours) ● Failure modes and calculation guidelines for gearing;** ● Failure modes and calculation guidelines for straight tooth drives;** ● Calculation of the load capacity of straight-toothed cylindrical gears;** ● Calculation of the load capacity of helical cylindrical gearing;** ● Design of cylindrical gear structures; ● Characteristics of bevel gearing; ● Geometric calculations for straight bevel gearing. **Chapter 7 Worm Drive** (6 contact hours; 4 self-study hours) ● Main parameters of ordinary cylindrical worm drives and failure modes and calculation criteria for worm drives;** ● Calculation of the load capacity of a common cylindrical worm drive;** ● Materials and permissible stresses for worm gearing; ● Efficiency, self-locking and thermal balance calculations for worm drives; ● Structural design of the worm and worm gear. **Chapter 8 Plain Bearings** (10 contact hours; 8 self-study hours) ● Sliding shaft systems; ● The form of construction of plain bearing, bushings and their materials. ● Design calculations for non-liquid friction plain bearings;* ● Operating principle of dynamic-pressure radial plain bearings, lubricant viscosity

	and Newton's viscosity law, Reynolds' equation and hydraulic distribution curve, minimum film thickness, bearing load factor, liquid friction coefficient, oil consumption coefficient, operating characteristic curve; ** ● Design of dynamic pressurized radial plain bearings. **Chapter 9 Rolling Bearings** (12 contact hours; 8 self-study hours) ● Structure, characteristics, types and designation of rolling bearings;** ● Selection of rolling bearing types; force and stress analysis, failure modes and calculation criteria for rolling bearings;** ● Selection of rolling bearing types by life calculation (rated life and rated dynamic load, life calculation formula, equivalent dynamic load) and selection of rolling bearing types by static load capacity (rated static load, equivalent static load, calculation conditions);** ● Design of rolling bearing assemblies (requirements for bearing housing and bearing bore, axial fixing, compensation of shaft elongation by heat, adjustment of bearing assembly positions, rolling bearing fits, axial preload, lubrication and sealing). **Chapter 10 Shaft** (10 contact hours; 10 self-study hours) ● The use, classification, and material of the shaft; ● Structural design and strength calculations of shafts (calculation of torsional strength, composite strength in bending and torsion, accurate calibration of shafts); ● Calculation of shaft stiffness (bending stiffness vs. torsional stiffness) and shaft vibration vs. critical speed. **Part B. Experiment/practice teaching** (4 experiment hours; 4 self-study hours)

	1. Elastic sliding of the belt drive (2 experimen hours; 2 self-study hours) 2. Reducer disassembly (2 experiment hours; 2 self-study hours)
Study and examination requirements and forms of examination	1. Basic requirements for class (no late arrivals, no early departures, and no unauthorized absences) 10%. 2. Assignments (including homework 50% and experiment reports 50%) 20%. 3. Final exam 70%.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] PU Lianggui, JI Minggang et al. *Mechanical Design (9th Edition)*, Beijing: Higher Education Press, 2013 2. Reference books [1] YANG Kezhen, CHENG Guangyun. *Fundamentals of Mechanical Design (6th Edition)*, Beijing: Higher Education Press, 2013 [2] SUN Zhili, MA Xingguo, HUANG Qiubo et al. *Mechanical Design.* Beijing: Science Press, 2008 [3] QIU Xuanhuai, GUO Keqian, WU Zongze. *Mechanical Design (4th ed.).* Beijing: Higher Education Press, 1997 [4] LIU Ying, WU Zongze. *A Course on Mechanical Design (2nd Edition)*. Beijing: Machinery Industry Press, 2008.

Appendix B - Syllabus - Engineering Fundamentals

Competence field	Engineering Fundamentals
Module designation	Interchangeability and Technical Measurement
Module level, if applicable	
Code, if applicable	019101
Subtitle, if applicable	
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Professor MAO Jian
Lecturer	Professor MAO Jian Associate Professor WU Jianmin Associate Professor ZHOU Yufeng Lecturer WU Minghui
Language	Chinese
Relation to curriculum	Interchangeability and Technical Measurement is a foundation course of mechanical and related programs with a focus on practice. Students will acquire basic knowledge of geometric accuracy of mechanical parts and their interaction as well as the fundamentals of technical measurement of geometric parameters. The course ensures that students have the basic knowledge and develop the skillset that are required of mechanical and related technicians.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 32 hours Of which Theoretical teaching: 28 hours Experiment/practice teaching: 4 hours Size of class: up to 70 students for theoretical teaching

Workload	Workload = 60 hours Contact hours = 32 hours Self-study hours = 28 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	Fundamentals of Drawing, Mechanical Principle
Module objectives/intended learning outcomes	Module objectives: The aim of this course is to provide students with basic knowledge of geometric accuracy of mechanical parts and their interaction, as well as the fundamentals of technical measurement of geometric parameters, through teaching and practice. Specific objectives include: **Knowledge:** 1. The basic concept, steps, foundational principles and general methods of mechanical precision design. 2. The basic concepts of geometry linear size, angle size, shape and position accuracy, relevant national standard, as well as the relationship between accuracy in form and dimension. 3. Fundamentals of precision design of typical components and transmission parts. **Skills:** 1. Ability to design geometric accuracy of mechanical components; 2. Ability to make general geometric measurement of mechanical parts using

	typical measurement techniques; 3. Ability to access and use relevant national standards for parameter calculations. **Competence:** Having the fundamental knowledge of geometric accuracy of mechanical parts and their interaction; able to conduct technical measurement of geometric parameters; able to apply knowledge to analyze, calculate and annotate the machining accuracy of mechanical parts, and solve engineering problems in the mechanical engineering industry.
Contents	**Part A Theoretical teaching** (28 contact hours; 24 self-study hours) **Chapter 1 Introduction** (2 contact hours; 2 self-study hours) ● The concept of interchangeability, its characteristics, classification, advantages and basic principles. ** ● The relationship between interchangeability and standardization. ● The basic content and characteristics of priority numbers and priority number systems, significance of numerical standardization, and the role of priority numbers in standardization. * ● International standards for the industry. **Chapter 2 Limits and Fits** (8 contact hours; 7 self-study hours) ● Basic terminology for broad bores, shafts and related dimensions;** ● The concept of deviation and tolerance;** ● Dimensional tolerance zone and fits zone and their mapping;** ● National standard and tolerance grade designators, basic deviation designators, tolerance zone designators and fit designators;** ● Bore and shaft tolerances and fits indicated in drawings. **

	● Principles and methods of accurate part designs. ** ● Unfilled tolerances for linear dimensions **Chapter 3 Form and Location Tolerances** (6 contact hours; 5 self-study hours) ● Basic concepts of form and location tolerances and the establishment, interpretation, characteristics and application of form and location tolerance zones. * ● Form and location tolerance items, selection of tolerance values and marking methods. ** ● Principles governing the relationship between dimensional and positional tolerances - the principles of independence and correlation. ● Criteria for assessing form and location errors. **Chapter 4 Surface Roughness** (2 contact hours; 1 self-study hour) ● Concepts of surface roughness, sample length, evaluation length and reference line. ● Surface roughness evaluation parameters and marking methods. ** ● Principles for evaluating parameters and selected values. * **Chapter 5 Tolerances and Fits of Rolling Bearings** (1 contact hour; 1 self-study hour) ● Rolling bearing accuracy level and its selection. ● Characteristics of tolerance zones of inside and outside diameter of rolling bearings. ** ● National standards related to rolling bearings with shaft, bore tolerance zones and other technical requirements of the selection and marking. ** **Chapter 6 Tolerances and Fit of Keys and Splines** (1 contact hour; 1 self-study hour) ● Types and characteristics of flat spline and rectangular spline combinations. ● Characteristics of tolerances and fits of flat spline and rectangular spline connections. ** ● Centering of rectangular spline

	connections and characteristics of tolerances and fits of rectangular splines. ● The selection and labeling of tolerances and fits of flat spline connections. ** ● Selection and labeling of tolerances and fits for rectangular spline connections. **Chapter 7 Tolerances and Fits of Cylindrical Gears** (4 contact hours; 3 self-study hours) ● Requirements for use of gear drive;** ● Sources of error in the main geometric parameters affecting the requirements for use of involute cylinders;* ● Rating indicators for individual gear and gear pairs as defined by national standards;* ● The main content of the standard for Accuracy of Involute Cylindrical Gears. ● The selection and labeling of tooth thickness limit deviations, selected gear blank tolerances and surface roughness values. **Chapter 8 Geometric Measurements** (1 contact hour; 1 self-study hour) ● The concept of accuracy and error;* ● The concept of "measurement" and the concepts of "class" and “grade" of gauge blocks;* ● Characteristics of measurement method classification, classification of measuring instruments, essential performance indicators. * **Chapter 9 Smooth Limit Gauge** (1 contact hour; 1 self-study hour) ● Principles for the determination of acceptance limits and the selection of common measuring instruments; ● The role, types and common construction of smooth limit gauges;

	● Design principles and requirements for smooth limit gauges. * **Chapter 10 Accuracy Design of Mechanical Parts** (2 contact hours; 2 self-study hours) ● Principles and methods of accuracy design of typical parts;** ● Basic content and steps of accuracy design of shaft parts;** ● Basic content of accuracy design of gear and housing parts. **Part B: Experiment: (4 experiment hours; 4 self-study hours)** 1. Measure bore and shaft diameters using a vertical optical comparator, a vertical digital optical meter, and a lever micrometer. (1 experiment hours; self-study hours) 2. Measure surface roughness using a light-section microscope. (1 experiment hours; 1 self-study hours) 3. Measure tooth pitch, radial run-out of tooth ring, common normal line, tooth thickness, and other parameters. (2 experiment hours; 2 self-study hours)
Study and examination requirements and forms of examination	Final score includes: 1. Final assessment (70%): final exam 2. In-class performance (30%): experiment, assignment, attendance
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	Reading list [1] ZHOU Yufeng, DU Xiangyang. *Interchangeability and Technical Measurement.* Beijing: Tsinghua University Press. 2008 Reference books:

	[1] WANG Boping. *Fundamentals of Interchangeability and Measurement Techniques.* 3rd Edition. Beijing: Machinery Industry Press, 2009 [2]HAN Jinhong, WANG Changchun. *Interchangeability and Technical Measurement.* Beijing: Peking University Press. 2006 [3]ZHOU Zhaoyuan. *Fundamentals of Interchangeability and Measurement Techniques.* Beijing: Machinery Industry Press, 2013

Competence field	Engineering Fundamentals
Module designation	Electrical Technology
Module level, if applicable	N/A
Code, if applicable	249205
Subtitle, if applicable	N/A
Semester(s) in which the module is taught	3rd Semester
Person responsible for the module	Associate Professor SU Shengchao
Lecturer	Associate Professor SU Shengchao Associate Professor FAN Xiaolan Associate Professor ZHANG Jingzhi Associate Professor ZHAO Chunfeng Associate Professor HE Zhimin Lecturer WANG Yanxin Lecturer LONG Yingwen Lecturer JI Mingming Lecturer ZHANG Zhixiong Lecturer CHEN Dexin
Language	Chinese
Relation to curriculum	This course is a technical foundation course for non-electrical programs and has two components: basic circuit analysis and electrical control technology. It includes chapters on basic concepts and methods of circuit analysis, analysis of sinusoidal AC circuits, three-phase sinusoidal AC circuits, transient analysis of first-order circuits, magnetic circuits and transformers, and AC motors. In the teaching process, typical examples and experiments are used to help student grasp theoretical knowledge, so that they acquire the necessary basic theories, knowledge and skills of electrical technology, and develop a solid foundation for subsequent study and practice.

Type of teaching, contact hours	Target students: juniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching + experiment teaching Contact hours: 64 hours Of which Theoretical teaching: 60 hours Experiment/practice teaching: 4 hours Size of class: up to 60 students for theoretical teaching
Workload	Total workload = 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	Unary Calculus (1); Unary Calculus (2); Multivariate Calculus (1); Multivariate Calculus (2); Physics (Electromagnetism)
Module objectives/intended learning outcomes	**Learning outcomes:** The main task of this course is to provide students with basic knowledge of circuit analysis, magnetic circuits, transformers, and electrical control technology, so that they develop holistic thinking, computational capability, and problem-solving skills. Specific objectives include: ● **Knowledge:** 1. Basic concepts and methods of circuit analysis, analysis of alternating current, three-phase AC circuits, transient analysis of first-order circuits, magnetic circuits and transformers, and AC motors. 2. Examples of typical circuits, transformers and e-motor control circuits;

	3. Trends and applications of new electrical technology. ● **Skills:** 1. Ability to simplify circuit analysis and calculations using engineering approximations or equivalent modeling methods from a practical perspective. 2. Ability to independently design and conduct electrical experiments and analyze the results. 3. Ability to select and use transformers and electric motors, and design basic control circuits for motors. ● **Competence:** Master the basic theories, laws, concepts and analysis methods of electrical technology. Able to analyze circuits, select electrical equipment, calculate and control engineering challenges according to the applications.
Contents	**Part A. Theoretical teaching** (60 contact hours; 52 self-study hours) **Chapter I Basic Concepts and Analysis Methods of Electric Circuits** (15 contact hours; 12 self-study hours) ● Function and composition of electric circuits and their state ● Reference points in circuits and ideal circuit components for reference orientation* ● Kirchhoff's circuit laws** ● Branch-current method* ● Node-voltage analysis ● Superposition theorem** ● Equivalent power theorem** **Chapter II Alternating Current** (15 contact hours; 14 self-study hours) ● Basic concepts of alternating current ● Phase representation of alternating current** ● Single-parameter AC circuit* ● RLC series AC circuit** ● Resistive series-parallel AC circuit** ● Resonance in electric circuit* ● Power factor improvement in AC circuits**

	Chapter III Three-Phase AC Circuits (6 contact hours; 5 self-study hours) ● Generation of three-phase electric potential ● Analysis and calculation of three-phase circuits** ● Three-phase power* **Chapter IV Transient Analysis of First-order Circuits** (6 contact hours; 5 self-study hours) ● Switch law* ● Zero input response, zero state response, and full response for first-order circuits* ● The three-element method for first-order circuit** **Chapter V Magnetic Circuits and Transformers** (5 contact hours; 4 self-study hours) ● Basic concepts and laws of magnetic circuits ● Basic electromagnetic relations of AC iron-core coil circuits ● The basic structure and working principles of transformer and its application*. **Chapter VI AC Motor Circuit** (6 contact hours; 5 self-study hours) ● Structure and working principles of three-phase asynchronous motor ● Mechanical characteristics of three-phase asynchronous motor* ● Type plate data for three-phase asynchronous motor* **Chapter VII Relay Contactor Control Circuits** (7 contact hours; 7 self-study hours) ● Structure and function of common low-voltage apparatus ● Basic control circuit of three-phase asynchronous motor** ● Sequence control circuit for three-phase asynchronous motor* **Part B. Experiment teaching** (4 contact hours; 4 self-study hours) In order to help students better understand and apply the theoretical knowledge of electrical technology and improve their practical skills, two of the following typical experiment sessions will be arranged:

	(1) Validation of the superposition theorem* (2 contact hours; 2 self-study hours) (2) Power factor improvement in single-phase AC circuits*(2 contact hours; 2self-study hours)
Study and examination requirements and forms of examination	1. Basic requirements for class (no late arrivals, no early departures, and no unauthorized absences) 10%. 2. Assignments (including homework 30% and big project 70%) 20%. 3. Final exam 70%.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks, etc.
Reading list	1. Required books: FAN Xiaolan. *Electrical Technology*. Beijing: Tsinghua University Press, 2013 2. Main reference books: [1] QIN Zenghuang. *Electrical Engineering (Vol. 1)*. 7th Edition. Beijing: Higher Education Press, 2009. [2] WANG Weirong. *Electronic Technology-Electrical Technology and Computer Simulation (2nd Edition)*. Shanghai: Shanghai Jiao Tong University Press, 2010 [3] The Editorial Board of the Electrical Engineering Handbook (Japan). *Practical Handbook of Electrical Engineering in Diagrams*. Beijing: China Science Publishing, 2006.

Competence field	Engineering Fundamentals
Module designation	Electronic Technology
Module level, if applicable	
Code, if applicable	249206
Subtitle, if applicable	
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Professor ZHANG Wei
Lecturer	Associate Professor FAN Xiaolan Associate Professor SU Shengchao Associate Professor WANG Jinghua Associate Professor ZHANG Jingzhi Associate Professor ZHAO Chunfeng Associate Professor HE Zhimin Lecturer WANG Yanxin Lecturer LONG Yingwen Lecturer HU Zhi Lecturer JI Mingming Lecturer ZHANG Zhixiong Lecturer CHEN Dexin
Language	Chinese
Relation to curriculum	This course is a basic course for non-electrical programs, mainly including analog and digital circuits, which provides a solid and necessary theoretical foundation for students' subsequent core courses and engineering practice. The content includes five key chapters on semiconductor devices, basic amplification circuits, integrated operational amplifiers, combinational logic circuits and time-sequence logic circuits. In addition, according to the students' program and the requirements of the secondary schools and colleges, there are four alternative chapters of A/D digital-to-analog conversion, DC power supply, negative feedback applications and power amplification circuits to cultivate students' independent

	thinking and improve their self-learning ability. The course shall highlight knowledge acquisition and capability development and use typical engineering cases in teaching to enrich and expand students' knowledge structure.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching + experiment teaching Contact hours: 64 hours Of which Theoretical teaching: 60 hours Experiment/practice teaching: 4 hours Size of class: up to 60 students for theoretical teaching
Workload	Total workload = 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	Unary Calculus (1); Unary Calculus (2); Multivariate Calculus (1); Multivariate Calculus (2); Physics (Electromagnetism); Electrical Technology
Module objectives/intended learning outcomes	**Learning outcomes:** This course aims to provide students with the basic knowledge of analog and digital circuits and cultivate their ability of holistic thinking, design reasoning and problem-solving in electronics. Specific objectives include: ● **Knowledge:** 1. Basic knowledge of analog electronics and

	digital electronics; 2. The principle and composition of basic amplification circuits and integrated operational amplifiers, the concept and discrimination of various negative feedback, the analysis and design of combined logic circuits and time-sequence logic circuits; 3. Typical examples of analog and digital circuits, design and application of new electronic circuits. ● **Skills:** 1. Able to perform engineering calculations and functional analysis of analog and digital circuits; 2. Able to design digital and combinational logic circuits that meet functional requirements. 3. Able to design and implement basic engineering experiments and analyze the results from a practical perspective, using engineering approximations or equivalent models. **Competence:** Master the basic theory, laws and analysis methods of analog and digital electronic technology. Ability to analyze the dynamic performance of circuits and control the logic of timing sequences; ability to apply basic theories and technical means of electronic technology to solve engineering problems.
Contents	**Part A. Theoretical teaching** (60 contact hours; 52 self-study hours) **Chapter 1 Semiconductors** (8 contact hours; 6 self-study hours) ● Basic knowledge of intrinsic and extrinsic semiconductors ● Voltammetric characteristics of ideal diode and analysis of their applications* ● Voltage-stabilized tubes and their applications ● Unidirectional conductivity of PN junctions* ● The principle of current amplification in transistors* ● Determining the operating state of transistor based on transistor

	input/output curve** **Chapter 2 Basic Amplification Circuits** (12 contact hours; 12 self-study hours) ● Basic concepts and components of amplified circuits* ● Three configurations of amplified circuits ● Significance of dynamic performance indicators (magnification, input resistance and output resistance) of amplified circuits* ● Transistor's differential equivalence model, using the differential equivalence circuit method to solve the dynamic performance metrics of amplification circuits* ● Using graphical methods to calculate the static operating point of amplification circuits and analyze their dynamic performance* ● Causes of amplified circuit waveform distortion* ● Stability of static work points ● Static and dynamic analysis methods for common emitter amplification circuits and split-voltage fixed bias amplification circuits** ● Circuit analysis and application of emitter devices **Chapter 3 Integrated Operational Amplifiers** (9 contact hours; 7 self-study hours) ● History and basic structure of integrated operational amplifiers ● Zero point drift in the circuit ● Differential amplification circuit composition, analysis and its role* ● Voltage transmission characteristics of integrated operation* ● Application circuit calculations for integrated operational amplifier operation in the linear region using "virtual short" and "virtual break" analysis** ● Application circuit using “virtual break" analysis to calculate the saturation region of the integrated operational amplifier* **Chapter 4 Negative Feedback** (7 contact hours; 5 self-study hours) ● Block diagram of basic concepts and principles of feedback ● The effect of negative feedback on

	amplified circuit performance ● Definition of negative feedback* ● Method of determining positive and negative feedback* ● Using instantaneous polarity method to determine positive and negative feedback** ● Determination of the four types of configuration by AC negative feedback** **Chapter 5 Basic Logic Gate Circuits and Combinatorial Logic Circuits** (12 contact hours; 10 self-study hours) ● The difference between analog and digital signals ● Number system and its conversion ● The basic logic of "in relation to", "or", "not "* ● Graphical representation of basic gates, logical expressions, truth tables* ● Simplifying logical functions using the laws of logical algebra and canonical diagrams** ● Methods of analysis and design of combinational logic circuits* ● Combined logic devices such as adders, encoders, decoders, etc. **Chapter 6 Trigger and Time-sequence Logic Circuits** (12 contact hours; 12 self-study hours) ● Circuit composition of basic RS trigger, controllable RS trigger, JK trigger and D-trigger ● Basic RS Trigger, Controlled RS Trigger, JK Trigger and D Trigger Logic Functions** ● Trigger logic function conversion and design ● Design of time-sequence logic circuits ● Register; ● Methods of Analysis of Time-sequence Logic Circuits** ● Arbitrary counters using feedback zeroing and place value methods* **Part B. Experiment teaching** (4 contact hours; 4 self-study hours) In order to help students better understand and apply the theoretical knowledge of electronic technology and improve their practical skills, two of the following typical experiment sessions will be arranged: (1) Common emitter single-tube amplifier circuit parameter test* (2 contact hours;

	2self-study hours) (2) Analytical design and testing of combinatorial logic circuits*(2 contact hours; 2self-study hours)
Study and examination requirements and forms of examination	1. Basic requirements for class (no late arrivals, no early departures, and no unauthorized absences) 10%. 2. Assignments (including homework 30% and big project 70%) 20%. 3. Final exam 70%.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] WANG Jinghua. *Electronic Technology*. Beijing: Tsinghua University Press, 2014 2. Main reference books: [1] LEI Yong. *Electrical Engineering (Volume 2). Electronic Technology* Beijing: Higher Education Press, 2018 [2] LI Chunmao. *Fundamentals of Electronic Technology (National Textbook for Undergraduate General Higher Education in the 12th Five-Year Plan Period).* Beijing: Machinery Industry Press, 2016. [3] SHI Yikai. *Electronic Technology (Electrical Engineering 2) (National Textbook for Undergraduate General Education in the 12th Five-Year Plan Period) 3rd Edition.* Beijing: Science Press, 2016

Competence field	Engineering Fundamentals
Module designation	Automatic Control Theory
Module level, if applicable	
Code, if applicable	109185
Subtitle, if applicable	
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Associate Professor LI Xiaobo
Lecturer	Associate Professor LI Xiaobo Lecturer HE Yu Lecturer HUANG Shujun
Language	Chinese
Relation to curriculum	As an engineering fundamental course for students majoring in Vehicle Engineering (Rail Transit Vehicle), this course mainly investigates the concepts of control system. Topics covered in this course include the mathematical models of open-loop system, closed-loop system and compound system; the solution to system transfer function and stability determination; the structure diagram and signal flow diagram of control system; time-domain analysis of high-level system; the error transfer function and its solution; the frequency characteristics of typical element and open-loop system; Nyquist stability criterion; the correction methods for linear system; the common calibration devices and their characteristics; and the concept of nonlinear control system. After successfully completing this course, students will be able to acquire comprehensive knowledge in the basic principles and approaches used in control theory fundamental course, and apply the concepts and techniques learned in this course to solve related system control issues in real urban rail transit contexts.

Type of teaching, contact hours	Target students: juniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 32 hours Of which Theoretical teaching: 32 hours Experiment/practice teaching: 0 hour Size of class: up to 60 students for theoretical teaching
Workload	Total workload = 60 hours Contact hours = 32 hours Self-study hours = 28 hours
Credit points	2.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	Unary Calculus (1); Unary Calculus (2); Multivariate Calculus (1); Multivariate Calculus (2); Physics (Mechanics); Physics (Electromagnetism)
Module objectives/intended learning outcomes	**Learning outcomes:** The course aims to provide students with a sound basis of knowledge in control theory. After successfully completing this course, students will be able to use the basic principles of and approaches to control theory to solve relevant correlation issues in real engineering contexts. They will also have skills in describing the above mentioned content in English. Specific objectives include: **Knowledge:** 1)Representation of differential equation for linear system; representation of zeros and poles of a transfer function, open loop gain,

	and root locus gain, etc.;; 2) Transfer function of a typical element; structure diagram and signal flow diagram of control system; equivalent transformation and simplification of structural diagrams; composition and nature of signal flow graph; conversion from a structure diagram to a signal flow diagram; 3) Calculation of transfer function and stability determination; performance index of linear system time response; linear system stability analysis, Routh criterion and its application; frequency characteristics of typical element and open-loop system; Nyquist stability criterion; **Skills:** 1) Demonstrate skills in describing related variables, parameters and transfer functions of typical control systems and typical elements; 2) Demonstrate skills in determining, analyzing and calculating the stability of a control system; 3) Demonstrate skills in using pre-position, post-position and other methods to correct the state parameters of typical control systems. ● **Competence:** After successfully completing this course, students will be able to apply the basic theoretical knowledge and principles of control system they have learned to solve issues in real engineering contexts, including perform basic control system modeling, stability determination and data analysis. Students will be able to analyze and solve problems from different perspectives. They will understand the features of various control systems, typical input signal performance and frequency domain characteristics. This course will also help students to expand their knowledge and acquire new skills.

Contents	**Part A. Theoretical teaching** (32 contact hours; 28 self-study hours) **Chapter 1** General Concepts of Control Systems (2 contact hours; 2 self-study hours) The main content, significance, main methods of learning and the final assessment of the course; Basic components of a feedback system; * Basic control modes; * Control system classification: open-loop, closed-loop, compound control * **Chapter 2** Mathematical Model of the System (6 contact hours; 6 self-study hours) Time domain models, differential equation representations; ** Complex domain models, definitions and properties of transfer functions; ** Zero and pole representations of the transfer function, open loop gain, root track gain, etc.; * Transfer functions of typical links (proportionality, inertia, differentiation, integration, oscillation); ** Structural and signal flow diagrams of control systems, equivalent transformations and simplifications of structural diagrams, composition and properties of signal flow diagrams, methods for transforming structural diagrams into signal flow diagrams, Mason's gain formula* **Chapter 3** Time Domain Analysis of Linear Systems (6 contact hours; 4 self-study hours) Performance scale for linear system time response t_r, t_p, t_s, $\sigma\%$; * Unit step response of a first-order system; * Time domain response and performance improvement of second-order systems; * Higher-order system time domain analysis, dominant closed-loop polar concept; Stability analysis of linear systems, the Routh–

	Hurwitz stability criterion and its application;* Steady-state errors for linear systems, error transfer function calculations, steady-state errors using the final value theorem, and steady-state errors under typical reference signal inputs; * Error coefficients, methods for reducing steady-state errors; **Chapter 4** Frequency Domain Analysis of Linear Systems (6 contact hours; 6 self-study hours) Concept of frequency characteristics, representation method; ** Frequency characteristics of typical links and open-loop systems, Nyquist stability criterion; * Stability margin, the relationship between system time domain indicators and frequency domain indicators. **Chapter 5** Calibration Methods for Linear Systems (6 contact hours; 4 self-study hours) Calibration methods, commonly used calibration devices and their characteristics; * Series calibration, feedback calibration, compound calibration, PID control principle **Chapter 6** Non-linear Control System Analysis (2 contact hours; 2 self-study hours) Nonlinear control system concepts, common nonlinear characteristics and their effects on system motion; Phase plane analysis, descriptive function method; **Chapter 7** Analysis and Correction of Linear Discrete Systems (4 contact hours; 4 self-study hours) Basic concepts of discrete systems, sampling and holding of signals. Mathematical modeling of discrete systems. Stability and steady-state error analysis and calculations for discrete systems. A discrete system calibration method based on the MATLAB language.

	Part B. Experiment/Practice Teaching (0 contact hour; 0 self-study hour)
Study and examination requirements and forms of examination	Final score includes: Attendance (10%), usual performance (20%, including assignments, attendance rate), final exam (70%).
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1]SUN Bingda. *Automatic Control Theory.* Beijing: Machinery Industry Press, 2004. 2. Reference books [1] HU Shousong et al. *Automatic Control Principle.* National Defense Industry Press, 3rd Edition, 1994. [2] YANG Wenmin et al. *Experimental Guidelines for the Application of MATLAB High-Level Language in Control Engineering*, 1998 [3] SHI Yang et al. *MATLAB - TOOLBOX Practical Guide*, Northwestern Polytechnical University Press, 1999.

Competence field	Engineering Fundamentals
Module designation	Engineering Materials
Module level, if applicable	
Code, if applicable	109163
Subtitle, if applicable	
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Professor YANG Jian
Lecturer	Professor YANG Jian Lecturer WEN Jing Lecturer MENG Xiaoliang Lecturer WENG Lin
Language	Chinese
Relation to curriculum	This course is a compulsory course for students of Vehicle Engineering (Rail Transit Vehicle). It shall enable students to acquire the following knowledge: classification of engineering materials and common failures and resistance indicators of mechanical parts; the Fe-Fe3C phase diagram and its application; impact of common impurities on steel properties; classification and application of carbon steel, ingot organization, defects and pressure processing impact; heat treatment process and properties of steel; the role of alloying elements in steel; performance characteristics and application of common alloy steel; types and application of stainless steel; graphitization process and classification of cast iron; properties and uses of different cast irons; the types and application of aluminum alloys; the application of engineering materials on rail vehicles and their performance requirements. Students will learn the relationship between composition, organization, structure and performance of common materials, commonly used

	engineering materials and material selection methods, and be able to apply them to solve urban rail transit related material problems.
Type of teaching, contact hours	Target students: juniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 32 hours Including: Theoretical teaching: 32 hours Experiment/practice teaching: 0 hour Size of class: up to 60 students for theoretical teaching
Workload	Total workload = 60 hours Contact hours = 32 hours Self-study hours = 28 hours
Credit points	2.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	Engineering Mechanics (1); Engineering Mechanics (2)
Module objectives/intended learning outcomes	**Learning outcomes:** This course covers the fundamentals of engineering materials through instruction, with specific objectives including: ● **Knowledge:** 1. Classification of engineering materials and common failure modes and resistance indicators of mechanical parts; Fe-Fe3C phase

	diagram and the influence of common impurity elements on steel properties; heat treatment process and properties of steel. 2. Common alloy steel performance characteristics, applications; types and applications of stainless steel; types and applications of aluminum alloy. 3. Essential performance of typical materials for rail vehicles, common processes and the application of new materials. ● **Skills:** 1. Demonstrate skills in describing iron-carbon phase diagram, and using iron-carbon phase diagrams to guide engineering applications, including composition analysis, and determination of heat treatment temperature, among others. 2. Demonstrate skills in classifying common carbon steel, stainless steel, and aluminum alloys and describing their typical applications. 3. Demonstrate skills in selecting suitable materials and processes according to the performance index in the design of rail transit vehicle components. ● **Competence:** Ability to apply basic knowledge of engineering materials to solve problems related to materials and processes in projects; understand the impact of engineering materials on the world and society; and continuously expand and acquire new knowledge.
Contents	**Theoretical teaching** (32 contact hours; 28 self-study hours) **Chapter 1 Failure Analysis of Mechanical Parts (or Devices)** (6 contact hours; 2 self-study hours) ● Classification of engineering materials. ● Mechanisms and classification of wear of vehicle components *. ● Excess deformation and resistance indexes under static load at room temperature *.

	● Fracture and resistance indicators under static and shock loads *. ● Part fatigue fracture (no cracks) and resistance index *. ● Abrasion loss efficiency and resistance indicators *. ● Corrosion failure and prevention *. ● Creep deformation and fracture failure at high temperatures and its prevention. **Chapter 2 Carbon Steel** (8 contact hours; 3 self-study hours) ● Organization and properties of pure iron; ● Interactions between iron and carbon, the constitutive phases of the tissue constituents in iron-carbon alloys and their performance characteristics *; ● The names, composition and properties of the phases, phase transitions and three thermostatic transitions and products in the Fe-Fe3C phase diagram **; ● Analysis of the crystallization and transformation of iron-carbon alloys of a given composition from the liquid phase to room temperature by slow cooling based on Fe-Fe3C phase diagrams; the principle of lever and its application; ● Practical application of Fe-Fe3C phase diagrams; ● Knowledge of the impact of common impurities in steel on its properties;* ● The organization and defects of ingots; ● Laws of influence of pressure processing on steel organization and properties; ● Classification, grades and main uses of carbon steel. **Chapter 3 Heat Treatment of Steel** (5 contact hours; 3 self-study hours) ● The transformation of steel on heating; ● Diagram of the isothermal transformation of austenite **; ● Common heat treatment processes and properties of steels *; ● Surface heat treatment processes and

	properties of steel; ● Special heat treatment processes for steel. **Chapter 4 Alloy Steels** (6 contact hours; 2 self-study hours) ● The transformation of steel on heating; ● The role of alloying elements in steel *; ● Classification and numbering of alloy steels; ● Performance characteristics and applications of common alloy structural steels; ● Common types and applications of alloy tool steel; ● Types and applications of stainless steel*. **Chapter 5 Iron Casting** (3 contact hours; 1 self-study hour) ● Graphitization process of cast iron and influencing factors; ● Classification of cast iron *; ● Properties and uses of different cast irons. **Chapter 6 Non-ferrous Metals and Their Alloys** (2 contact hours; 1 self-study hour) ● Industrial pure aluminum; ● Types and applications of aluminum alloys **Chapter 7 Material Selection and Processing of Parts** (1 contact hour; 6 self-study hours) ● The significance of stiffness and elasticity indicators, hardness and strength indicators, and plasticity and impact toughness indicators in the selection of materials; ● Application of fracture toughness in material selection. ● The principle of material selection based on the material's performance in use, processing, and economics. ● Metal material processing routes **Chapter 8 Typical Applications of Engineered Materials** (1 contact hour; 10 self-study hours) ● Application of engineering materials on

	rail vehicles **Part B. Experiment teaching** (0 contact hours; 0 self-study hours)
Study and examination requirements and forms of examination	Final score includes: Attendance (10%), usual performance (30%) and final exam (report) (60%). Performance includes: assignments, attendance rate
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks, etc.
Reading list	1. Required books [1] SHEN Lian. *Mechanical Engineering Materials.* Beijing: Machinery Industry Press, 2018. 2. Reference books [1] DAI Qixun. *Metallic Materials Science.* Beijing: Chemical Industry Press, 2012. [2] ZHANG Zhenggui, NIU Jianping. *Practical Mechanical Engineering Materials and Their Selection.* Beijing: Machinery Industry Press, 2014. [3] Zhu Zhangxiao et al. *Engineering Materials.* Beijing: Tsinghua University Press. 2009 [4] ZHANG Ergeng. *Mechanical Engineering Materials.* Shanghai: Shanghai Science and Technology Press, 2017.

Appendix B - Syllabus - Engineering Fundamentals

Competence field	Engineering Fundamentals
Module designation	Fundamentals of Engineering Drawing
Code, if applicable	219604
Subtitle, if applicable	
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Professor ZHANG Xu
Lecturer	Professor ZHANG Xu Associate Professor WANG Keyong Lecturer ZHU Xiling
Language	Chinese
Relation to curriculum	The Fundamentals of Drawing course is a foundation course for engineering programs. This course covers the principle of orthogonal projection, national standards of mechanical drawing, view drawing, axonometric drawing, drawing axonometric drawings and three-view drawings by hand, section view drawing, simplified drawing and prescriptive drawing (such as threads and threaded fasteners). Its purpose is to familiarize students with the basic knowledge of engineering drawings, develop their three-dimensional spatial imagination, and acquire skills to draw and read engineering drawings.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: Using lecturing as a primary teaching method, in combination with classroom discussion Contact hour: 64 hours Of which Theoretical teaching: 64 hours Experiment/practice teaching: 0 hour Computer practice: 0 hour Size of class: 90-100 students
Workload	Total workload = 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	N/A
Module objectives/intended learning outcomes	**Learning outcomes:** ● **Knowledge:**

	1. The basic concepts of orthographic and graphical methods of projection and their expression of mechanical components 2. National standards of mechanical drawing. 3. Methods of drawing and marking common and standard parts. ● **Skills:** 1. Able to express spatial geometric forms using orthographic projection and to solve spatial geometry problems using diagramming. 2. Able to use drawing tools correctly, master common geometric drawing methods, and understand the provisions of national standards related to mechanical drawing 3. Able to read and draw mechanical parts and assembly diagrams; ● **Competence:** Ability to think spatially and physically, to read and draw mechanical drawings, and to implement national mechanical drawing standards.
Contents	**Part A. Theoretical teaching (64 contact hours; 56 self-study hours)** **Fundamentals of Drawing** **Chapter O.** Introduction (2 contact hours; 1 self-study hours) ● The nature of the curriculum, requirements and learning methods;* ● Projection method and its classification. * **Chapter 1.** Fundamentals of Cartography (4 contact hours; 3 self-study hours) ● Some basic provisions of national standards for cartography;** ● Common geometric methods of drawing; * **Chapter 2.** Projection of Points, Lines, And Surfaces(6 contact hours; 5 self-study hours) ● The relationship of projections of points, lines and surfaces;** **Chapter 3.** Stereoscopic projection (14 contact hours; 12 self-study hours)

	● Basic knowledge of three views;** ● The development of spatial imagination through basic three-dimensional projections and methods of taking points on their surfaces;** ● Basic three-dimensional truncated line projections to develop spatial imagination;** ● Basic three-dimensional coherent line projections to develop spatial imagination. ** **Chapter 4.** Composite Solids (12 contact hours; 11 self-study hours) ● The assembly of composite solids;* ● Systematic drawing of the shapes, combinations and relative positions of composite solids using form analysis and line and surface analysis methods;* ● Step-by-step approach to drawing, reading and dimensioning. ** **Chapter 5.** Axonometric Projection Drawing (6 contact hours; 4 self-study hours) ● Concepts related to axonometric drawings;* ● Method of drawing an isometric drawing. ** **Chapter 6.** Common Expressions for Machine Parts (5 contact hours; 5 self-study hours) ● Various methods of expression such as views, sections, cross-sections and simplified drawings;** **Chapter 7.** Joints and Connections of Parts (11 contact hours; 11 self-study hours) ● The prescribed method of drawing and marking of threads, threaded fasteners;** ● Marking method for keys and pins and drawing of connections. **Chapter 8.** Gears and Springs (4 contact hours; 4 self-study hours) ● Prescribed drawing method of gears, calculation of parameters;** ● Drawing of springs. **Part B. Experiment/practice teaching: 0 hour**
Study and examination requirements and forms of examination	After-class assignment shall be done independently by students after each class. Usual performance 20%,

	including after-class homework and attendance; periodic assessment 20%; final assessment 60%.
Media employed	PPT courseware, multimedia computers, projectors, laser pointers, blackboards, etc.
Reading list	1. Required books [1] TANG Jueming, XIANG Yang. *Fundamentals of Drawing Exercise Collection (1st Edition).* Shanghai: Tongji University Press, 2014. 2. Reference books [1] QIAN Keqiang. *Mechanical Drawing (3rd Edition).* Beijing: Higher Education Press, 2011. [2] TANG Jueming, XU Tenggang, ZHU Xiling et al. *Modern Engineering Design and Graphics (1st Edition).* Beijing: Tsinghua University Press, 2013. [3] ZHU Hui et al. *Descriptive Geometry and Engineering Drawing (6th Edition).* Shanghai: Shanghai Science and Technology Press, 2007. [4] LU Guodong. *A Course on Graphic Applications (2nd Edition).* Beijing: Higher Education Press, 2010.

Hydraulic and Pneumatic Transmission

Competence field	Engineering Fundamentals
Module designation	Hydraulic and Pneumatic Transmission
Module level, if applicable	
Code, if applicable	109108
Subtitle, if applicable	
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Professor YANG Jian
Lecturer	Professor YANG Jian Lecturer YUAN Tianchen Lecturer WU Aizhong
Language	Chinese
Relation to curriculum	This is a fundamental course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle). Topics covered in this course include the basic concepts and components of hydraulic transmission, and the working principle, structural analysis, performance calculations and selection methods of hydraulic pumps, hydraulic motors and hydraulic cylinders; hydraulic valve working principle and application characteristics; operating principle of hydraulic basic circuits and typical hydraulic circuits; pneumatic transmission basic theory, common pneumatic components, speed control, pressure control and other basic pneumatic circuits, and pneumatic logic system design methods. This course aims to provide students with a sound basis of theoretical knowledge in hydraulic and pneumatic transmission. Students will be able to understand the basic structures and principles of vehicle hydraulic shock absorber and pantograph pneumatic system, and apply the knowledge and skills

	they have learned in this course to solve the related issues of hydraulic and pneumatic systems in real urban rail transit vehicles.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 32 hours Of which Theoretical teaching: 28 hours Experiment / practice teaching: 4 hours Size of class: up to 70 students for theoretical teaching
Workload	Total workload = 60 hours Contact hours = 32 hours Self-study hours = 28 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	
Module objectives/intended learning outcomes	Module objectives: The main purpose of the course is to enable students to master the basic theoretical knowledge of hydraulic and pneumatic transmission, and understanding the basic structure and principles of vehicle hydraulic shock absorber and pantograph

	pneumatic system. Students will learn to apply knowledge of mathematics, natural sciences and mechanical engineering to practice, be able to develop experimental plans, carry out experiments, analyze and interpret data, and acquire skills of drawing, calculation, measurement, process operations and computational application. Specific objectives include: **Knowledge:** (1) Basic knowledge of hydraulic fluid mechanics, and basic algorithms used in of hydrostatics and hydrodynamics; The basic principles, composition, and typical components of hydraulic and pneumatic systems; (2) Basic circuits and control methods of hydraulic and pneumatic systems, principles, components and operating features of typical hydraulic circuits and pneumatic circuits; (3) Methods of reading drawings of hydraulic and pneumatic systems; principles and work flow of typical hydraulic and pneumatic system; calculation for hydraulic and pneumatic systems and control laws of solenoid valve.. **Skills:** (1) Able to use the basic principles of hydraulics and pneumatics to analyze hydraulic and pneumatic systems. (2) Able to select and analyze hydraulic and pneumatic components for specific applications; (3) Able to apply theory and methods of hydraulics and pneumatics to analyze the working process of hydraulic dampers and pantograph pneumatic circuits of urban rail transit vehicles. **Competence:** Students who successfully complete this course will be able to use relevant concepts and knowledge of

	hydraulic and pneumatic system to analyze and improve hydraulic and pneumatic systems in real engineering contexts. They will be able to understand various hydraulic and pneumatic systems, and analyze, summarize, determine and reason about the basic operating principles of specific hydraulic and pneumatic components in rail transit vehicles. This course will also help students to expand their knowledge and acquire new skills.
Contents	**Part A Theory teaching** (28 contact hours; ** self-study hours) **Chapter 1 Fundamentals of Hydraulic Fluid Mechanics** (4 contact hours; 4 self-study hours) ● Properties of hydraulic fluids ● Liquid statics and dynamics; ● Bernoulli's equation** ● Calculation of the state of fluid motion ● Pipeline flows* ● Orifice flow and crevice flow* **Chapter 2 Hydraulic Pumps** (2 contact hours; 2 self-study hours) ● Basic theory of hydraulic pump ● The working principle of plunger pump, vane pump, gear pump* ● Structural characteristics of the plunger pump ● Oil trapping in gear pumps* ● Calculation of hydraulic pump operating parameters** **Chapter 3 Hydraulic Motors and Cylinders** (2 contact hours; 2 self-study hours) ● Basic theory of hydraulic motor ● Hydraulic motor construction ● Calculation of hydraulic motor operating parameters*

	● Basic theory of hydraulic cylinder ● Hydraulic cylinder structure ● Hydraulic cylinder differential connection** ● Calculation of hydraulic cylinder working parameters** **Chapter 4 Hydraulic Control Valves** (4 contact hours; 4 self-study hours) ● Hydraulic control valve basic structure and working principle* ● Directional valves, pressure valves, flow valves structure and composition* ● Principle of pilot valve** ● Hydraulic control valve selection ● Electrohydraulic servo valves and proportional valves **Chapter 5 Hydraulic Auxiliaries** (2 contact hours; 2 self-study hours) ● Classification of auxiliary components ● Accumulators, filters, tanks, fittings and seals ● Operating principle and function of accumulators* **Chapter 6 Hydraulic Basic Circuit** (6 contact hours; 6 self-study hours) ● Pressure control circuits** ● Speed control circuit** ● Speed changeover circuit ● Directional control loop* **Chapter 7 Typical Hydraulic Circuits** (2 contact hours; 2 self-study hours) ● Hydraulic system diagramming and analysis** ● Analysis of the hydraulic system of the power slide of combined machine tool ● Hydraulic system analysis for presses **Chapter 8 Pneumatic Drive Basics** (2 contact hours; 2 self-study hours) ● Air properties

	● Gas flow patterns ● Inflation and deflation time ● Gas state equation* **Chapter 9 Air Source Devices and Pneumatic Components** (2 contact hours; 2 self-study hours) ● Air source devices* ● Gas actuators ● Pneumatic control valve ● Pneumatic sensors **Chapter 10 Basic Pneumatic Circuits and Common Circuits** (2 contact hours; 2 self-study hours) ● Pressure circuits* ● Speed control circuits* ● Position control circuits ● Common circuits **Part B: Experiment (4 experiment hours; 2 self-study hours)** 1. Determination of the performance of hydraulic dampers for urban rail vehicles (2 experiment hours; 1 self-study hour) ● Understanding typical hydraulic components* ● Understanding hydraulic system schematics* ● Determination of hydraulic damper performance curve 2. Pantograph pneumatic system for urban rail vehicles (2 experiment hours; 1 self-study hour) ● Familiarity with electro-axial pneumatic system* ● Pantograph pneumatic system schematics* ● Adjustment of rising and falling bow

Study and examination requirements and forms of examination	1. Basic requirements for class (no late arrivals, no early departures, and no unauthorized absences) 10%. 2. Assignments (including homework 30% and experiment reports 70%) 40%. 3. Final exam 50%.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books XU Fuling. *Hydraulic and Pneumatic Transmission.* Hubei: Huazhong University of Science and Technology Press, 2008. 2. Main reference books: 1. ZUO Jianmin. *Hydraulic and Pneumatic Transmission.* Beijing: Machinery Industry Press, 2002. 2. ZHANG Qunsheng. *Hydraulic and Pneumatic Transmission.* Beijing: Machinery Industry Press, 2002. 3. JIANG Jihai. *Hydraulic and Pneumatic Transmission.* Beijing: Higher Education Press, 2002. 4. Angela S. Gomez-Ramirez. *Hydraulics.* Nova Science Publishers, 2013.

Competence field	Engineering Fundamentals
Module designation	Power Electronics Technology
Module level, if applicable	
Code, if applicable	109149
Subtitle, if applicable	
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Associate professor SHI Wei
Lecturer	Associate professor SHI Wei Associate professor YU Chaogang Lecturer HUANG Shujun
Language	Chinese
Relation to curriculum	This course is a foundation course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle). This course systematically introduces power electronic devices and the technology of devices for transforming and regulating electric energy, including basic circuits and control theory of rectifier, chopper, inverter, AC to AC converter, and PWM control. The basic principles, circuit control processes, as well as design and calculation methods of rectifier, inverter and their PWM control technologies in power conversion are highlighted. Given the fact that the theoretical knowledge of power electronics is critical to analysis of electric traction equipment, auxiliary power supply equipment and other equipment for urban rail transit, this course is designed to lay a theoretical foundation for engineering applications, design and operation of electrical equipment such as power traction and auxiliary power supply in urban rail transit.

Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theory teaching and experiment teaching Contact hours: 32 hours Of which Theoretical teaching: 26 hours Experiment/practice teaching: 6 hours Size of class: up to 70 students for theoretical teaching
Workload	Total workload = 60 hours Contact hours = 32 hours Self-study hours = 28 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	Electrical Technology; Electronic Technology
Module objectives/intended learning outcomes	Module objectives: The objective of this course is to provide, through teaching and practice, an understanding of power electronics devices and the basic theory of how devices transform and regulate electric energy. Specific objectives include: **Knowledge:** 1. Mainstream power electronics device structures, characteristics; 2. Basic principles of power conversion circuits, circuit control processes, design and calculation methods, including rectification, chopping, inverting and AC-AC conversion. 3. Basic principles of PWM control

	technology, circuit control processes, design and calculation methods. **Skills:** 1. Ability to use knowledge of power conversion of power electronics to identify and analyze specific engineering systems; 2. Ability to carry out preliminary design, calculation and verification of specific power electronic system. 3. Ability to perform analysis and calculation and select power electronic devices for specific power electronic systems.. **Competence:** After successfully completing this course, students will be able to understand related concepts and basic principles of power electronics, and analyze and track various types of existing and new power electronic systems in real engineering contexts. Students will be able to continuously analyze, summarize, determine and reason about the typical features of power electronic systems based on the actual characteristics of engineering.
Contents	**Part A Theoretical teaching** (26 contact hours; 22 self-study hours) **Chapter 1 Introduction** (2 contact hours; 2 self-study hours) ● The basic concepts of power electronics technology**; ● History of power electronics technology; ● Application of power electronics technology*. **Chapter 2 Power Electronics Devices** (4 contact hours; 2 self-study hours) ● Operating principles, characteristics and main parameters of diodes, thyristors*. ● Operating principles, characteristics and main parameters of GTO, GTR*. ● Operating principles,

	characteristics and main parameters of power MOSFETs and IGBTs**. ● Other power electronic devices **Chapter 3 Rectifier Circuits** (4 contact hours; 4 self-study hours) ● Single-phase half-wave controlled rectifier circuits*. ● Single-phase bridge full-wave controllable rectifier circuits**. ● Single-phase bridge semi-controlled rectifier circuits. ● Three-phase half-wave controlled rectifier circuits*. ● Three-phase bridge controllable rectifier circuits**. **Chapter 4 Chopper Circuits** (4 contact hours; 4 self-study hours) ● Step-down chopper circuits**. ● Boost chopper circuits**. ● Composite chopper circuits*. **Chapter 5 AC-AC Power Conversion Circuits** (4 contact hours; 2 self-study hours) ● Single-phase phase-controlled AC voltage regulator circuits*; ● Three-phase phase-controlled AC regulator circuits** ● AC power regulator circuits* ● Single-phase output AC-AC inverter circuits* ● Three-phase output AC-AC inverter circuit* **Chapter 6 Inverter Circuits** (4 contact hours; 6 self-study hours) ● Modes of commutation* ● Single-phase inverter circuits* ● Three-phase voltage-type active inverter circuits** **Chapter 7 PWM Technology** (4 contact hours; 2 self-study hours) ● The basic principle of PWM control ** ● PWM inverter circuit control method* ● How to generate PWM waveforms **Part B: Experiment:** (6 experiment hours; 6 self-study hours) 1. Sawtooth wave synchronous phase shift trigger circuit experiment (2 experiment hours; 2self-study hours) 2. Single-phase half-wave controlled rectifier circuit experiment (4 experiment hours; 4 self-study hours)

Study and examination requirements and forms of examination	Final score includes: 1. Attendance (5%): usual performance, no late arrivals, no early departures, and no unauthorized absences 2. Experiments (10%): report and performance of experiments 3. Assignments (including homework 30% and big project 70%) 25%. 4. Final assessment (60%): final exam
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] WANG Zhaoan, LIU Jinjun. *Power Electronics Technology (5th Edition).* Beijing: Machinery Industry Press, 2009. 2. Reference books [1] HONG Naigang. *Fundamentals of Power Electronics Technology.* Beijing: Tsinghua University Press, 2015 [2] LENG Zengxiang, XU Yirong. *Fundamentals of Power Electronics Technology (3rd Edition).* Nanjing: Southeast University Press, 2012 [3] ZHAO Lihua. *Power Electronics Technology.* Beijing: Machinery Industry Press, 2011 [4] Harb, Ahmad. *Power Electronics: Circuit Analysis and Design*. USA: Springer, 2018.

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