Appendix B - Syllabus - Electives

Competence field	Electives
Module designation	Microcomputer Principle and Interface Technology
Module level, if applicable	
Code, if applicable	109107
Subtitle, if applicable	
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Associate Professor YU Chaogang
Lecturer	Associate Professor YU Chaogang Lecturer SHU Yanjun
Language	Chinese
Relation to curriculum	This is a core course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle). This course investigates the composition and working principle of microcomputer hardware system, 8086 instruction system and working principle of the I/O system. This course finds profound applications in real railway engineering context, and aims to prepare students to work and succeed in their workplace of future. This course finds profound applications in real railway engineering context, and aims to prepare students to work and succeed in their workplace of future. Topics covered in this course include the composition of microcomputer hardware system, 8086 instruction system, assembly language programming, and working principles of commonly used programmable interface chips.

Type of teaching, contact hours	Target students: juniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 48 hours Of which Theoretical teaching: 48 hours Experiment/practice teaching: 0 hour 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	Electronic Technology
Module objectives/intended learning outcomes	**Learning outcomes:** This course aims to provide students with a thorough grounding in the basics of microcomputer systems, with an aim to enable them to track the development trend of microcomputer systems and interface technology and achieve self-development. Specific objectives include: ● **Knowledge:** **1**. Demonstrate understanding of the composition and working principle of microcomputer system, number system and commonly-used cods, function of the external pins of 8088/8086 microprocessor and fundamental functions of buses; 2. Demonstrate an appreciation of instruction format and operand addressing mode, and basic assembler architecture; 3. Demonstrate understanding of the general

	concept and classification of memory systems; 4. Demonstrate understanding of the concept of basic input/output systems and interrupt technology, working principle of commonly used programmable interface chips, and working principle of A/D and D/A converters. ● **Skills:** **1**. Demonstrate understanding of the conversion methods between different number systems and the algorithm of binary numbers with and without signs; **2**. Demonstrate understanding of the basic assembly language programming methods, including the branch programing, loop programming and sub-programming; **3**. Demonstrate understanding of the basic application of commonly used programmable interface chips (i.e., 8253, 8255 and 8250) and skills in designing and developing software and hardware for input/output interface control systems. ● **Competence:** After successfully completing this course, students will be able to apply the principles of microcomputers to analyze and solve problems, and have an ability to develop and design microcomputer application systems at a beginner's level.
Contents	**Part A Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1. Introduction to Microcomputer Fundamentals** (4 contact hours; 4 self-study hours) The main topics of this course, the significance of learning this course, main learning methods and final assessment methods; Composition and working principle of microcomputer systems*; Number system and coding in computers**; Arithmetic and logical operations of unsigned binary numbers*; Representation and operation of signed/unsigned binary numbers**.

	Chapter 2. Microprocessor and Bus (2 contact hours; 2 self-study hours) Overview of microprocessor processing unit External pin of 8088/8086 microprocessor and its function**; Basic functions of buses*. **Chapter 3 8088/8086 Instruction System** (6 contact hours; 6 self-study hours) Basic component and execution time of instruction; Addressing mode**; 8086 instruction system**; Introduction to Pentium's new instruction. **Chapter 4 Assembly Language Programming** (6 contact hours; 6 self-study hours) Source program of assembly language**; Pseudo-instruction**; BIOS and DOS function call*; Basics of assembly language source programming**. **Chapter 5 Memory System** (4 contact hours; 4 self-study hours) General concept of memory system; Semiconductor memory and its classification*. **Chapter 6 Input and Output and Interrupt Technology** (10 contact hours; 8 self-study hours) Overview of input and output systems**; Simple interface circuit**; Basic input and output mode**; Interrupt technology**; Programmable interrupt controller 8259A*; **Chapter 7 Commonly-used Digital Interface Circuit** (10 contact hours; 8 self-study hours) Parallel and serial communication*; Programmable timer/counter 8253**; Programmable parallel port chip 8255*; Programmable serial port chip 8250*. **Chapter 8 Analog Input and Output** (6 contact hours; 4 self-study hours) Analog input and output channels; D/A converter*;

	A/D converter*. **Part B. Experiment teaching** (0 contact hours; 0 self-study hours)
Study and examination requirements and forms of examination	Final score includes: attendance (10%), daily performance (20%) and final exam (70%).
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] WU Ning, QIAO Yanan. *Microcomputer Principle and Interface Technology (4th Edition).* Beijing: Tsinghua University Press, 2016 2. Reference books [1] ZHANG Fan, SHENG Xunhua, DAI Shenghua. *Microcomputer Principle and Interface Technology (2nd Edition).* Beijing: Tsinghua University Press, Beijing Jiaotong University Press, 2010 [2] Barry B. *The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386,80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4-Architecture, Programming, and Interfacing. The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386,80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4-Architecture, Programming, and Interfacing.* Machinery Industry Press, 1998. [3] Barry B. *The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386,80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4-Architecture, Programming, and Interfacing.*

	Brey, Pearson Education, 2001

Competence field	Electives

Module designation	Finite Element Analysis
Module level, if applicable	
Code, if applicable	109122
Subtitle, if applicable	
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Associate Professor LIAO Aihua
Lecturer	Associate Professor LIAO Aihua Associate Professor WEN Yongpeng Lecturer WENG Lin
Language	Chinese & English
Relation to curriculum	As an elective course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle). This course aims to provide students with a thorough grounding in the basic concepts of deformable body mechanic and its basic equations and solutions, along with the description of its core content in English. The related basic algorithms and solutions to relevant questions will be fully developed. Topics covered in this course also include the basic concepts, theories and development trends of finite element method and description of its core content in English; the basic process and analysis steps of finite element method; the content and basic requirements of structural analysis on railway vehicles by using calculation software and description of its core content in English. After successfully completing this course, students will be able to acquire comprehensive knowledge in the basic principles and methods of finite element, and make use of finite element calculation tools learned in this course to solve related issues in strength check,

	optimization or innovative design of mechanical components related to urban rail transit in real engineering contexts.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching contact hours： 48 hours Of which Theoretical teaching: 48 hours Experiment/practice teaching: 0 hour Size of class: up to 60 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	Engineering Mechanics (1), Engineering Mechanics (2), Fundamentals of Drawing, Computational Method, Linear Algebra, Fundamentals of Computer Applications
Module objectives/intended learning outcomes	**Learning outcomes:** This course aims to provide students with a sound basis of knowledge in the basic theory and content of finite element method and its corresponding description in English. After successfully completing this course, students will be able to use finite element concepts and calculation tools learned in this course to solve

	related issues in structural analysis, verification and design of mechanical components in real engineering contexts. Specific objectives include: ● **Knowledge:** (1) Basic concepts, basic equations and basic solutions of deformable body mechanics. (2) Basic algorithms and solutions to related questions. Basic concepts, theories and development trends of finite element methods. (3) Basic process and analysis steps of finite element method. Content and basic requirements of structural analysis for railway vehicles. ● **Skills:** (1) Demonstrate understanding of advanced component design and optimization process based on numerical simulation; (2) Demonstrate skills in identifying system objective and establishing appropriate finite element models to determine model variables and refine system boundary conditions based on analysis of the actual vehicle structure. Demonstrate skills in using Ansys and other finite element analysis software based on the basic theories of finite element methods to solve finite element models; (3) Demonstrate skills in restoring the solution results of finite element model to actual issues and make correct judgment. Demonstrate skills in modifying and improving the existing finite element models based on actual analysis objectives. (4) Demonstrate skills in describing the core concepts and content of finite element method in English. ● **Competence:** After successfully completing this course,

	students will be able to make use of FEM calculation software to perform strength check, optimization or innovative design of mechanical components related to urban rail transit in real engineering contexts, and describe the core FEM concepts and content in English. Students will be able to discuss issues related to their professionalism in English, and analyze and solve problems from different perspectives. This course will also help students to expand their knowledge and acquire new skills.
Contents	**Part A Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1. Introduction to Finite Element Analysis** (2 contact hours; 2 self-study hours) (1) Classification and features of various mechanics courses*; (2) History of finite element method*; (3) Finite element analysis software*; (4) Main content of railway vehicle structure analysis*. **Chapter 2. Finite Element Method for Structural Analysis of Rod and Beam** (6 contact hours; 4 self-study hours) (1) Mechanical analysis process for simple spring system*; (2) Mechanical analysis process for rod structure*; (3) Treatment of boundary conditions*; (4) Basic steps of finite element analysis**. **Chapter 3. Mechanical Description of Continuous Deformation Body** (6 contact hours; 4 self-study hours) (1) Description of general deformable body and variable definition**; (2) Basic equations for forces in plane*; (3) Basic equations for forces in space*; (4) Mechanical criteria for material failure*. **Chapter 4. Finite Element Method of Continuous Deformation Analysis** (8 contact hours; 6 self-study hours) (1) Axisymmetric problem and its unit

	building*; (2) Building unit for an object in space*; **Chapter 5. Application of Finite Element Analysis (1)** (4 contact hours; 4 self-study hours) (1) Workbench-Mechanical basic analysis steps*; (2) Workbench-Mechanical engineering data application*; (3) Make use of Stress Wizard to build models and find stress, displacement and safety factors of a structure model**. **Chapter 6. Application of Finite Element Analysis (2)** (6 contact hours; 6 self-study hours) (1) Workbench-Mechanical pre-processing**; (2) Workbench-Mechanical contact control*; (3) Mesh division and mesh control of Workbench-Mechanical*; **Chapter 7. Application of Finite Element Analysis (3)** (6 contact hours; 6 self-study hours) (1) Linear structure analysis of Workbench-Mechanical*; (2) Structure analysis settings of Workbench-Mechanical**; (3) Workbench-Mechanical loads and constraints*; (4) Workbench-Mechanical solution setting*; (5) Results and post-processing of Workbench-Mechanical*. **Chapter 8. Application of Finite Element Analysis (4)** (6 contact hours; 6 self-study hours) (1) Modal analysis of Workbench-Mechanical**; (2) Steady-state thermal analysis of Workbench-Mechanical**. **Chapter 9. Application of Finite Element Analysis (5)** (4 contact hours; 4 self-study hours) (1) Buckling analysis of Workbench-Mechanical**.

	Part B. Experiment teaching (0 contact hours; 0 self-study hours)
Study and examination requirements and forms of examination	Final score includes: attendance (20%), assignments (20%) and final report (60%)
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	**1. Required books** [1] ZENG Pan. *Engineering Finite Element Method.* Science Press, 2010. **2. Reference books** [1] O.C.Zienkiewicz, R.L. Taylor, J.Z.Zhu. *The Finite Element Method.* MA：Butterworth-Heinemann, 2013. [2] TIAN Hongqi. *Analysis Theory of Railway Vehicle Structure.* Changsha: Central South University Press, 2009. [3] (USA) Written by Saeed MOAVENI and translated by WANG Song, LIU Lijuan, DONG Chunmin, et al. *Finite Element Analysis: Theory and Application with ANSYS.* Beijing: Electronic Industry Press, 2013. [4] Edited by SHANG Yuejin, WANG Hong. *Finite Element Principles and ANSYS Practice.* Beijing: Tsinghua University Press, 2012.

Appendix B - Syllabus - Electives

Competence field	Electives
Module designation	Electrical Equipment of Urban Railway Vehicles
Module level, if applicable	
Code, if applicable	109112
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate Professor LI Xiaobo
Lecturer	Associate Professor LI Xiaobo Lecturer PENG Lele
Language	Chinese
Relation to curriculum	As an elective course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle), this course investigates the structure, and operating principle of main electrical equipment for urban rail vehicle (including vehicle electrical appliance, traction motor, traction converter, auxiliary system, electronic and electrical control, lighting and door, among others), as well as related maintenance knowledge and skills. This course aims to provide students with skills in solve real-world engineering problems in the use of urban rail transit electrical equipment, thus preparing students to work and succeed in their workplace or scientific research in future.
Type of teaching, contact hours	Target students: juniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 48 hours Of which Theoretical teaching: 48 hours Experiment/practice teaching: 0 hour Size of class: up to 60 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	Electrical Technology, Electronic Technology, Power Electronics Technology, Electrical Traction and Control of Urban Railway Vehicle
Module objectives/intended learning outcomes	**Learning outcomes:** This course aims to provide students with a thorough grounding in the structure, and operating principle of electrical equipment for urban rail transit vehicle as well as related maintenance knowledge and skills. Specific objectives include: ● **Knowledge:** 1. Structure and operating principle of typical electrical equipment, including high-voltage electrical appliance and low-voltage electrical appliance for urban rail transit vehicle; 2. Internal component of traction converter and auxiliary power supply system, and operating principle of main protection functions; 3. Reading of vehicle electrical control circuit diagram; 4. Maintenance and repair of vehicle electrical equipment and system. ● **Skills:** 1. Demonstrate skills in identifying and evaluating the status of vehicle electrical equipment and systems, and in identifying and analyzing common faults.

	2. Demonstrate skills in reading vehicle electrical control circuit diagram; ● **Competence:** Students who successfully complete this course will be able to use their knowledge of and skills in urban railway vehicle electrical equipment and system to perform fault diagnosis and analysis for typical electrical equipment and systems. Students will be able to analyze and solve problems from different perspectives. This course will also help students to have a better understanding of fault diagnosis techniques for electrical equipment and system, and expand their knowledge and acquire new skills.
Contents	**Part A Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1. Overview of Electrics for Urban Rail Transit Vehicle** (6 contact hours; 4 self-study hours) The main topics of this course, the significance of learning this course, main learning methods and final assessment methods; Basic concepts of vehicle electrical equipment; brief introduction to the main faults during vehicle operation; preliminary understanding of common electrical faults during operation; main electrical equipment on railway vehicle Wear mechanism and classification of vehicle parts. **Chapter 2. Electrical Appliance for Urban Railway Vehicle** (9 contact hours; 6 self-study hours) Structure and operating principle of high-voltage electrical appliances for urban railway vehicle*; Structure and operating principle of low -voltage electrical appliances for urban railway vehicle*; Knowledge of and skills in maintenance and

	repair of key electrical equipment for urban railway vehicle** Case study **Chapter 3. Traction Motor and Traction Converter** (9 contact hours; 8 self-study hours) Analyze the advantages and disadvantages of various traction motors; briefly review the structure, operating principle and control method of traction motor, and the operating principle of traction converter; the operating principle of internal components of traction converter and their main protection functions**; basic motor maintenance methods and means*; basic failure analysis methods and means of traction converter**. **Chapter 4. Vehicle Auxiliary System** (9 contact hours; 6 self-study hours) Overview of auxiliary system; internal structure and basic operating principle of auxiliary inverter**; monitoring and protection circuit of auxiliary inverter**; understand the diagnostic function of and maintenance skills in auxiliary inverter controller; case study. **Chapter 5. Comprehensive Route Map** (9 contact hours; 6 self-study hours) How to read vehicle electrical control circuit diagram*; how to read main circuit diagram in the urban rail transit context; how to read control circuit diagram; how to read auxiliary circuit diagram and wiring diagram of central control unit **Chapter 6. Electrical Failure and Case Study** (6 contact hours; 6 self-study hours) Common failures of traction system and case study; common failure of auxiliary circuit and case study; common failure of CCU and case study; common failure of door control and case study **Part B. Experiment teaching** (0 contact hours; 0 self-study hours)

Study and examination requirements and forms of examination	Final score includes: attendance (10%), daily performance (30%) and final exam (60%)
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] CHEN Xiaoli, SHI Wei, FANG Yu. *Electrical Equipment of Urban Rail Transit Vehicles.* Beijing: China Railway Publishing House, 2013. 2. Reference books 1. WEI Xiaodong, Editor-in-Chief. *Power Supply System Technology for Urban Rail Transit*. Beijing: Publishing House of Electronics Industry, 2002. 2. PAN Qiping, Editor-in-Chief. *Maintenance Technology and Equipment for Urban Rail Transit.* Beijing: China Water & Power Press, 2009. 3. YANG Dong, LU Guiyun, Editor-in-Chief. *Urban Rail Transit Vehicle Maintenance*. Beijing: China Machinery Industry Press, 2010. 4. WANG Yanrong, Editor-in-Chief. *Electrical Maintenance of Urban Rail Transit Vehicle*. Shanghai: Shanghai Science and Technology Press, 2010.

Appendix B - Syllabus - Electives

Competence field	Electives
Module designation	Railway Vehicle System Dynamics
Module level, if applicable	
Code, if applicable	109116
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate Professor YAO Huiming
Lecturer	Associate Professor YAO Huiming Lecturer MENG Xiaoliang Lecturer ZHU Wenliang
Language	Chinese
Relation to curriculum	This is an important foundation course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle). This course investigates the relationship between the main structure and suspension parameters of a vehicle and the dynamic performance of its system, the basic wheel-rail contact theory and calculation methods, and track disturbance and its influence on the dynamic performance of the vehicle system, among others. Topics covered in this course also include analysis of the relationship between the basic wheelset structure and its dynamics performance, analysis of simple vehicle dynamics systems, and methods of finding wheel-rail creep force. As a theoretical subject, this course finds profound applications in real rail transit context, and aims to lay a solid theoretical foundation for other related professional courses.

Type of teaching, contact hours	Target students: juniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 48 hours Of which Theoretical teaching: 48 hours Experiment/practice teaching: 0 hour Size of class: up to 60 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	Physics (Mechanics), Engineering Mechanics (1), Engineering Mechanics (2), Mechanical Design, Overview of Urban Rail Transit System; Structure of Urban Railway Vehicle
Module objectives/intended learning outcomes	**Learning outcomes:** This course aims to provide students with a sound basis of knowledge in urban railway vehicle system dynamics and related basic principles. Specific objectives include: ● **Knowledge:** 1. Vehicle system dynamics indicators and evaluation standards, geometric relationship theory of wheel-rail contact, and contact theory of wheel-rail rolling. 2. Relationship between suspension system structure and vehicle dynamics performance. 3. Professional knowledge about wheel-rail creep dynamics model, track disturbance/spectrum, and vehicle

	stability analysis, etc. ● **Skills:** 1. Demonstrate understanding of the basics of vehicle dynamics systems, and skills in describing the relationship between basic structure of a vehicle and its dynamic performance. 2. Make use of differential equations for basic dynamic modeling, simulation, and dynamic behavior analysis of vehicle systems. 3. Demonstrate skills in analyzing simple causes of failures in the vehicle dynamics system, and performing tests and analysis when faced with dynamic vibration faults and maintenance tasks of complex vehicle systems; **Competence:** After successfully completing this course, students will be able to acquire comprehensive knowledge in vehicle dynamics, and make use of the principles of vehicle system dynamics and professional knowledge to establish mathematical models and perform dynamic simulations. They will be able to analyze and solve problems from the perspective of vehicle dynamics. Students will demonstrate skills in monitoring typical dynamics system failures in vehicles and providing valuable analysis solutions. They will also demonstrate their innovative spirit in the improvement and optimization of vehicle structure.
Contents	**Part A. Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1. Overview** (4 contact hours; 4 self-study hours) Vehicle system movement; ** Application of vehicle system dynamics. **Chapter 2. Vehicle System Dynamics Indicators and Evaluation Criteria**

	(6 contact hours; 4 self-study hours) Dynamic performance of railway vehicle system; Safety of vehicle operation and its evaluation indicators*; Vehicle operation stability and its evaluation indicators**. **Chapter 3. Wheelset Structure and Wheel-Rail Contact Geometry** (8 contact hours; 8 self-study hours) Wheelset structure and its influence on dynamic performance; Wheel-rail contact status and influencing factors*; Finding wheel-rail contact geometry**; Wheel-rail contact geometry in turnout area. **Chapter 4. Wheel-Rail Rolling Contact** (8 contact hours; 6 self-study hours) Application of Hertz contact theory; Wheel-rail creep; Wheel-rail creep theory**; Approximate calculation and correction of nonlinear creep force; Application examples of wheel-rail creep theory**. **Chapter 5. Relationship Between Suspension System and Vehicle Dynamics** (8 contact hours; 8 self-study hours) Requirements of vehicle system dynamics performance on axle box positioning; Positioning structure of passenger car axle box*; Impact of axle box positioning parameters on system dynamics**; Requirements of central suspension device design and central suspension structure*; Suspension features of passenger car bogies at different speeds; Relationship between central suspension parameters and system dynamics**. **Chapter 6. Vehicle System Dynamics Model** (6 contact hours; 4 self-study hours) Principles of vehicle system dynamics modeling**;

	Description of vehicle system forces; Vertical dynamics model of vehicle system*; Lateral dynamics model of vehicle system; Attenuation effect of suspension system on wheel-rail system vibration. **Chapter 7. Track Disturbance and Track Spectrum** (4 contact hours; 4 self-study hours) Basic characteristics of railway track construction; Forms of track irregularity; Power spectrum of track irregularity**; Numerical simulation of track irregularity*. **Chapter 8. Motion Stability of Vehicle System** (4 contact hours; 4 self-study hours) Vehicle serpentine locomotion*; Basic algorithms to determine critical speed of vehicle system; Methods to improve vehicle system stability**; Factors affecting derailment stability. **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%, in which after-class exercises account for 40% and big projects account for 60%); final exam (60%) Performance includes: assignments and attendance rate
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] REN Zunsong. *Fundamentals of Vehicle Dynamics*. Beijing: China Railway Publishing House, 2009 2. Reference books [1] WANG Futian. *Vehicle System Dynamics* Beijing: China Railway Publishing House, 1994. [2] ZHANG Dingxian. *Locomotive Track System Dynamics*. Beijing: China Railway Publishing

	House, 1996. [3] Translated by SHEN Liren. *Railway Vehicle System Dynamics*. Chengdu: Southwest Jiaotong University Press, 1998. [4] HU Haiyan. *Fundamentals of Mechanical Vibration*. Beijing: Beihang University Press, 2005. [5] HU Yongsheng. *Modern Railway Vehicle Dynamics*. Beijing: China Railway Publishing House, 2009.

Appendix B - Syllabus - Electives

Competence field	Electives
Module designation	English for Urban Railway Vehicle
Module level, if applicable	
Code, if applicable	109118
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate Professor LI Xiaobo
Lecturer	Associate Professor LI Xiaobo Lecturer ZHONG Qianwen
Language	Chinese-English
Relation to curriculum	As a unique elective course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle), this course focuses on professional English for subway vehicle. Topics covered in this course include English description in regard to the vehicle overview, the vehicle composition, and the main parameters of vehicle; carriage body, coupler, bogie, and gangway in vehicle structure; the electric drive system composition, power supply system, and communication part; and pneumatic and braking system. This course aims to help students learn railway vehicle in English, and support their concurrent and subsequent studies. After successfully completing this course, students will be able to understand the fundamental rail transit knowledge in English, and can read vehicle engineering textbooks, reference books and scientific literature in English.

Type of teaching, contact hours	Target students: juniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 48 hours Of which Theoretical teaching: 48 hours Size of class: up to 60 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	College English, Overview of Urban Rail Transit System; Structure of Urban Railway Vehicle
Module objectives/intended learning outcomes	**Learning outcomes:** This course aims to provide students with a better understanding of railway vehicle in English, and support their concurrent and subsequent studies. After successfully completing this course, students will be able to understand the fundamental rail transit knowledge in English, and can read vehicle engineering textbooks, reference books and scientific literature in English. Students will have an international vision and can communicate and cooperate across cultures. Specific objectives include: ● **Knowledge:** Demonstrate understanding of description of rail vehicle composition and main vehicle parameters in English. 1. Carriage body, coupler, bogie, gangway and other parts of subway vehicles; 2. Composition of electric drive system, power supply system, and

	communication part; 3. Pneumatic system, and braking system, among others. ● **Skills:** 1. Demonstrate a certain level of discipline knowledge in English; demonstrate skills in reading professional literature in English, and understanding of subway vehicle literature and materials in English; 2. Demonstrate skills in communicating with industry insiders in English and discussing professional issues in English; 3. Demonstrate skills in making use of professional English to track the development trend of subway vehicle and related fields. ● **Competence:** After successfully completing this course, students will be able to use English to communicate across cultures, and present and discuss professional issues. They will be able to further expand their scope of work and business based on their professional background and professional English. They can continue to learn relevant cutting-edge knowledge and, and apply their professional knowledge and skills in real subway vehicle context.
Contents	**Part A. Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1. Overview** (3 contact hours; 3 self-study hours) ● General vehicle description, e.g. carbody, doors, couplers, bogies; ● Composing of vehicle; ● Main technical parameters of vehicle; ● Kinds of vehicle*. **Chapter 2. Mechanism** (21 contact hours; 20 self-study hours)

	● Carbody: Carbody structure; Interior lighting, exterior lighting and indicator lamps*; Passenger door, seating, the cab arrangement, air condition system**; ● Bogies: Composing of bogies; Action of wheel-rail; ● Couplers: Composing of couplers; Different couplers position**; ● Gangways: Composing of gangways. ● Suspension system*. **Chapter 3. The electrical and electronic technology** (15 contact hours; 14 self-study hours) ● Vehicle transmission and control**: Traction equipment*; ● Power supply: Auxiliary, inverter auxiliary and inverter battery; High-voltage equipment*; ● Monitoring and information system: Fault diagnostic system, the radio equipment, the PA system and the indicator unit*. **Chapter 4. Pneumatic system and braking system** (6 contact hours; 5 self-study hours) ● Pneumatic system: Composing of pneumatic system; Motor compressor unit, inter-cooler and after-cooler*; Air duct, driver's cab ventilation unit and roof-mounted compact a/c unit*; ● Braking system**: Braking modes; Brake system operation. **Part B. Experiment teaching** (0 contact hours; 0 self-study hours)

Study and examination requirements and forms of examination	Final score includes: attendance (10%), daily performance (30%) and final exam (60%). Of which: 1. Attendance (10%): no late arrivals, no early departures, and no unauthorized absences 2. Assignments (30%): including homework (accounting for 30%) and big project (accounting for 70%) 3. Final assessment (60%): 3. Final exam
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] LI Xiaobo. *English for Urban Railway Vehicle.* Beijing: China Railway Publishing House. 2012 2. Reference books [1] DING Wangcai, LI Ningzhou. *Professional English for Rolling Stock.* Beijing: China Railway Publishing House, 2008. [2] MIN Liping. *Professional English for Urban Rail Transit.* Beijing: China Railway Publishing House, 2006. [3] YE Qingpin. *Professional English for Railway Transport and Signal.* Wuhan: Huazhong University of Science and Technology Press, 2008.

Appendix B - Syllabus - Electives

Competence field	Electives
Module designation	Maintenance Technology of Urban Railway Vehicle
Module level, if applicable	
Code, if applicable	109124
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate Professor LIAO Aihua
Lecturer	Associate Professor LIAO Aihua Associate Professor HU Dingyu Lecturer WEN Jing
Language	Chinese
Relation to curriculum	As an elective course designed for students majored in Vehicle Engineering (Rail Transit Vehicle), this course investigates the common failure diagnosis for urban railway vehicles, the maintenance system of maintenance companies, and the maintenance process of key components. This course finds profound applications in real railway engineering context, and aims to prepare students to work and succeed in their workplace of future. Topics covered in this course include the fundamental theories of urban railway vehicle maintenance, the reliability of urban railway vehicles, maintenance process management, the maintenance system of urban railway vehicles, the infrastructure of and equipment for urban railway vehicle maintenance yards, and maintenance process of key components. After successfully completing this course, students will be able to use the related specialized knowledge they have learnt to determine the maintenance procedures and cycles, develop important process documents for on-site maintenance (including but not limited to technological procedures and standard operation procedures), and identify the maintenance checklists and testing methods of key vehicle components.

Type of teaching, contact hours	Target students: juniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 48 hours Of which Theoretical teaching: 48 hours Experiment/practice teaching: 0 hour Size of class: up to 60 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	*Structure of Urban Railway Vehicle*, *Electric Traction and Control of Urban Railway Vehicle*, *Braking Technology of Urban Railway Vehicle*
Module objectives/intended learning outcomes	**Learning outcomes:** This course aims to provide students with the knowledge and skills to enable them to develop important process documents for railway vehicle maintenance, be familiar with the maintenance process and maintenance management, and identify the maintenance checklists and testing methods of key vehicle components. Specific objectives include: ● **Knowledge:** 1. Demonstrate understanding of the existing maintenance system of urban railway vehicle maintenance enterprises, the basic approach to create a vehicle maintenance procedure and other important process documents for on-site maintenance (including but not limited to technological procedures and standard operation procedures). 2. Demonstrate understanding of the fundamental knowledge of vehicle maintenance management, the key

	principles of equipment configuration for vehicle maintenance, and the functions, basic principles and applicable occasions of existing vehicle maintenance equipment; 3. Be familiar with the existing maintenance process, maintenance checklists and testing methods of key vehicle components. **Skills:** 1. Apply the skills learnt from this course, along with the prior knowledge of vehicle structure and electrical equipment, to diagnose common vehicle problems and their causes and perform basic fault tree analysis; 2. Demonstrate ability to determine the maintenance procedures and cycles, and skills in creating important process documents for on-site maintenance (including but not limited to technological procedures and standard operation procedures). 3. Demonstrate ability to configure necessary equipment for vehicle maintenance according to appropriate maintenance procedures, and skills in identifying the maintenance checklists and testing methods of key vehicle components. ● **Competence:** After successfully completing this course, students will be able to apply the knowledge and skills they have learned to analyze basic failure data and create maintenance plans for related components. Students will be able to analyze and solve problems from different perspectives and have sound managerial skills and organizational capabilities. This course will also help students to have a better understanding of maintenance and testing techniques, and expand their knowledge and acquire new skills.

Contents	**Part A Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1. Introduction to Urban Railway Vehicle Maintenance** (4 contact hours; 4 self-study hours) Topics covered in this course, the significance of learning this course, main learning methods and final assessment methods; The key concepts of failure, failure classification and fundamental principles and failure mechanism**; The mechanism of vehicle component wear and tear and classification*. **Chapter 2. Reliability of Urban Railway Vehicles** (10 contact hours; 10 self-study hours) Key concepts of reliability and maintainability**; Collection, processing and analysis of reliability data; Definition of FMECA (i.e., failure mode, effects and criticality analysis) for railway vehicles *; Failure criticality analysis for railway vehicles *; Cases of failure criticality analysis; Fault Tree Analysis (FTA)*. **Chapter 3. Maintenance Process Management** (10 contact hours; 10 self-study hours) Process and process management; Vehicle maintenance process**; Optimization of vehicle maintenance procedures*. **Chapter 4. Maintenance System for Urban Railway Vehicles** (8 contact hours; 6 self-study hours) Maintenance management of urban railway vehicles**; Maintenance methods for urban railway vehicles*; Maintenance level of urban railway vehicles*. **Chapter 5. Infrastructure of and Equipment for Urban Railway Vehicle Maintenance Yard**

	(6 contact hours; 4 self-study hours) Overview of the infrastructure of and equipment for urban railway vehicle maintenance yards; Elaboration on maintenance equipment for urban railway vehicles*. **Chapter 6. Bogie Maintenance** (2 contact hours; 1 self-study hours) Bogie maintenance. **Chapter 7. Maintenance of Vehicle Connection Devices** (2 contact hours; 1 self-study hours) 1. Maintenance of coupler buffer devices; 2. Gangway maintenance. **Chapter 8. Car Body Maintenance** (1 contact hour; 1 self-study hour) Car body maintenance; Lifting system. **Chapter 9. Door Maintenance** (2 contact hours; 1 self-study hour) Maintenance of passenger compartment doors; Maintenance of driver compartment doors; **Chapter 10. Maintenance of Electric Traction System** (1 contact hour; 1 self-study hour) Maintenance of electric traction system. **Chapter 11. Braking System Maintenance** (1 contact hours; 0.5 self-study hours) Maintenance of braking system. **Chapter 12. Auxiliary System Maintenance** (1 contact hours; 0.5 self-study hours) Auxiliary system maintenance **Part B. Experiment teaching** (0 contact hours; 0 self-study hours)
Study and examination requirements and forms of examination	Final score includes: Attendance (10%), performance (30%) and final exam (report) (60%).
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] LIAO Aihua, HUANG Lixin, FANG Yu. *Maintenance Technology of Urban Railway*

	Vehicle. Beijing: China Railway Publishing House, 2013. 2. Reference books [1] FANG Yu, SHI Wei, SHI Xuan, et al. *Introduction to Urban Railway Vehicle.* Beijing: China Railway Publishing House. 2012. [2] SHU Qiping. *Maintenance Technology of Urban Railway Vehicle*. Beijing: China Water & Power Press, 2009. [3] YANG Dong, LU Guiyun. *Maintenance of Urban Railway Vehicle.* Beijing: China Machinery Industry Press, 2010. [4] DONG Ximing.. Reliability, Availability, Maintainability, and Safety (RAMS) of Railway Vehicle. Beijing: China Railway Publishing House, 2009.

Competence field	Electives
Module designation	Project Management
Module level, if applicable	
Code, if applicable	109181
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate Professor ZHU Haiyan
Lecturer	Associate Professor ZHU Haiyan Lecturer MENG Xiaoliang Lecturer WEN Jing
Language	Chinese & English
Relation to curriculum	As an elective course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle), this course investigates the definition and implications of knowledge system for modern project management, the definition of project process and project management process, and the approaches to and practices of project life cycle. Emphasis is given both to the approaches and tools for project scope planning and project work breakdown; the decomposition and prioritization of project activities; and project cost estimation, budgeting and control. Topics covered in this course include the project quality plan and project quality assurance system; the formulation and implementation of project integration plan; the identification, measurement and monitoring of project risks and risk response; and project organization and management and project stakeholders. After successfully completing this course, students will be able to acquire comprehensive knowledge in the basic principles of and approaches to knowledge system for modern engineering project management, and apply

	the concepts and techniques learned in this course to solve related management issues in real urban rail transit engineering contexts.
Type of teaching, contact hours	Target students: juniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 48 hours Of which Theoretical teaching: 48 hours Experiment/practice teaching: 0 hour Size of class: up to 60 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	Overview of Urban Rail Transit System
Module objectives/intended learning outcomes	This course aims to provide students with a thorough grounding in the basics of knowledge system of and related approaches to engineering project management, and an appreciation of the basic principles of engineering project management and the corresponding English terms, aiming to prepare students to apply the theoretical

	methods and tools learned in this course in real engineering project management context. Specific objectives include: ● **Knowledge:** 1. Fundamental principles, basic approaches and basic tools of special project management; 2. Implication of each special management and correlation between each special project management in the project management knowledge system 3. Whole process of project management and application of project management tools in rail transit vehicle projects. ● **Skills:** 1. Demonstrate skills in the breakdown of project scope based on project objectives and project outputs, and make use of appropriate tools of project time management and project cost management to formulate a project objective management plan based on the results of project scope breakdown; 2. Demonstrate skills in performing project risk identification and measurement, and performing project quality control according to project quality plan. Demonstrate skills in formulating and implementing project integration management plan; 3. Demonstrate skills in identifying project stakeholders, performing project organization and management, and formulating project organization and management plan. 4. Demonstrate skills in describing the core content of project management in English. ● **Competence:** On successful completion of this course, students will be able to organize team

	members to accomplish their responsibilities in their work; have an appreciation of the overall structure of project management and economic decision-making; and demonstrate skills in performing project schedule management, cost management, quality management, and risk management in a multidisciplinary approach. They will have a foundation of knowledge for lifelong learning for project management. They will become familiar with the independent learning strategies and the ways to expand their knowledge and improve their ability for project management. They will also know the strategies for effective communicate across cultures.
Contents	**Part A Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1. Introduction** (2 contact hours; 3 self-study hours) The main topics of this course, the significance of learning this course, main learning methods and final assessment methods; Project definition and characteristics*; Definition and implication of project management**; Knowledge system for project management; History of project management. **Chapter 2. Project Process, Evaluation and Decision-making** (4 contact hours; 4 self-study hours) Project evaluation and decision-making*; Project process and project management process**; Approaches to and practices of project life cycle. **Chapter 3. Project Scope Management** (6 contact hours; 5 self-study hours) Overview of project scope management; Project scope plan and breakdown structure of project work**; Project scope confirmation;

	Project scope control*. **Chapter 4. Project Time Management** (6 contact hours; 5 self-study hours) Concept of project time management; Project activity breakdown; Project activity prioritization; Project schedule development*; Project schedule control**. **Chapter 5. Project Cost Management** (6 contact hours; 5 self-study hours) Project cost and its management; Project resource plan; Project cost estimation; Project cost budget*; Approaches to project cost control and project earned value management**. **Chapter 6. Project Quality Management** (6 contact hours; 5 self-study hours) Basic concept of project quality management; Project quality plan*; Project quality assurance; Project quality control**. **Chapter 7. Project Integration Management** (6 contact hours; 5 self-study hours) Introduction to project integration management; Project integration management approach*; Development and implementation of project integration plan**; Fully integrated management of project changes. **Chapter 8. Project Risk Management** (6 contact hours; 5 self-study hours) Project risk and project risk management; Project risk management plan; Identification and measurement of project risk*; Project risk monitoring and response**. **Chapter 9. Project Organization Management** (6 contact hours; 5 self-study hours) Project organization management and its full integration*;

	Relevant project stakeholders**. **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 (60%)
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] QI Anbang. *Project Management (3rd Edition).* Beijing: Science Press, 2019. 2. Reference books [1] PMI. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide) — Sixth Edition.* Pennsylvania: Project Management Institute, Inc., 2017. [2] DING Shizhao. *Project Management (2nd Edition).* Beijing: China Construction Industry Press, 2014. [3] BAI Sijun. *Introduction to Modern Project Management.* Beijing: Publishing House of Electronics Industry. 2013. [4] WANG Zuhe. *Modern Engineering Project Management.* Beijing: Publishing House of Electronics Industry. 2013. [5] WANG Xiaojin. *Project Management Methodology (2nd Edition).* Beijing: China Electric Power Press, 2015.

Competence field	Electives
Module designation	Equipment Safety Technology
Module level, if applicable	
Code, if applicable	109182
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate Professor ZHU Lin
Lecturer	Associate Professor ZHU Lin Lecturer WU Aizhong
Language	Chinese
Relation to curriculum	This is one of the elective courses designed for students majoring in Vehicle Engineering (Rail Transit Vehicle). This course investigates the particularity and complexity of professional equipment used in urban railway vehicle engineering, and offers an introduction to general technology for machinery and electrical safety. From the aspect of the state of things, human behavior and environmental factors, this course aims to provide student with an appreciation of the safety technical knowledge and cases of urban railway vehicles and station equipment. Topics covered in this course include: (1) basic concepts of safety, danger, risk and accident; (2) dangerous parts of machinery and main forms of mechanical damage, safety technology of machining, electrical and lightning accidents and their prevention, mechanical and electrical explosion-proof technology; (3) safe driving technology, braking technology, and safe vehicle inspection and repair of urban railway vehicle; (4) structure and operating principle of rail transit platform door, systemic function and safety requirements of platform door; (5)

	structure, operating principle, safety specification and safe use management of elevator and escalator; and (6) equipment safety checklist, event tree analysis, risk level and risk reduction method. After successfully completing this course, students will be able to apply scientific and engineering knowledge to solve equipment safety problems and have the ability to manage safety technology.
Type of teaching, contact hours	Target students: juniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 48 hours Of which Theoretical teaching: 48 hours Experiment/practice teaching: 0 hour Size of class: up to 60 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	Foundation of Manufacturing Technology, Electrical Technology, Overview of Urban Rail Transit System, Structure of Urban Railway Vehicle, Electrical Traction and Control of Urban Railway Vehicle, Braking Technique of Urban Railway Vehicle

Module objectives/intended learning outcomes	Learning outcomes: This course aims to provide students with a sound basis of knowledge in mechanical and electrical safety and safety technology for urban railway vehicle and station equipment, so as to prepare students to work and succeed in their technical management work of future. Expected outcomes include: ● **Knowledge:** 1. Fundamental knowledge of safety technology for mechanical and electrical equipment; 2. Systemic function and safety specification of rail transit platform doors, elevators and escalators in stations; 3. Basic theoretical knowledge related to the safety of urban railway vehicle; 4. Safety evaluation method and safety management knowledge; 5. Frontier development status and trends of Vehicle Engineering (Rail Transit Vehicle). ● **Skills:** 1. Demonstrate skills in analyzing and identifying mechanical and electrical hazards of rail transit electromechanical equipment; 2. Demonstrate skills in developing safety checklists for equipment related to railway vehicle engineering; 3. Demonstrate skills in drafting safety inspection report or safety assessment report. ● **Competence:** After successfully completing this course, students will have enhanced safety awareness in engineering design and application and can apply scientific and engineering knowledge to solve related equipment safety issues in real engineering contexts. They will be able to identify the risk sources of electromechanical equipment for urban railway vehicles and be competent for

	technical management of professional equipment.
Contents	**Part A Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1. Introduction to Equipment Safety Technology** (4 contact hours; 4 self-study hours) 1. 1. Basic concepts of safety, danger and risk*; 2. 2. Classification of accidents* and accident investigation methods. **Chapter 2. Technical Foundation for Mechanical and Electrical Safety** (12 contact hours; 10 self-study hours) 1. Identification of mechanical hazards** (dangerous parts of machinery, main forms of mechanical damage) 2. General machinery safety technology* (safety technology for metal-cutting machines, grinders, forging presses, punching shears, cranes, woodwork machinery, welding machinery) 3. Electrical accidents and their prevention** (effects of electric injury on human body, types of electric shock accidents, prevention of electric shock accidents) 4. Lightning accidents and their prevention* (types and hazards of lightning, lightning protection technology) 5. Fire- and explosion-proof technology (hazardous substances and hazardous environment, mechanical explosion-proof technology, electrical explosion-proof technology) **Chapter 3. Safety Technology for Urban**

	Railway Vehicle (8 contact hours; 8 self-study hours) 1. Safe driving technology* (section blocking method and equipment; safety of passengers getting in and out of vehicle door; safety protection in the carriage) 2. Vehicle braking technology** (friction braking vs. dynamic braking; adhesive braking vs. non-adhesive braking; air braking vs. electric braking) 3. Safety in maintenance work* (human behavior; status of things; environmental factors) **Chapter 4. Safety Technology for Rail Transit Platform Door** (8 contact hours; 6 self-study hours) 1. Structure and operating principle of platform door* 2. Systemic function and safety requirements of platform doors* 3. Tunnel piston wind effect **Chapter 5. Safety Technology for Elevator and Escalator** (10 contact hours; 8 self-study hours) 1. Traction elevator structure and operating principle* 2. Escalator structure and operating principle* 3. Safety specification and safe use management of elevator and escalator* **Chapter 6. Equipment Safety Assessment and Management** (6 contact hours; 6 self-study hours) 1. Equipment safety checklist* and event tree analysis 2. Risk assessment and risk reduction **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%, including assignments, attendance rate), final exam (70%, i.e., big projects).
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] SUN Shimei, FU Huilong, LIU Hui. *Mechanical and Electrical Safety Technology*. China Architecture and Building Press, 2016. 2. Reference books [1] SHI Yimin, FENG Wuwei. *Mechanical and Electrical Safety Technology.* Beijing: Ocean Press, 2016. [2] FANG Yu, SHI Wei, SHI Xuan, et al. *Introduction to Urban Railway Vehicle*. Beijing: China Railway Publishing House, 2012. [3] DONG Ximing. *Reliability, Availability, Maintainability, and Safety (RAMS) of Railway Vehicle.* Beijing: China Railway Publishing House, 2009. [4] ZHU Dewen, LIU Jian. *Elevator Safety Technology.* Beijing: China Electric Power Press, 2007. [5] CHEN Shaozhang. Subway Platform Screen Door System. Beijing: Science Press, 2005.

Competence field	Electives
Module designation	Fault Diagnosis of Urban Mass Transit Vehicle
Module level, if applicable	
Code, if applicable	109145
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate professor: HU Dingyu
Lecturer	Associate professor: HU Dingyu Associate professor: LIAO Aihua Lecturer: MENG Xiaoliang
Language	Chinese
Relation to curriculum	This is an elective course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle). This course investigates the technical concepts and procedures of fault diagnosis, signal acquisition, basics of signal processing, fault diagnosis of vehicle bogie, and fault diagnosis of vehicle traction system. This course aims to provide students with a solid basis of knowledge in the general process of fault diagnosis, ability to process signals, and an appreciation of the common fault diagnosis methods based on vibration, acoustics, and temperature signal measurement, understanding of the common faults of vehicle bogie and traction system. Students will also be able to understand the common methods and ideas of vehicle fault diagnosis method, the development trend of vehicle fault diagnosis method, and have basic skills in preparing a fault diagnosis plan.

Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching & experimental teaching Contact hours: 48 hours Of which Theoretical teaching: 42 hours Experiment / practice teaching: 6 hours Size of class: up to 100 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, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam.
Recommended prerequisites	*Machinery Design, Mechanical Principle, Measurement and Sensor Technology, Electrical Technology, Engineering Mechanics, Structure of Urban Railway Vehicle*
Module objectives/intended learning outcomes	Module objectives: This course aims to provide students with a thorough grounding in vehicle condition diagnosis and maintenance, and skills required for preparing plans for vehicle fault diagnosis and maintenance, engineering reasoning and problem-solving, as well as sound managerial skills and organizational capabilities. Specific objectives include: Knowledge: 1. Demonstrate understanding of common failure modes and failure mechanisms of the running gear and traction system of urban

	railway vehicles; 2. Demonstrate understanding of common tools and systems for vehicle fault diagnosis; 3. Demonstrate understanding of common processing methods of fault signals; 4. Demonstrate understanding of development trends of fault diagnosis for urban railway vehicles. Skills: 1. Ability to demonstrate the phenomena of fault, and correctly select the sensor for acquiring signal. 2. Ability to make use of common signal processing methods to analyze and process engineering signals; 3. Demonstrate understanding of mechanism and system architecture of typical vehicle failures, and fundamental skills in preparing a diagnosis plan. Capabilities: After successfully completing this course, students will be able to apply their professional knowledge to rationally analyze and assess vehicle failures and provide appropriate solutions. Students will also be able to perform engineering reasoning based on specific problems, and analyze and solve problems. Students will have sound coordination skills and organizational capabilities, along with the sense of safety vehicle operation and maintenance.
Contents	**Part A: Theoretical teaching** (42 contact hours; 36 self-study hours) **Chapter 1 Basics of Fault Diagnosis** (3 contact hours; 2 self-study hours) Definition, classification, function and significance of fault diagnosis* General procedure for fault diagnosis** Features of railway vehicle fault diagnosis** Development of fault diagnosis method for

	railway vehicles **Chapter 2 Commonly-used Fault Diagnosis Methods** (15 contact hours; 10 self-study hours) Basics of signal acquisition and processing** Vibration monitoring method* Acoustic diagnosis method Fault tree analysis **Chapter 3 Fault Diagnosis of Bogie** (21 contact hours; 17 self-study hours) Fault diagnosis of bogie frame and axle** Fault diagnosis of wheel tread** Fault diagnosis of axle box bearing** Fault diagnosis of gearbox* **Chapter 4 Fault Diagnosis of Traction Power Supply System** (6 contact hours; 5 self-study hours) Fault diagnosis of pantograph* Fault diagnosis of traction motor **Chapter 5 Modern Diagnostic Methods and Development Trends** (3 contact hours; 2 self-study hours) Development trend of modern fault diagnosis expert system for intelligent fault diagnosis **Part B. Experiment:** (6 experiment hours; 6 self-study hours) 1. Experiments on vibration diagnosis of bearing fault (3 experiment hours; 3 self-study hours) 2. Experiment on acoustic diagnosis of bearing fault (3 experiment hours; 3 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 15%, experiment 15% and big project 70%) 30%. 3. Final exam 60%.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	Required books: HU Dingyu *Fault Diagnosis Methods for Urban Railway Vehicles.* Shanghai: Lecture notes of Shanghai University of Engineering Science, 2019 Reference books: [1] HUANG Cailun, FAN Xiaoping, CHEN Tefang. *On-line Diagnosis Methods and Application of Train Failure*. Beijing: National Defense Industry Press, 2006. [2] GUO Shiming. *EMU Detection and Fault Diagnosis*. Chengdu: Southwest Jiaotong University Press. 2008. [3] JIA Limin. *Fault Diagnosis of Bearing and Suspension System for Railway Train.* Chengdu: Southwest Jiaotong University Press. 2015. [4] ZHAO Huibing, CHEN Jianyi, SUN Shangpeng. *Fault Diagnosis Method for Train Operation Control System.* Beijing: China Railway Publishing House. 2015. [5] ZHOU Ping. *Monitoring of Railway Gearbox Condition and Fault Diagnosis.* Chengdu: Southwest Jiaotong University Press. 2012. [6] R. Isermann, *Fault-Diagnosis Systems: an Introduction from Fault Detection to Fault Tolerance*. Berlin: Springer. 2006.

Competence field	Electives
Module designation	Operation of Urban Railway Transportation
Module level, if applicable	
Code, if applicable	109302
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate professor: ZHU Haiyan
Lecturer	Associate professor: ZHU Haiyan Lecturer: WANG Jing Lecturer: FANG Yong
Language	Chinese
Relation to curriculum	This is one of the elective courses designed for students majoring in Vehicle Engineering (Rail Transit Vehicle). This course investigates the operation and management of urban rail transit system from a systematic perspective. Topics in this course cover almost all aspects of the operation organization of urban rail transit system, including operation characteristics, equipment management, passenger flow forecasting and analysis, operation plan formulation, transportation capacity calculation, train operation diagram principle and preparation, train operation organization, and station work organization, among others. This course aims to provide students with a thorough grounding in rail transit operation and management, so that students will be able to apply relevant knowledge and mathematical skills to solve rail transit engineering issues.

Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching Contact hours: 48 hours Of which Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour Size of class: up to 70 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, 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: This course offers an introduction to the general situation of rail transit system operation in major cities around the world, and provides students with a thorough grounding in the basics of rail transit system operation principles. It aims to provide students with the basic knowledge and basic skills in rail transit system operation and management to support their understanding of the rail transit construction and its development trend in China. Specific objectives include: **Knowledge:** 1. Demonstrate understanding of the basic expertise of rail transit system

	equipment. 2. Demonstrate skills in formulating train schedule and calculating train routing plan. 3. Demonstrate understanding of the core contents of train operation scheduling, train operation, and yard operation, as well as the commonly used workflows and approaches. 4. Demonstrate understanding of the procedures of and approaches to passenger transport organization and rail transit accident response. **Skills:** 1. Demonstrate skills in collecting, analyzing, and predicting passenger flow data, and designing and optimizing train operation plan. 2. Demonstrate skills in responding to emergencies, and in performing information collection and effective analysis. **Competence:** After successfully completing this course, students will be able to apply relevant knowledge and mathematical skills to solve issues in real rail transit engineering context. Students will be able to apply scientific principles to investigate and analyze engineering issues in real rail transit context by using literature research and other related approaches.
Contents	**Part A. Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1. Urban Rail Transit Operation and Development** (4 contact hours; 3 self-study hours) Significance of urban traffic* Definition of rail transit* Classification of urban rail transit** Overview of rail transit development world-wide

	Operational characteristics of urban rail transit system ** **Chapter 2. Equipment for Urban Rail Transit System** (4 contact hours; 3 self-study hours) Train operation equipment** Passenger service equipment* Other equipment* **Chapter 3. Operation Plan** (8 contact hours; 8 self-study hours) Passenger flow plan** Full-day train operation plan** Vehicle utilization plan** Train operation plan** **Chapter 4. Train Operation Diagram** (8 contact hours; 8 self-study hours) Basic concept of train operation diagram** Graphical representation and elements of train operation diagram** Train operation diagram development** Review of train operation diagram and index calculation* **Chapter 5. Train Operation Dispatch and Management** (4 contact hours; 4 self-study hours) Operation management of rail transit train Traffic organization under normal conditions* Traffic organization under abnormal conditions* Operation quality analysis** Regulation system for train operation dispatching* **Chapter 6. Station Traffic Organization** (6 contact hours; 6 self-study hours) Station overview* Traffic blocking** Token and traffic report* Main line equipment at station* Train operation at station* Station construction and management **Chapter 7. Rail Transit Yard Operation and Organization** (4 contact hours; 2 self-study hours) Planning and design of vehicle base* Vehicle maintenance facilities and operation Vehicle operation and maintenance facilities* Organization of train operation in vehicle base* **Chapter 8. Passenger Transport Management in Urban Rail Transit** (6 contact hours; 4 self-study hours) Passenger flow forecast and survey analysis*

	Feature and organization process of passenger services Rail transit service management* Rail transit service measures **Chapter 9. Rail Traffic Accident and Accident Response** (4 contact hours; 4 self-study hours) Risk factors for accidents* Accident response and emergency plan in urban rail transit* Safety precautions in urban rail transit Safe operation and control system* **Part B. Experiment teaching** (0 contact hours; 0 self-study hours)
Study and examination requirements and forms of examination	1. Basic requirements for class attendance (no late arrivals, no early departures, and no unauthorized absences) 20%. 2. Assignment and in-class performance 20%. 3. Final exam 60%.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	Required books: [1] HE Jing. *Urban Rail Transit Operation Management (3rd Edition).* Beijing: China Railway Publishing House, 2017 Reference books [1] TAN Fuxing, GAO Weijun. *Overview of Urban Rail Transit System.* China Water & Power Press, 2007. [2] ZHANG Guobao, *Operation of Urban Railway Transportation*. Shanghai Science and Technology Press, 2008 [3] MU Wei. *Operation of Urban Railway Transportation*. China Communications Press, 2012. [4] CHENG Gang, Cao Jie. *Operation of Urban Railway Transportation*. Southwest Jiaotong University Press, 2010. [5] HE Zonghua. *Operation of Urban Railway Transportation*. China Architecture and Building Press, 2003.

Appendix B - Syllabus - Electives

Competence field	Electives
Module designation	Traffic Signal for Urban Railway Transportation
Module level, if applicable	
Code, if applicable	109203
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Professor CHAI Xiaodong
Lecturer	Professor CHAI Xiaodong Lecturer WEI Lili Lecturer CHONG Lei Senior Laboratory Technician HU Guo
Language	Chinese
Relation to curriculum	As an elective course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle) of the School of Urban Rail Transportation, this course investigates the function, composition, basic operating principle and application of basic signal equipment, interlocking system, block system, and train control system for traffic signal of urban railway transportation. Topics covered in this course include the roles and features of traffic signal systems for urban railway transportation, the concepts and control principles of train operation, section block, and station interlocking, the principles of signal configuration, the operating principles of electric switch machines and relays, the composition of track circuits, and the principles of use of sensors (beacons), among others. After successfully completing this course, students will be able to have a sound basis of knowledge in basic traffic signal equipment in urban railway system and an appreciation of engineering application.

Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theory teaching: Contact hours: 48 hours Of which Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour Size of class: up to 70 students for theory 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, 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: This course aims to provide students with a thorough grounding in the operating principles of various traffic signal components for urban railway transportation, and skills required for integrative thinking, engineering reasoning and problem-solving, as well as sound managerial skills and organizational capabilities. Specific objectives include: **Knowledge:** 1. Demonstrate understanding of the roles and features of traffic signal systems in urban railway transportation 2. Demonstrate understanding of the concepts and control principles of train operation,

	section block, and station interlocking 3. Demonstrate understanding of the principles of signal configuration, the operating principles of electric switch machines and relays, the composition of track circuits, and the principles of use of sensors (beacons). **Skills:** 1. Demonstrate skills in reading the interlocking relationship diagram of urban railway signal systems to perform interlocking logic derivation and analysis; 2. Demonstrate skills in describing the key control circuits of urban railway systems and an ability to design interlocking control circuits. 3. Demonstrate an ability to analyze the logical relationship between line block and automatic train control. **Competence:** After successfully completing this course, students will be able to acquire comprehensive knowledge in signal systems, and an appreciation of a fault-driven concept for safe signal control. Students will also be able to apply their background engineering knowledge to perform reasonable analysis of and evaluation on the real-world engineering application of traffic signal systems, and provide reasonable suggestions.
Contents	**Part A. Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1 Function and Composition of Traffic Signal System for Urban Railway Transportation** (2 contact hours; 2 self-study hours) Function of traffic signal system* Feature of traffic signal system for urban railway transportation* **Chapter 2 Basic Equipment of Traffic**

	Signal System (16 contact hours; 16 self-study hours) Track circuit** Signal machine** Relay* Relay circuit Switch machine* Switch control circuit Axle counter** Transponder** **Chapter 3 Signals and Operation** (8 contact hours; 6 self-study hours) Urban railway lines* Train operation, demarcation points and station classification* Principle of signal layout** Function, significance and preparation method of train operation diagram **Chapter 4 Block System** (6 contact hours; 6 self-study hours) Concept and function of block system** Principle of semi-automatic block* Principle of automatic block** Relationship between block and ATP system **Chapter 5 Interlocking System** (12contact hours; 10 self-study hours) Concept and function of interlocking system* Station interlocking system** Access lock and unlock* Station interlock table** Computer interlocking **Chapter 6 Overview of Automatic Train Operation Control System** (6 contact hours; 2 self-study hours) Composition and function of ATC system* Function and principle of ATS subsystem Function and principle of ATP subsystem Function and principle of ATO subsystem Function and principle of CBTC system* **Part B. Experiment teaching** (0 contact hours; 0 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 big project 50%) 30%. 3. Final exam 60%.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	Required books: [1] XU Jinxiang. *Detection Technology of Traffic Signal for Urban Railway Transportation.* Beijing: China Railway Publishing House, 2010 Reference books [1] GAO Jixiang. *A Beginner's Guide to Traffic Signal Operation for Railway Transportation.* Beijing: China Railway Publishing House, 2005 [2] Science and Technology Committee of Shanghai Construction and Management Committee. *Shanghai Metro Line 2 Project.* Shanghai: Shanghai Science and Technology Press, 2005. [3] ALCATEL, ALSTOM, USS technical information. 2000-2006.

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