Appendix B - Syllabus - Practical Training

Competence field	Practical Training
Module designation	Fundamentals Physics Experiments
Code, if applicable	219751
Subtitle, if applicable	
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Associate Professor: CHEN Huimin, WU Jianbao
Lecturer	Associate Professor: CHEN Huimin, SUN Xiaohui
Language	Chinese
Relation to curriculum	This course mainly contains the error theory and five fundamentals physics experiments in the fields of electrophysics, mechanics, and optics. By learning measuring instrument experiments of basic physical quantities, students are able to know the use of basic measuring instruments, grasp the measurement range, division value, and reading error of instruments, and measure readings correctly; through the learning of volt-ampere characteristics experiment of electrical components, students are able to grasp the methods of measuring volt-ampere characteristics of electrical components with the voltmeter and ammeter, and draw experiment diagrams correctly; the research experiment of the viscosity phenomenon in liquids enables students to learn how to find the empirical equation by studying the relative change relationship between two physical quantities; the spectrometer regulation experiment enables students to understand the principle and structure of spectrometer, and learn to regulate the spectrometer and conduct angle measurement; the experiment of observing the waveform, voltage, and frequency of AC signal with oscilloscope enables students to understand the operating principle of oscilloscope, and observe the waveform of AC signal and measure the peak-peak value and frequency of signal voltage with oscilloscope. By learning this course, students receive training on the methods and techniques of physics experiments, have preliminary understanding of the theory on experimental error treatment and basic methods of science experiments, grasp fundamental knowledge, methods and skills of physics experiments, and build sound foundations for learning further experiment courses.
Type of teaching, contact hours	Target students: students of all undergraduate programs in engineering Type of teaching: theoretical and practice teaching Contact hours: 15 hours Of which Theoretical teaching: 5 hours Experiment / practice teaching: 10 hours

Workload	Workload = 22.5 hours Contact hours = 15 hours Self-study hours = 7.5 hours
Credit points	0.75
Requirements according to the examination regulations	Complete all required experiments and submit experimental reports.
Recommended prerequisites	Unary Calculus (1), Unary Calculus (2), Physics (Mechanics), Physics (Electromagnetism)
Module objectives/intended learning outcomes	Module objectives: Through necessary experiment theoretical teaching and a series of corresponding fundamentals physics experiments, students can learn fundamental knowledge, methods and techniques of physics experiments in the observation and analysis of experimental phenomena, and the measurement of physical quantities, and develop their primary ability for scientific experiments. ● **Knowledge:** (1)Fundamental knowledge on physics experiments and usage of common measuring instruments; (2) Methods of measuring basic physical quantities in electricity, optics, and mechanics, methods of recording and processing experiment data; (3) Safety knowledge in fundamentals physics experiments and laboratory safety code. ● **Skills:** (1) Ability to use common experimental instruments correctly with the help of textbooks and instrument manuals; (2) Ability to record and analyze fundamental physics experimental phenomena correctly; (3) Ability to record and process experimental data, draw diagrams, and evaluate experimental results correctly; ● **Competences:** Grasp basic ideas and methods of science experiments, and basic skills for physics experiments in electricity, optics, mechanics, etc.; have primary ability for science experiments, have basic literacy for science experiments, and have the reasoning and judging ability on experimental phenomena.

<table>
<tr><td>Contents</td><td>

1. Theoretical teaching (4 contact hours, 2.5 self-study hours)

<table>
<tr><td>No.</td><td>Theoretical teaching:</td><td>Contact hours</td><td>Self-study hours</td></tr>
<tr><td>1</td><td>Measurement and error</td><td>2</td><td>2</td></tr>
<tr><td>2</td><td>Type of experiment</td><td>2</td><td>1.5</td></tr>
</table>

2. Experiment teaching (10 contact hours, 5 self-study hours)

<table>
<tr><td>No.</td><td>Experiment</td><td>Contact hours</td><td>Self-study hours</td></tr>
<tr><td>1</td><td>Measuring instruments of basic physical quantities</td><td>2</td><td>1</td></tr>
<tr><td>2</td><td>Volt-ampere characteristics of electrical components</td><td>2</td><td>1</td></tr>
<tr><td>3</td><td>Research on viscosity phenomenon in liquids</td><td>2</td><td>1</td></tr>
<tr><td>4</td><td>Regulation of spectrometer</td><td>2</td><td>1</td></tr>
<tr><td>5</td><td>Observation of waveform, voltage, and frequency of AC signal with oscilloscope</td><td>2</td><td>1</td></tr>
</table>

</td></tr>
<tr><td>Study and examination requirements and forms of examination</td><td>Final assessment (100%): Average achievements of all experiments are the final achievements of this course (20% per experiment)</td></tr>
<tr><td>Media employed</td><td>Multimedia computers, projectors, blackboard-writing</td></tr>
<tr><td>Reading list</td><td>1. Required books
Department of Physics Experiment Teaching, Shanghai University of Engineering Science Fundamentals of College Physics Experiments, Shanghai: Donghua University Press, 2008
2. Other materials
[1] Southeast University and the other six engineering colleges MA Wenwei (adaptation). Physics (5th Edition) Beijing: Higher Education Press, 2006
[2] LI Jing, CAO Yang Fundamentals of College Physics. Beijing: Machinery Industry Press, 2014
[3] ZHU Jizhen, HUANG Gang, ZHOU Jiang College Physics Experiments. Wuhan: Huazhong University of Science and Technology Press, 2010
[4] LU Sihua, DUAN Jiaqi, ZHANG Zhaohui New Fundamentals Physics Experiments. Beijing: Higher Education Press, 2013</td></tr>
</table>

	[5] ZHU Hongmei, ZHANG Yibing, ZHANG Jincang, et al. *College Fundamentals Physics Experiments*. Beijing: Higher Education Press, 2012.

Competence field	Practical Training
Module designation	Comprehensive Physics Experiments
Code, if applicable	219752
Subtitle, if applicable	
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Associate Professor: CHEN Huimin, WU Jianbao
Lecturer	Associate Professor: CHEN Huimin, SUN Xiaohui
Language	Chinese
Relation to curriculum	This is a compulsory foundation course designed to develop students' skills for comprehensive physics experiments. This course contains 4 comprehensive physics experiments of choice and experiment ability assessment. Experimental items include 14 comprehensive physics experiments of different types such as mechanics, electricity and magnetism, from which students can choose 4 based on their interest and program characteristics. By learning Comprehensive Physics Experiments, students are able to apply the theory of experimental error treatment, and various physical knowledge and experimental skills in mechanics, electricity, optics, magnetism, etc. to empirical measurement and analysis as well as data processing, and build sound foundations of error theory and experiments for further courses.
Type of teaching, contact hours	Target students: students of all undergraduate programs in engineering Type of teaching: practice teaching Contact hours: 15 hours
Workload	Workload = 22.5 hours Contact hours = 15 hours Self-study hours = 7.5 hours
Credit points	0.75
Requirements according to the examination regulations	Complete all required experiments and submit experimental reports.
Recommended prerequisites	Unary Calculus (1), Unary Calculus (2), Physics (Mechanics), Physics (Electromagnetism), Wave and Optics
Module objectives/intended learning outcomes	Module objectives: Through the training with a series of comprehensive physics experiments, to further develop and improve students' competence for science experiments during observation and analysis of experimental phenomena, and measurement of physical quantities; to further develop and improve students' literacy for science experiments, down-to-earth attitude toward science, earnest and serious working style, and the spirit of active thinking and research. ● **Knowledge:**

(1) Comprehensive knowledge on physics experiments in mechanics, electricity, optics, magnetism, etc.;

(2) Observation and analysis of physics experimental phenomena, and methods of measuring physical quantities in mechanics, electricity, optics, magnetism, etc.;

(3) Knowledge on safety in physics experiments.

- **Skills:**

(1) Ability to regulate correctly instruments for physics experiments in mechanics, electricity, optics, magnetism, etc. according to experiment requirements, and complete experiments independently;

(2) Master codes and processes for physics experiments in mechanics, electricity, optics, magnetism, etc.;

(3) Ability to apply physics knowledge to make specific analysis and judgments on experimental phenomena;

(4) Process fully experimental data, draw diagrams, evaluate experimental results, and write standard experiment reports independently.

- **Competences:**

Acquire all kinds of knowledge and experimental skills in mechanics, electricity, optics, magnetism, etc.; have the ability to observe and analyze experiments and process experimental data, have good literacy for science experiments, and the ability of active thinking, reasoning, and research.

Contents

Experiment teaching: (14 Contact hours, 8.5 Self-study hours)

No.	Experiment	Contact hours	Self-study hours
C1	Comprehensive physics experiments (mechanics)	3	2
C2	Comprehensive physics experiments (electricity I)	3	2
C3	Comprehensive physics experiments (electricity II)	3	1.5
C4	Comprehensive physics experiments (optics)	3	1.5
D1	Experiment competency check	2	1.5

Comprehensive Physics Experiments (14 items)

Determination of sound velocity

	Research on relationship between voltage and current phase in alternating current circuit
	Simple harmonic vibration of spring oscillator
	Description of electrostatic field
	Potentiometer and its applications
	Resistance testing with Wheatstone bridge
	Determination of elasticity modulus
	Measurement of linear expansion coefficient of solids by the optical lever method
	Measurement of focal length of convex lens
	Measurement of magnetic field with Hall elements
	Measurement of curvature radius of spherical lens by the Newton ring interference method
	Diffraction grating
	Validation of the parallel-axis theorem of moment of inertia by the torsion-pendulum method
	Determination of moment of inertia
Study and examination requirements and forms of examination	Final assessment (100%): Make comprehensive assessment of "comprehensive physics experiments" and "experiment competency check" (the final achievements for this course consist of achievements of 4 comprehensive physics experiments 80% and achievement of experiment competency check 20%)
Media employed	Multimedia computers, projectors
Reading list	1. Required books Department of Physics Experiment Teaching, Shanghai University of Engineering Science *Fundamentals of College Physics Experiments*, Shanghai: Donghua University Press, 2008 2. Other materials [1] JIANG Daya, XIAO Jinghua, ZHU Hongbo. *College Physics Experiment* 3rd Edition, Beijing: Beijing University of Post and Telecommunications, 2011. [2] SU Yuling, SHEN Yan. *College Physics Experiments*, Beijing: Higher Education Press, 2014. [3] MA Ying. *College Physics Experiments* (2nd Edition), Beijing: Tsinghua University Press, 2013.

Competence field	Practical Training
Module designation	Design Innovative Physics Experiments
Code, if applicable	219753
Subtitle, if applicable	
Semester(s) in which the module is taught	3rd semester
Person responsible for the module	Associate Professor CHEN Huimin
Lecturer	Associate Professor WU Jianbao, Associate Professor CHEN Huimin Lecturer LIU Ye
Language	Chinese
Relation to curriculum	This is a compulsory foundation course designed to develop students' skills for scientific experiments and innovative thinking. It includes physics experiments and one innovative experiments. The physics experiments cover topics such as mechanics, thermal physics, optics, electrical science and magnetics, from which students may select four types of their interest and program relevance to work on. Innovative experiments are to be determined by students. Upon completion of this course, students will master the basic ideas and methods of scientific experiments, cultivate innovation awareness, develop innovative capability, and lay a good foundation for subsequent courses.
Type of teaching, contact hours	Target students: students of all undergraduate programs in engineering Type of teaching: Experiment Contact hours: 30 hours
Workload	Total workload = 60 hours Contact hours = 30 hours Self-study hours = 30 hours
Credit points	2
Requirements according to the examination regulations	Complete all required experiments and submit experimental reports.
Recommended prerequisites	Physics (Mechanics); Physics (Electromagnetism); Wave and Optics; Heat and Modern Physics; Fundamentals Physics Experiments; Comprehensive Physics Experiments
Module objectives/intended learning outcomes	Module objectives: The course develops and improves students' ability to independently design and complete scientific experiments and to apply their knowledge of physics and experiment to solve practical problems, whilst enhancing their scientific and experiment literacy. Students will further develop a down-to-earth attitude toward science, earnest and serious working style, and the spirit of active thinking and research.

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Knowledge:
(1) Demonstrate understanding of general methods of physics experiments;
(2) Demonstrate understanding of methods for conducting independent scientific experiments and problem analytics;
(3) Demonstrate understanding of general approach to evaluating scientific experiments
(4) Demonstrate understanding of methods of engineering design and innovation.
Skills:
(1) Demonstrate ability to apply knowledge of physics to independently design an experiment and improve it during the course of implementation to reach set goals;
(2) Demonstrate ability to apply knowledge of physics to make analytical judgments about experiment phenomena;
(3) Demonstrate ability to properly record and process experimental data, draw graphs, evaluate results, and write competent lab reports.

Competence:
Demonstrate ability to design and complete physics experiments in mechanics, electricity, magnetism, and optics independently, to analyze experimental phenomena and record and analyze data using theoretical knowledge of physics, and to develop a sense for innovation, spirit of exploration and have a pragmatic scientific attitude.
</td></tr>
<tr><td>Contents</td><td>
Experiment teaching:
<table>
<tr><th>No.</th><th>Experiment</th><th>Contact hours</th><th>Self-study hours</th></tr>
<tr><td>1</td><td>Design-based experiment item (mechanics)</td><td>7.5</td><td>5</td></tr>
<tr><td>2</td><td>Design-based experiment item (electrical science)</td><td>7.5</td><td>5</td></tr>
<tr><td>3</td><td>Design-based experiment item (optics)</td><td>7.5</td><td>5</td></tr>
<tr><td>4</td><td>Design-based experiment item (sensor)</td><td>7.5</td><td>5</td></tr>
<tr><td>5</td><td>Innovative experiment (modern optics)</td><td>/</td><td>10 (optional)</td></tr>
</table>
<table>
<tr><td>Catalog of design-based experiment items</td></tr>
<tr><td>Mechanics:</td></tr>
<tr><td>1. Study of coupling pendulum</td></tr>
<tr><td>2. Forced vibration</td></tr>
<tr><td>3. Doppler effect synthesis experiment</td></tr>
</table>
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</table>

	4. Determination of gravitational acceleration using rotating liquids	
	5. Determination of air density and gas universal constant	
	Thermal physics:	
	1. Steady-state method to measure thermal conductivity of bad conductors	
	2. Determination of specific heat of vaporization of liquids	
	3. Measurement of high temperature water vapor pressure	
	4. Thermal effect experiment	
	5. Determination of the coefficient of linear expansion of solids	
	6. Determination of the air specific heat capacity ratio C_P/C_V	
	Magnetics:	
	1. Electron paramagnetic resonance	
	2. Pulse nuclear magnetic resonance	
	3. Giant magneto resistive effect	
	4. Magneto resistive effect	
	5. Curie temperature	
	6. C-type electromagnets for the study of magnetic fields in the air gap	
	7. Observe the dynamic hysteresis return line of transformer silicon steel sheet	
	8. The Seaman Effect	
	9. Bending method to measure the elastic modulus and Hall position sensor calibration	
	10. Helmholtz magnetic field measurement	
	Optics (I):	
	1. Determine the wavelength of sodium light by double-beam interference	
	2. Laser interferometry of wedge angle of flat glass	
	3. Photoelectric effect	
	4. Measure the spin rate and concentration of polarizable solutions with a polarimeter	
	5. Michelson interferometer	
	6. Electro-optical effect	
	7. Abbe refractometer	
	Optics (II):	

	1. Measure the refractive index of a prism by the critical angle method
	2. Hydrogen atom spectra in the visible region
	3. Measure glass refractive index using Brewster's law
	4. Study of prismatic dispersion relations
	5. Ultrasonic grating to measure the speed of sound
	Modern Optics:
	1. Integrated measurement of photocells, photoresistors, and photodiodes
	2. Self-assembled telescopes and microscopes
	3. Tunneling microscope
	4. Bipolar resistance effect study
	5. Lateral photovoltaic effect study
	6. Measure the refractive index and thickness of thin films by the guided wave method
	7. Vacuum coating experiment
	8. YAG laser output characteristics test
	9. Diffraction grating spectrometer
	10. Fiber grating pressure sensor
	11. Fiber grating temperature sensor
	Electrical science (I):
	1. RC steady-state process for series circuits
	2. RC transient process for series circuits
	3. RLC transient process for series circuits
	4. Fourier decomposition of square-wave electrical signals
	5. Physical properties of semiconductor PN junctions and measurement of weak currents
	Electrical science (II):
	1. Design and assembly of ohmmeter
	2. Research on sensitive current meters
	3. The study of temperature-dependent electrical phenomena
	4. Chaos studies of Tsai nonlinear circuits
	5. Electron beam deflection experiments
	6. Electron diffraction
	7. Resistance temperature sensor characteristic measurement
	Sensor:
	1. Research on thermal radiation

	2. Computer controlled chord meter 3. Measurement of the Earth's magnetic field 4. Sensor optics comprehensive experiment 5. Comprehensive experiment on sensor mechanics 6. Bridge vibration test 7. Measurement of the constant of gravity
Study and examination requirements and forms of examination	Final assessment (100%): The grade for this course consists of four design experiments (20% each) and one innovative experiment (20%). The grade for each design experiment is based on the preparation (20%), implementation (40%) and report (40%). The grade for the innovative experiment is based on the experiment (30%), defense of the experiment (30%) and report (40%).
Media employed	Multimedia computers, projectors
Reading list	1. Required books [1] YAO Lieming, HUO Zhongsheng et al. *Structured University Physics Experiments (Second Edition)*, Beijing: Higher Education Press, 2012. 2. Other materials [1] ZHANG Zhidong, WEI Huaipeng, et al. *College Physics Experiments (Fourth Edition)*, Beijing. Science Press, 2011. [2] WU Jianbao, ZHANG Chaomin, LIU Lie, CHEN Huimin, SHANG Rong, et al. (eds.), *Course for College Physics Experiments*, Beijing: Tsinghua University Press, 2013. [3] LI Xiangyin, XU Yongxiang, et al. *College Physics Experiments (Second Edition)*, Beijing: Higher Education Press, 2009. [4] ZHANG Zhaokui, MIAO Lianyuan, et al. College Physics Experiments (Third Edition), Beijing: Higher Education Press, 2008.

Appendix B - Syllabus - Practical Training

Competence field	Practical Training
Module designation	Practice of Manufacturing Technology Fundamentals
Code, if applicable	249301
Subtitle, if applicable	
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Senior Laboratory Technician: GU Bei
Lecturer	Senior Laboratory Technician: GU Bei Senior Laboratory Technician: XIN Lihua Engineer: WU Shuai Engineer: DING Ting Laboratory Technician: LIU Shengmin Laboratory Technician: ZHENG Jiahua Laboratory Technician: HUANG Hewei
Language	Chinese
Relation to curriculum	This is a technical practice course with focus on quality-oriented education, an essential prerequisite course for learning Foundation of Mechanical Manufacturing Technology, Practice of Modern Manufacturing Technology, and core courses in mechanics, and acquiring basic knowledge on mechanical manufacturing. Fundamentals Practice of Manufacturing Technology includes six parts: turning, bench work, casting, welding, pneumatic hand drill disassembly and assembly, milling, planing, and grinding. It enables students to grasp certain operating skills in manufacturing technology, and build a practical foundation for their engineering work.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: experiment teaching Contact hours: 90 hours
Workload	Workload = 120 hours Contact hours = 90 hours Self-study hours = 30 hours
Credit points	4.0
Requirements according to the examination regulations	Complete all practices required for the course, and finish practice reports and need-to-know tests.
Recommended prerequisites	Fundamentals of Drawing
Module objectives/intended learning outcomes	Module objectives: To cultivate students to grasp basic theory in mechanical engineering and machinery and necessary fundamentals of engineering, have the experience in engineering practice, grasp basic

<table>
<tr><td></td><td>innovation methods, have the attitude and consciousness of innovation; to have the systematic experience in basic engineering practice, and the ability to apply comprehensively basic engineering theory and technical means to solve problems.
● Knowledge:
(1) Basic theory on mechanical process and operating skills;
(2) Processing principle, simple processing techniques and methods for basic types of work in manufacturing technology
(3) Usage and technical procedures for safe operation of equipment, cutters, fixtures, and measuring implements;
● Skills:
(1) Grasp and apply benchwork, welding, and casting techniques and skills, and use modern engineering tools in mechanical engineering practice;
(2) Have hands-on skills, can operate lathe, milling machine, planing machine, grinding machine, etc. independently;
(3) skills of processing and assembling parts in practical production;
● Competences:
Grasp basic processing methods, have the attitude and consciousness of innovation; have the systematic experience in basic engineering practice, and the ability to apply comprehensively basic engineering theory and technical means to solve problems, can take into account restraints such as economy, environment, law, safety, health, and ethic in the course of solution; have the abilities of organization, management, expression, interpersonal communication, and can play a role in a team.</td></tr>
<tr><td>Contents</td><td>Experiment teaching:
Fundamentals Practice of Manufacturing Technology includes six parts: turning, bench work, casting, welding, pneumatic hand drill disassembly and assembly, milling, planing, and grinding.
<table>
<tr><th>No.</th><th>Experiment</th><th>Contact hours</th><th>Self-study hours</th></tr>
<tr><td>1</td><td>Turning</td><td>15</td><td>5</td></tr>
<tr><td>2</td><td>Benchwork</td><td>15</td><td>5</td></tr>
<tr><td>3</td><td>Casting</td><td>15</td><td>5</td></tr>
<tr><td>4</td><td>Welding</td><td>15</td><td>5</td></tr>
<tr><td>5</td><td>Pneumatic hand drill disassembly and assembly</td><td>15</td><td>5</td></tr>
<tr><td rowspan="3">6</td><td>Milling</td><td>15</td><td>5</td></tr>
<tr><td>Planing</td><td>15</td><td>5</td></tr>
<tr><td>Grinding (select one of the</td><td>15</td><td>5</td></tr>
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	three)
Study and examination requirements and forms of examination	1. In-class performance (70%): practice performance, hands-on operating skills. 2. Assignments (15%): internship report. 3. Final assessment (15%): need-to-know test.
Media employed	Multimedia aided teaching
Reading list	1. Required books [1] ZHU Jianjun. *Fundamentals Practice of Manufacturing Technology*. Beijing: Machinery Industry Press, 2016. 2. Other materials [1] XU Zhenghao, CHENG Qiong. *Practical Training on Fundamentals of Manufacturing Technology*. Beijing: Machinery Industry Press, 2008. [2] JIANG Yinfang, WANG Hongyu. *Practical Training on Fundamentals of Mechanical Manufacturing Technology*. Beijing: Chemical Industry Press, 2007. [3] JIA Zhenyuan, WANG Fuji. *Foundation of Mechanical Manufacturing Technology*. Beijing: Science Press, 2011.

Appendix B - Syllabus - Practical Training

Competence field	Practical Training
Module designation	Practicum for Mechanical Principles
Module level, if applicable	
Code, if applicable	019308
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 ZHANG Chunyan Associate Professor LU Chenhui Lecturer ZHANG Chao Lecturer ZHANG Meihua
Language	Chinese
Relation to curriculum	Course Design for Mechanical Principles is designed to provide students with a complete opportunity for preliminary practice in mechanical design. It instructs students to apply basic mechanics theory learned to a simple mechanical system in a short period of time, and to further master knowledge taught in classroom through overall design of mechanical drive solutions, mechanism analysis and integration. In combination with the preliminary training in engineering design, the course develops students' ability to apply technical data, improve their abilities of drawing and calculation, in the meantime, lays emphasis on the development of students' consciousness of innovation.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical and practice teaching Contact hours: 30 hours Practice teaching: each lecturer teaches 3-5 teams, each group 5-7 students.
Workload	Total workload = 60 hours Contact hours = 30 hours Self-study hours = 30 hours
Credit points	2.0
Requirements according to the examination regulations	1. Two sketches of mechanical movement (A3) 2. A design specification
Recommended prerequisites	Mechanical Principles

Module objectives/intended learning outcomes	**Learning objectives:** The objectives of Course Design for Mechanical Principles are: according to given requirements for general mechanical functions, to decompose a function, select and combine mechanism models for a simple machine (of which the process movements are simple), design mechanical movements, compare, evaluate, and select movement designs, draw sketches of mechanical movements, and draw movement cycle of mechanisms; to make movement analysis and dimensional synthesis of the mechanism, etc. in the selected design; to analyze mechanical dynamics. **Knowledge:** (1) Method points for decomposing a function according to given requirements for general mechanical function, selecting and combining mechanism models; (2) Content, method, and steps of mechanical movement design; (3) Full concept of dynamic analysis. **Skills:** (1) The skill of making mechanical movement design according to functional needs; (2)Ability to sketch mechanical movements, and draw movement cycle of mechanisms: (3) Basic skills of making movement analysis and dimensional synthesis of mechanisms, etc., and analyzing mechanical dynamics. **Competence:** Enable students to have preliminary understanding of the full process of mechanical design, and the ability to make mechanical movement design according to functional needs, and the abilities of calculation, drawing, and computer application. Develop students' abilities of expression, summarization, and conclusion through specification preparation.
Contents	**Content of the course design 1:** Draw movement cycles (10 practice teaching hours; 10 self-study hours) (1) Select operating principle of a machine according to general functional requirements for the machine to be designed, and decompose the function; (2) Draw mechanical movements as the basis for selecting execution form and making mechanical movement design according to the operating principle of the machine, and requirements for movement coordination of components*. **Content of the course design 2:** Design analysis and integration (10 practice teaching hours; 10 self-study hours) (1) Sketch movement of mechanisms in various designs according to the requirements of design specifications; (2) Select and combine mechanism models, study changes and coupling of movement forms, analyze structure and compare

	performance of the mechanisms, and draw schematic diagrams of transmission*. (3) Analysis of operating characteristics and dimensional design of connecting rod, cam profile design**. **Content of the course design 3:** Prepare design specifications (10 practice teaching hours; 10 self-study hours) (1) Prepare specifications in written form based on relevant course design content and design experience. (2) Complete two A3 drawings, movement analysis and design procedures of 1-2 principle mechanisms, write a design specification*.
Study and examination requirements and forms of examination	Final assessment (100%): assignments 10%, design report (detailed design description + drawings) 70%, oral examination 20%
Media employed	PPT courseware, projectors, drawing
Reading list	[1] ZHENG Wenwei, WU Kejian. *Mechanical Principles* (7th Edition) Beijing: Higher Education Press. 1997. [2] SUN Heng, CHEN Zuomo, GE Wenjie. *Mechanical Principles* (7th Edition) Beijing: Higher Education Press. 2006. [3] SUN Huan, CHEN Zuomo, GE Wenjie. *Mechanical Principles* (8th Edition). Beijing: Higher Education Press. 2013. [4] LU Ning, FAN Jiangling et al. *Mechanical Principles* (2nd Edition). Beijing: Tsinghua University Press. 2012.

Competence field	Practical Training
Module designation	Electrical Engineering Practice
Code, if applicable	249405
Subtitle, if applicable	
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Associate professor: PU Yonghong
Lecturer	Associate professor: PU Yonghong Associate professor: ZHANG Ting Lecturer: CHEN Guoming Lecturer: CHEN Yang Lecturer: LU Shanting
Language	Chinese
Relation to curriculum	This is an elective practice course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle) of the School of Urban Rail Transportation. The course contains two parts: practical training of electronic technology, and practical training of electrical technology. Through engineering practice of knowing electrical low-voltage devices and electronic components, integral installation, circuit debugging, etc., students will have preliminary knowledge of and grasp general electrical and electronic techniques, production techniques and processes of electrical devices and electronic products. The course lays foundations for the study of subsequent core courses, engineering application, and practice.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: experiment teaching Contact hours: 45 hours
Workload	Workload = 90 hours Contact hours = 45 hours Self-study hours = 45 hours
Credit points	3
Requirements according to the examination regulations	Complete all required experiments and submit experimental reports.
Recommended prerequisites	Electrical Technology
Module objectives/intended learning outcomes	Module objectives: Through practical operation of electrical and electronic technologies, to consolidate and deepen the understanding of fundamental theory and knowledge on electrical and electronic techniques required for engineering work; To develop the ability of

<table>
<tr><td></td><td>practical operations of electrical and electronic technologies, and the ability to analyze operation results.
● Knowledge:
(1) Basic knowledge on electrical safety, use of common electric tools;
(2) Structure and function of common low-voltage apparatuses;
(3) Operating principle, wiring check, and troubleshooting of motor direct start control circuit and forward / backward rotation start control circuit;
(4) Electronic components and operating characteristics;
(5) Fundamental principle of direct current regulating circuit.
● Skills:
(1) Master skills of controlling and using low-voltage apparatus, and using measuring instruments;
(2) Skill of practical operations of electrical and electronic technologies;
(3) Master electrical and electronic experimental methods, skills, and data processing methods, and ability to analyze operation results;
● Competences: Develop students' practical ability, special experiment skills, and knowledge application ability in electrical engineering. Train students to formulate scientific plans of electrical experiments, design right steps and emergency measures of electrical experiments, and analyze and solve problems in electrical experiments.</td></tr>
<tr><td>Contents</td><td>Experiment teaching:
The electrical engineering practice contains two parts: practical training of electrical technology (A), and practical training of electronic technology (B).
<table><tr><td>No.</td><td>Experiment</td><td>Contact hours</td><td>Self-study hours</td></tr><tr><td>A1</td><td>Basic knowledge on electrical engineering, electrical safety education, and use of electric tools</td><td>3</td><td>3</td></tr><tr><td>A2</td><td>Structure and function of common low-voltage apparatuses;</td><td>3</td><td>3</td></tr><tr><td>A3</td><td>Operating principle, wiring check, and troubleshooting of three-phase motor direct start control circuit</td><td>8</td><td>8</td></tr><tr><td>A4</td><td>Operating principle, wiring</td><td>9</td><td>9</td></tr></table></td></tr>
</table>

		check, and troubleshooting of three-phase asynchronous motor forward / backward rotation start control circuit			
	B1	Identification and testing of electronic components	3	3	
	B2	Use of electric soldering iron and welding	3	3	
	B3	Welding and testing of simple direct current regulating circuits	8	8	
	B4	Welding and testing of series direct current regulating circuits	8	8	
Study and examination requirements and forms of examination	Usual performance accounts for 50% of final score (attendance, participation in experiment process, experimental ability and experiment quality). Experimental report accounts for 50% of final score (understanding of experiment objectives / principles / equipment; results of experimental data; analysis of experimental data)				
Media employed	Multimedia aided teaching				
Reading list	1. Required books [1] WANG Yanxin. *Practical Training for Electrical and Electronic Experiments*. Beijing: Posts & Telecom Press, 2015. 2. Other materials [1] FAN Xiaolan. *Electrical Technology*. Beijing: Tsinghua University Press, 2013. [2] WANG Jinghua. *Electronic Technology*. Beijing: Tsinghua University Press, 2014 [3] QIU Yongjin. *Fundamentals of Electrical Engineering*. Beijing: Chemical Industry Press, 2016.				

Appendix B - Syllabus - Practical Training

Competence field	Practical Training
Module designation	Practicum for Mechanical Design
Module level, if applicable	
Code, if applicable	019309
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 Associate Professor ZHANG Chunyan Associate Professor LU Chenhui Lecturer ZHANG Chao Lecturer ZHANG Meihua
Language	Chinese
Relation to curriculum	Course Design for Mechanical Design is an essential procedure of comprehensive and practical teaching after the teaching of Mechanical Design, and the first complete design training course for students majoring in machinery in higher education institutions of engineering. It is aimed to train students' abilities to apply knowledge learned to analyze and solve practical problems while helping consolidate and deepen their learning of Mechanical Design; to cultivate students' down-to-earth design idea, enable them to grasp general design methods and basic skills of design, calculation, drawing, etc., and improve their ability to apply data, albums, manuals, standards, and specifications.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical and practice teaching Contact hours: 60 hours Practice teaching: each lecturer teaches 3-5 teams, each group 5-7 students.
Workload	Total workload = 90 hours Contact hours = 60 hours Self-study hours = 30 hours
Credit points	3.0
Requirements according to the examination regulations	1. One retarder assembly drawing (A1) 2. Two parts working drawings (A3) 3. A design specification
Recommended prerequisites	Mechanical Design

Module objectives/intended learning outcomes	Learning objectives: Through the course design practice, to establish correct design ideas, and develop the ability to comprehensively apply the theories and practical knowledge learned from the Mechanical Design course and other prerequisite courses to analyze and solve problems in mechanical design. **Knowledge:** (1) General methods and rules of mechanical design; (2) Movement forms, design, calibration, and installation of common mechanisms (3) Tolerance and cooperation between mechanical components, knowledge in machining and manufacturing. (4) Consideration of manufacturing process, installation and adjustment, use and maintenance, economy, safety, and other issues, structural design of machines and parts. **Skills:** (1) Ability to develop or analyze designs, make reasonable choices of electric motors, transmission mechanisms, and parts based on functional requirements of machines; (2) Basic skills for mechanical design: calculation, drawing, consultation of data and manuals, application of standards and specifications; (3) Master the methods of using computer in design calculation and structural design and drawing assembly drawings and parts drawings where permitted under objective conditions. **Competence:** Through the course design practice, to establish correct design ideas, and develop the ability to comprehensively apply the theories and practical knowledge learned from the Mechanical Design course and other prerequisite courses to analyze and solve problems in mechanical design. Ability to analyze and interpret experiment results, and make sound and valid conclusions through information collection. Skills of report writing, draft design, presentations, etc., and ability to employ them in solving complex mechanical engineering problems.
Contents	**1. Overall design of transmission devices**(10 contact hours; 5 self-study hours) The overall design of transmission devices includes developing transmission solution, selecting prime mover, determining total transmission ratio, allocate transmission

	ratio at all stages, and calculating motion and dynamic parameters of the transmission device. **2. Design calculation of transmission parts**(10 contact hours; 5 self-study hours) The design calculation of transmission parts consists of the design calculation of transmission parts inside and outside of retarder. It includes the determination of materials of transmission parts, heat treatment method, parameters, dimensions, and main structures to prepare for the design of assembly sketch. **3. Assembly sketch design**(10 contact hours; 5 self-study hours) Initial drawing of retarder assembly sketch, strength check calculation of shafts, bearings, and keys, completion of assembly sketch design. **4. Assembly working drawing design**(10 contact hours; 5 self-study hours) Drawing of all views of assembly working drawing, marking of dimensions, part numbers, headings, and breakdowns, technical characteristics and conditions of retarder, check of assembly working drawing. **5. Parts working drawing design**(10 contact hours; 5 self-study hours) Design requirements of parts working drawing, design of shaft parts working drawing, design of gear parts working drawing. **6. Preparation of design calculation specification**(10 contact hours; 5 self-study hours) List of contents, design specification, electric motor selection and calculation, calculation of motion and dynamic parameters of transmission device, design calculation of transmission parts, design calculation of shafts, rolling bearing selection and life calculation; coupling selection.
Study and examination requirements and forms of examination	Comprehensive evaluation of course design, formal assembly drawing (50%), specification, part drawing (30%), oral examination (20%)
Media employed	PPT courseware, projectors, laser pointers, blackboards, chalks, drawing

Reading list	[1] PU Lianggui, JI Minggang, et al. *Machinery Design* (9th Edition) Beijing: Higher Education Press, 2013. [2] YANG Kezhen, CHENG Guangyun. *Fundamentals of Mechanical Design* (6th Edition). Beijing: Higher Education Press. 2013 [3] GONG Guiyi. *Guidebook on Course Design for Mechanical Design.* Beijing: Higher Education Press. 1994 [4] GONG Guiyi. *Album of Course Design for Mechanical Design* Beijing: Higher Education Press. 1994 [5] WANG Kun, HE Xiaobo, et al. *Course Design for Fundamentals of Mechanical Design*. Beijing: Higher Education Press. 1995

Competence field	Practical Training
Module designation	Braking Experiments of Urban Railway Vehicle
Code, if applicable	109111
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Laboratory Technician: SONG Ruigang
Lecturer	Laboratory Technician: SONG Ruigang Lecturer: YUAN Tianchen Laboratory Technician: SHI Xuan
Language	Chinese
Relation to curriculum	This is an elective practice course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle) in the School of Urban Rail Transportation. The course contains four parts: electric braking experiment of urban railway vehicle, air braking experiment of urban railway vehicle, performance experiment of key valve parts of air brake system, and braking energy recovery experiment. The course builds foundations for students' engineering application, analysis, and practice on jobs related to urban railway vehicle brake systems.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical and practice teaching Contact hours: 30 hours Of which Theoretical teaching: 4 hours Experiment / practice teaching: 26 hours Size of class: up to 20 students
Workload	Workload = 60 hours Contact hours = 30 hours Self-study hours = 30 hours
Credit points	2.0
Requirements according to the examination regulations	Complete all required experiments and submit experimental reports.
Recommended prerequisites	Mechanical Principle, Engineering Mechanics (1); Engineering Mechanics (2), Overview of Urban Rail Transit System, Braking Technique of Urban Railway Vehicle
Module objectives/intended learning outcomes	Module objectives: ● **Knowledge:** 1. Structures and operating principle of brake system of urban railway vehicle

2. Operating principle of valve parts in brake system of urban railway vehicle
3. Cutting-edge testing methods of brake system of railway vehicle

- **Skills:**

1. Skill of analyzing structure and principle of all parts of brake system;
2. Skill of analyzing critical principle of vehicle braking technique;
3. Skill of testing critical indicators and characteristics of brake system;
4. Preliminary skill of testing and analyzing electric traction system and brake system based on virtual instrument technology.

- **Competences:** Develop students' practical ability, special experiment skills, and knowledge application ability. Develop students' skills for science experiments to meet the requirements of market economy for engineers.

Contents

1. Theoretical teaching

No.	Theoretical teaching	Contact hours	Self-study hours
1	Design principle of electric traction testbed	1	1
2	Development and principle of air brake	1	1
3	Principle of key valve parts of brake	1	1
4	Overview of braking energy recovery technology	1	1

2. Experiment/practice teaching

Braking experiments of urban railway vehicle include four parts: electric braking experiment of urban railway vehicle (A), air braking experiment of urban railway vehicle (B), performance experiment of key valve parts in air brake system (C), and braking energy recovery experiment (D).

No.	Experiment	Contact hours	Self-study hours
A1	Braking experiment of variable frequency speed regulating resistance	3	3
A2	Braking experiment of variable frequency speed regulating feedback	4	4
B1	Operation experiment of microcomputer-controlled straight air brake system	3	3

<table>
<tr><td></td><td>
<table>
<tr><td>B2</td><td>Performance test experiment of microcomputer-controlled straight air brake system</td><td>4</td><td>4</td></tr>
<tr><td>C1</td><td>Performance experiment of relay valve of air brake system</td><td>3</td><td>3</td></tr>
<tr><td>C2</td><td>Performance experiment of empty and load valve of air brake system</td><td>4</td><td>4</td></tr>
<tr><td>D1</td><td>Operation experiment of braking energy recovery system</td><td>2</td><td>2</td></tr>
<tr><td>D2</td><td>Performance experiment of braking energy recovery system</td><td>3</td><td>3</td></tr>
</table>
</td></tr>
<tr><td>Study and examination requirements and forms of examination</td><td>Usual performance accounts for 40% of final score (attendance, participation in experiment process, experimental ability and experiment quality). Experimental report accounts for 60% of final score (understanding of experiment objectives / principles / equipment; results of experimental data; analysis of experimental data)</td></tr>
<tr><td>Media employed</td><td>Multimedia aided teaching</td></tr>
<tr><td>Reading list</td><td>1. Required books
[1] Song Ruigang et al. Guidebook on Braking Experiments of Urban Railway Vehicle. Shanghai: Lecture notes of Shanghai University of Engineering Science, 2018.
2. Other materials
[1] SHU Qiping. Braking Technology for Urban Railway Vehicles. Beijing: Intellectual Property Publishing House, 2011.
[2] LI Huabo, TAO Yan. Electric Traction Converter and Transmission Technology. Chengdu: Southwest Jiaotong University Press, 2015.
[3] XIONG Shibo et al. Fundamentals of Mechanical Engineering Testing Technology. Beijing: Machinery Industry Press, 2018.</td></tr>
</table>

Competence field	Practical Training
Module designation	Detection Technology Experiments of Urban Railway Vehicle
Code, if applicable	109130
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Laboratory Technician: SONG Ruigang
Lecturer	Laboratory Technician: SONG Ruigang Laboratory Technician: SHI Xuan
Language	Chinese
Relation to curriculum	This is an elective practice course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle) in the School of Urban Rail Transportation. The course contains four parts: computer experiment of virtual instrument programming software LabVIEW, vibration test experiment, temperature measurement and control experiment, and motor test and control experiment. The course builds foundations for students for engineering application, analysis, and practice in detection of urban railway vehicles.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical and practice teaching Contact hours: 30 hours Of which Theoretical teaching: 4 hours Experiment / practice teaching: 26 hours Size of class: up to 60 students
Workload	Workload = 60 hours Contact hours = 30 hours Self-study hours = 30 hours
Credit points	2.0
Requirements according to the examination regulations	Complete all required experiments and submit experimental reports.
Recommended prerequisites	Overview of Urban Rail Transit System, Structure of Urban Railway Vehicles, Measurement and Sensor Technology
Module objectives/intended learning outcomes	Module objectives: ● **Knowledge:** 1. Fundamentals of computer applications; 2. Signal analysis and processing based on virtual instrument platform; 3. Basic methods of signal detection, analysis and processing, and use of tools;

<table>
<tr><td></td><td>4. Basic components of detection technology, theories on detection and sensing technology.
● Skills:
1. Basic skills of using virtual instrument programming software LabVIEW;
2. Basic skills of using virtual instrument platform to conduct analysis and processing;
3. Basic methods and means of measurement based on virtual instrument technology.
● Competences: Develop students' practical operating ability; enable them to apply computers to solve engineering problems; strengthen their science style and ability to combine theory and practice.</td></tr>
<tr><td>Contents</td><td>1. Theoretical teaching:
<table>
<tr><td>No.</td><td>Theoretical teaching:</td><td>Contact hours</td><td>Self-study hours</td></tr>
<tr><td>1</td><td>Development of detection technology</td><td>1</td><td>1</td></tr>
<tr><td>2</td><td>Pressure data collection technology</td><td>1</td><td>1</td></tr>
<tr><td>3</td><td>Technology of close-loop temperature measurement and control</td><td>1</td><td>1</td></tr>
<tr><td>4</td><td>AC-motor testing and control technology</td><td>1</td><td>1</td></tr>
</table>
2. Experiment/practice teaching
The Detection Technology Experiments of Urban Railway Vehicle contains four parts: computer experiment of virtual instrument programming software LabVIEW (A), pressure test experiment (B), temperature measurement and control experiment (C), and motor testing and control experiment (D).
<table>
<tr><td>NO.</td><td>Experiment</td><td>Contact hours</td><td>Self-study hours</td></tr>
<tr><td>A1</td><td>Basic VI program creation</td><td>2</td><td>2</td></tr>
<tr><td>A2</td><td>Program debugging technology</td><td>2</td><td>2</td></tr>
<tr><td>A3</td><td>Program structure</td><td>4</td><td>4</td></tr>
<tr><td>A4</td><td>Graphic display</td><td>3</td><td>3</td></tr>
<tr><td>A5</td><td>File importing and storage</td><td>3</td><td>3</td></tr>
<tr><td>B1</td><td>Pressure testing loop building</td><td>2</td><td>2</td></tr>
<tr><td>B2</td><td>Pressure testing and analysis system</td><td>2</td><td>2</td></tr>
<tr><td>C1</td><td>Digital temperature testing</td><td>2</td><td>2</td></tr>
</table></td></tr>
</table>

		loop		
	C2	Close-loop temperature control system	2	2
	D1	AC-motor local control	2	2
	D2	AC-motor variable frequency control based on virtual instrument	2	2

Study and examination requirements and forms of examination	Usual performance accounts for 40% of final score (attendance, participation in experiment process, experimental ability and experiment quality). Experimental report accounts for 60% of final score (understanding of experiment objectives / principles / equipment; results of experimental data; analysis of experimental data)
Media employed	Multimedia aided teaching
Reading list	Reading list 1. Required books [1] SHI Xuan. *Guidebook on Detection Technology Experiments of Urban Railway Vehicle* Shanghai: Lecture notes of Shanghai University of Engineering Science, 2019. 2. Other materials [1] LI Chenghua, SHU Zhenxiao, ZHAO Chaohui, *Modern Testing Technology* (2nd Edition). Beijing: China Agricultural University Press 2012. [2] ZHANG Faqi. *Modern Testing Technology and Applications*. Xi'an Xidian University Press, 2005. [3] ZUO Fang, HU Renxi, YAN Congcong, et al. *Mastering LabVIEW 2013Chinese version* [M]. Beijing: Machinery Industry Press, 2014. [4] XIONG Shibo, et al. *Fundamentals of Mechanical Engineering Testing Technology*. Beijing: Machinery Industry Press, 2018.

Competence field	Practical Training
Module designation	Electrical Traction and Control Experiments of Urban Railway Vehicle
Code, if applicable	109131
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate professor: SHI Wei
Lecturer	Associate professor: SHI Wei Lecturer: YUAN Tianchen Lecturer: SHU Yanjun Lab instructor: SONG Ruigang Lab instructor: SHI Xuan
Language	Chinese
Relation to curriculum	This is an elective practice course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle) in the School of Urban Rail Transportation. It consists of three parts: comprehensive experiment of DC electric traction, comprehensive experiment of AC electric traction and control system, and experiment of urban rail transit electric traction main circuit and control circuit demonstration. The course builds foundations for students' engineering application, analysis, and practice in urban railway electrical traction and control.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical and practice teaching Contact hours: 30 hours Of which Theoretical teaching: 7 hours Experiment / practice teaching: 23 hours Size of class: 20 people
Workload	Total workload = 60 hours Contact hours = 30 hours Self-study hours = 30 hours
Credit points	2.0
Requirements according to the examination regulations	Complete all required experiments and submit experimental reports.
Recommended prerequisites	Electrical Traction and Control of Urban Railway Vehicle
Module objectives/intended	Module objectives: ● **Knowledge:**

<table>
<tr><td>learning outcomes</td><td>1. Experimental methods of DC traction system composition and speed regulation;
2. Experimental methods of AC traction system composition and speed regulation;
3. Principle and experimental methods of electric traction control circuit for urban rail vehicles.
● Skills:
1. Performance and application of AC/DC electric traction and control;
2. Professional experimental methods, skills and data processing methods;
3. Able to apply theoretical knowledge and experiment skills to analyze practical problems of urban rail vehicle electric traction.
● Competence: Cultivate students' practical ability, experimental skills and problem-solving ability in AC/DC traction speed regulation and control of urban rail vehicles.</td></tr>
<tr><td>Contents</td><td>1. Theoretical teaching:
<table>
<tr><th>No.</th><th>Theoretical teaching</th><th>Contact hours</th><th>Self-study hours</th></tr>
<tr><td>1</td><td>Experiment content, equipment and precautions</td><td>1</td><td>1</td></tr>
<tr><td>2</td><td>DC traction experiment principle and precautions</td><td>2</td><td>2</td></tr>
<tr><td>3</td><td>AC electric traction experiment principle and precautions</td><td>2</td><td>2</td></tr>
<tr><td>4</td><td>Experiment principle of main and control circuits of urban rail vehicle</td><td>2</td><td>2</td></tr>
</table>
2. Experiment teaching:
Comprehensive experiments on electric traction control of urban rail vehicles: DC electric traction experiment (A), AC electric traction experiment (B), and urban rail electric traction main and control circuits experiment (C).
<table>
<tr><th>No.</th><th>Experiment</th><th>Contact hours</th><th>Self-study hours</th></tr>
<tr><td>A1</td><td>DC traction control resistance and speed control experiment</td><td>3</td><td>3</td></tr>
<tr><td>A2</td><td>DC traction control voltage and speed control</td><td>3</td><td>3</td></tr>
</table></td></tr>
</table>

		experiment		
	B1	AC electric traction SPWM speed control experiment	2	2
	B2	AC electric traction SPWM speed control experiment	2	2
	C1	Urban rail vehicle activation experiment	2	2
	C2	Urban rail vehicle driver's cab occupancy experiment	1	1
	C3	Urban rail car lifting bow experiment	2	2
	C4	High-speed circuit breaker closing/opening test for urban rail vehicles	2	2
	C5	Parking brake application/mitigation experiment for urban rail vehicles	2	2
	C6	Experiment on manual traction for urban rail vehicles	2	2
	C7	Emergency braking experiments on urban rail vehicles	2	2
Study and examination requirements and forms of examination	Usual performance accounts for 40% of final score (attendance, participation in experiment process, experimental ability and experiment quality). Experimental report accounts for 60% of final score (understanding of experiment objectives / principles / equipment; results of experimental data; analysis of experimental data)			
Media employed	Multimedia aided teaching			
Reading list	1. Required books [1] SHI Wei. *Guidebook on Electric Traction and Control of Urban Rail Vehicle.* Shanghai: Lecture notes of Shanghai University of Engineering Science, 2019 2. Other materials [1] WANG Shulin, WANG Xi. *Electric Traction Control System.* Beijing: China Electric Power Press, 2005 [2] CHU Wenjie, QIU Zhongcai. *Comprehensive Experiment Course on Power Electronics and Power Transmission.* Chengdu: Southwest Jiaotong University Press, 2009 [3] LI Huabai, TAO Yan. *Electric Traction Converter and Transmission Technology.* Chengdu: Southwest Jiaotong University Press, 2015			

	[4] DONG Fenying. *Experiment Guidebook on the Basics of Electric Motors and Traction and Power Electronics Converter Technology*. Shanxi: Shanxi Science and Technology Press, 2001

Competence field	Practical Training
Module designation	Driving Simulation Experiments of Urban Railway Vehicle
Code, if applicable	109137
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Lab instructor: SONG Ruigang
Lecturer	Lab instructor: SONG Ruigang Lab instructor: SHI Xuan
Language	Chinese
Relation to curriculum	This is an elective practice course designed for students majoring in urban rail vehicle in the School of Urban Rail Transportation. The course is composed of six parts: simulated driving and its basic principles, experiments on train preparation and operation, setting up trains into operation and checking, driving in different modes, fault analysis and handling of train preparation and fault analysis and handling of train operation. The course provides the foundation for students to diagnose and analyze faults and provide solutions in the operation and maintenance of urban rail vehicles.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: experiment teaching Contact hours: 30 hours
Workload	Total workload = 60 hours Contact hours = 30 hours Self-study hours = 30 hours
Credit points	2.0
Requirements according to the examination regulations	Complete all required experiments and submit experimental reports.
Recommended prerequisites	Overview of Urban Rail Transit System, Structure of Urban Railway Vehicle
Module objectives/intended learning outcomes	Module objectives: ● **Knowledge:** (1) Response measures to emergency and sudden train failures; (2) Fault and mechanisms of urban rail vehicles; (3) Train wake-up, driving mechanisms and failure mechanisms; (4) Simulation of diagnosing and troubleshooting problems in a driving test. ● **Skills:** (1) Knowledge of common condition testing techniques, methods related to vehicle systems, modern diagnostic

<table>
<tr><td></td><td>techniques and the use of various types of testing equipment;
(2) Ability to observe and analyze driving problems and to gather and analyze relevant technical information;
(3) Able to solve faults and problems in the operation of urban vehicles.
● Competence: Teamwork spirit; ability to respond to crises and emergencies and take appropriate measures; able to solve engineering problems using scientific methods and perspectives; able to analyze and synthesize theories.</td></tr>
<tr><td>Contents</td><td>Experiment teaching:
Simulated driving experiments on urban rail vehicles include simulated driving and basic principles (A), train preparation experiments(B), setting up trains into operation and checking (C), driving in different modes (D), failure analysis and solution in train preparation (E), and operation failure analysis and solution (F).
<table>
<tr><th>No.</th><th>Experiment</th><th>Contact hours</th><th>Self-study hours</th></tr>
<tr><td>A1</td><td>Names and functions of each panel instrument, button and switch on the control panel</td><td>2</td><td>2</td></tr>
<tr><td>A2</td><td>Operation simulation of the entire driving system</td><td>2</td><td>2</td></tr>
<tr><td>B1</td><td>Vehicle wake-up and sleep circuit overview</td><td>2</td><td>2</td></tr>
<tr><td>B2</td><td>Train wake-up and sleep operation experiments</td><td>2</td><td>2</td></tr>
<tr><td>C1</td><td>Prepare the train for operation</td><td>2</td><td>2</td></tr>
<tr><td>C2</td><td>Inspection the train for operation</td><td>2</td><td>2</td></tr>
<tr><td>D1</td><td>Manual driving test</td><td>3</td><td>3</td></tr>
<tr><td>D2</td><td>Automated ATO driving and other experiments with different modes of driving</td><td>3</td><td>3</td></tr>
<tr><td>E1</td><td>Failure diagnosis in train preparation</td><td>3</td><td>3</td></tr>
<tr><td>E2</td><td>Troubleshooting in train preparation</td><td>3</td><td>3</td></tr>
<tr><td>F1</td><td>Failure diagnosis in train operation</td><td>3</td><td>3</td></tr>
<tr><td>F2</td><td>Troubleshooting in train operation</td><td>3</td><td>3</td></tr>
</table></td></tr>
<tr><td>Study and examination</td><td>Usual performance accounts for 40% of final score (attendance,</td></tr>
</table>

requirements and forms of examination	participation in experiment process, experimental ability and experiment quality). Experimental report accounts for 60% of final score (understanding of experiment objectives / principles / equipment; results of experimental data; analysis of experimental data)
Media employed	Multimedia aided teaching
Reading list	1. Required books [1] Song Ruigang, SHI Xuan. *Guidebook for Driving Simulation Experiments of Urban Railway Vehicle.* Shanghai: Shanghai University of Engineering Science, 2018. 2. Other materials [1] Shanghai Shentong Metro Group Co., Ltd. *Urban Rail Transit Electric Vehicle Driving.* Beijing: China Railway Publishing House, 2010. [2]YAN Junmao. *Vehicle Engineering.* Beijing: China Railway Publishing House, 2007. [3] Edited by ZHANG Zhenmiao. *Urban Rail Transit Vehicles.* Beijing China Railway Publishing House, 2007.

Competence field	Practical Training
Module designation	Door System Experiments of Urban Railway Vehicle
Code, if applicable	109170
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Lab instructor: SONG Ruigang
Lecturer	Lab instructor: SONG Ruigang Lab instructor: SHI Xuan
Language	Chinese
Relation to curriculum	This course is an elective practical course for students majoring in Vehicle Engineering (Rail Transit Vehicle) in the School of Urban Rail Transportation. It consists of four parts: disassembly and installation, system commissioning, fault diagnosis and overhaul. The course builds foundations for students' engineering application, analysis, and practice in door systems of urban rail vehicle.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical and practice teaching Contact hours: 30 hours Of which Theoretical teaching: 4 hours Experiment/practice teaching: 26 hours Size of class: up to 20 students
Workload	Total workload = 60 hours Contact hours = 30 hours Self-study hours = 30 hours
Credit points	2.0
Requirements according to the examination regulations	Complete all required experiments and submit experimental reports.
Recommended prerequisites	Overview of Urban Rail Transit System; Structure of Urban Railway Vehicle
Module objectives/intended learning outcomes	Module objectives: ● **Knowledge:** **1.** Principles of the mechanical structure and electrical components of electric door systems; **2.** Door maintenance procedures and specifications; **3.** Theory of vehicle structure and principles. ● **Skills:** **1.** Ability and means to perform general vehicle door maintenance;

2. Ability to use common tools and simple instrumentation;

3. Ability to handle simple malfunctions of doors.

- **Competence:** Practical skills, professional experiment skills and knowledge application. Develop students' science experiment skills to meet the requirements of market economy for engineers.

Contents

1. Theoretical teaching

No.	Theoretical teaching	Contact hours	Self-study hours
1	Principle of electric door system	1	1
2	Door signal transmission principle	1	1
3	Door security and control technology	1	1
4	Door fault diagnosis technology	1	1

2. Experiment/practice teaching

Door system experiments of urban railway vehicle includes disassembly (A), installation (B), system commissioning (C), and troubleshooting (D).

NO.	Experiment	Contact hours	Self-study hours
A1	Door hinge drive system analysis and disassembly	1	1
A2	Emergency unlock system analysis and disassembly	2	2
A3	Isolating switch module analysis and disassembly	2	2
B1	Isolating switch module installation and commissioning	1	1
B2	Emergency unlocking device installation and commissioning	2	2
B3	Door hinge drive system installation and commissioning	2	2
C1	Assembly and testing of door control system	1	1
C2	Internal/external door lock test	2	2
C3	Anti-pinch safety testing	2	2
C4	Door resection system testing	2	2
D1	Diagnostic and maintenance	1	1

<table>
<tr><td></td><td>
<table>
<tr><td></td><td>software parameter settings</td><td></td><td></td></tr>
<tr><td>D2</td><td>Door function failure diagnosis</td><td>2</td><td>2</td></tr>
<tr><td>D3</td><td>EDCU troubleshooting</td><td>2</td><td>2</td></tr>
<tr><td>D4</td><td>Monitoring troubleshooting</td><td>4</td><td>4</td></tr>
</table>
</td></tr>
<tr><td>Study and examination requirements and forms of examination</td><td>Usual performance accounts for 40% of final score (attendance, participation in experiment process, experimental ability and experiment quality). Experimental report accounts for 60% of final score (understanding of experiment objectives / principles / equipment; results of experimental data; analysis of experimental data)</td></tr>
<tr><td>Media employed</td><td>Multimedia aided teaching</td></tr>
<tr><td>Reading list</td><td>1. Required books
[1] SONG Ruigang et al. Guidebook for Comprehensive Experiments on the Door Systems of Urban Rail Vehicle. Shanghai: Lecture notes of Shanghai University of Engineering Science, 2018.
2. Reference books
[1] XIONG Shibo et al. Fundamentals of Mechanical Engineering Testing Technology. Beijing: Machinery Industry Press, 2018.
[2] XIE Liyang, SUN Hongchun, LIN Guiyu. Mechanical Engineering Testing Technology. Beijing: Machinery Industry Press, 2012.
[3] PING Peng. Mechanical Engineering Measurement and Data Processing Technology. Beijing: Metallurgical Industry Press, 2008.
[4] KNT-CGM01Training Device for Urban Rail Transit Vehicle Door System Instruction Manual V1.0. Nanjing: Nanjing Kangni Technology Industry Co., Ltd., 2014.</td></tr>
</table>

Appendix B - Syllabus - Practical Training

Competence field	Practical Training
Module designation	Practicum for Construction of Urban Railway Vehicle
Code, if applicable	109159
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Associate Professor LIAO Aihua
Lecturer	Associate Professor LIAO Aihua Associate Professor HU Dingyu Lecturer MENG Xiaoliang Lecturer WU Aizhong Lecturer WENG Lin
Language	Chinese
Relation to curriculum	This is a core course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle). This course applies the knowledge of urban rail vehicle structure to the drawing, modeling and calculation of components or the entire rail transit vehicle. Students may select any of the following topics for course design: Design and calculation of rail vehicle bogie, rail vehicle lightweight design and calculation, design of low-noise urban rail vehicle, tribological design of disk brakes for urban rail vehicle, design of pantograph structure of rail vehicle, and design of urban rail vehicle pedal unit brakes. Through this course, students will be able to comprehensively apply theoretical knowledge and practical skills in practice, master design methods and steps of urban rail vehicle structures, improve vehicle design ability, familiarize with the design process, learn to accurately use data, conduct design calculations, analyze design results, make drawings, and develop innovative ideas for engineering design.
Type of teaching, contact hours	Target students: seniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical teaching and practical instruction Contact hours: 120 hours Of which Theoretical teaching: 20 hours Experiment/practice teaching: 100 hours Size of class: up to 32 students for theoretical teaching Practice teaching: each lecturer teaches 3-5 teams, each group 5-7 students.
Workload	Total workload = 360 hours Contact hours = 120 hours Self-study hours = 240 hours

Credit points	12.0
Requirements according to the examination regulations	During the project, students shall participate all the team meeting, complete all tasks carefully, listen attentively to instructions of teachers.
Recommended prerequisites	Fundamentals of Drawing; Engineering Mechanics (1); Engineering Mechanics (2); Foundation of Manufacturing Technology; Mechanical Principle; Mechanical Design; Interchangeability and Technical Measurement; Structure of Urban Railway Vehicle; Electrical Equipment of Urban Rail Transit Vehicles; Finite Element Analysis
Module objectives/intended learning outcomes	Module objectives: This is a core course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle) of the School of Urban Rail Transportation. The task of this course is to enable students to learn the basic knowledge of engineering, to acquire engineering practice, to cultivate the ability of applying the knowledge of mathematics, natural science and mechanical engineering sciences, and to develop the ability to analyze problems, make simulation calculations and interpret data. ● **Knowledge:** 1. Demonstrate understanding of the design standards and specifications related to key vehicle mechanical components; selection principles of common vehicle mechanical components; basic process requirements for the design and manufacture of vehicle mechanical components; 2. Demonstrate understanding of 3D modeling of urban rail vehicle structures and finite element analysis; 3. Demonstrate understanding of basic methods of calculation, analysis of vehicle structure parameters and mechanics, and safety standards for key vehicle mechanical components. ● **Skills:** 1. Demonstrate ability to consult library materials, product manuals and tools as required for design; 2. Demonstrate ability to design and model the mechanical structure of rail vehicles using relevant mechanical design standards and specifications; 3. Demonstrate ability to use structural analysis software to calculate, analyze, and optimize components or the entirety of a rail vehicle. ● **Competence:** Students will develop the ability to search for information and use modern information technology to obtain relevant information; to form basic ideas and methods of vehicle structure design; to apply mechanical related standards and specifications to engineering problems, vehicle structure

	design, modeling, calculation and analysis and optimization; to consider various constraints such as engineering reality with a sense for innovation; to improve organizational and management skills, communication and expression skills and to play a role in a team.
Contents	**Professional Comprehensive Course Design** (120 contact hours; 240 self-study hours) **Part A Theoretical teaching** (20 theoretical teaching hours; 20 self-study hours) ● General principles and requirements of design ● Schematic design, final assembly analysis and structural analysis ● Simulation analysis methods ● Decomposition of objectives and tasks for different design projects **Part B Practice teaching** (100 contact hours; 220 self-study hours) **Content of the course design 1: Design calculation for rail vehicle bogies** ● Determination of the structure and parameters of bogie components and finalization of the overall technical solution for the bogie based on load characteristics of municipal rail vehicle*; ● Preparation of bogie parts drawings and 3D design models**; ● Perform structural strength calibration calculations for critical bogie components**. **Content of the course design 2: Rail vehicle lightweight design and calculation** ● Research and analysis of different types of vehicle structures, internal equipment and facilities; ● Rational lightweight design of rail vehicle; ● Structural scheme of the vehicle body, and vehicle body deformation analysis through simulation under the effect of static load**. ● Design the internal equipment and facilities of the vehicle by lightweight design methods and means, to reduce weight through material substitution, reduction of material use and other methods as well as optimizing the original structural form*. **Content of the course design 3: Low-noise design for urban rail vehicle** ● Analyze the impact of urban rail vehicle body on the noise

	level inside the vehicle, determine the main concept of noise reduction design with investigation and analysis, and formulate specific solutions*. ● Establish a three-dimensional design model for new low-noise vehicle body**; ● Analyze and compare the noise levels prior to improvement*. **Content of the course design 4: Tribological design of disk brakes for urban rail vehicle** ● Selection of friction component for disc brakes*; ● Design of brake disc structure and surface*; ● Design of brake lining structure and surface layer**; ● Analysis of thermal stress coupling during friction braking of brake discs and brake pads**; ● Design to improve wear resistance of disc brakes **Content of the course design 5: Pantograph structural design for rail vehicle** ● Investigation and analysis of the structure, working principle and design method of the pantograph; ● Analysis of the deformation of pantograph components under static load by means of simulation software**; ● Three-dimensional modeling of each component of the pantograph, assembly of each component, and understanding of the working principle of the pantograph lifting bow through kinetic simulation**. **Content of the course design 6: Electrical cabinet design and analysis for rail vehicle** ● Three-dimensional modeling of an existing vehicle power distribution cabinet and relays*; ● Use finite element analysis software to conduct static mechanical analysis and modal analysis on the power distribution cabinet structure to study its deformation under different conditions and stress distribution**; ● Based on the results of static and modal analyses and considering relevant standards, optimize the design of power distribution cabinets*. **Content of the course design 7: Design of pedal unit brakes on urban rail vehicle** ● Design of unit brake solutions for rail vehicle* ● Parameter design of unit brakes for rail vehicle**.

	● Calibration and analysis of critical force components of unit brakes, and functional calibration*; ● Based on the calculation and verification results, complete 3D modeling and draw the 2D machining drawings*.
Study and examination requirements and forms of examination	At the end of project, every student need to hand in design instruction, which introduce the team work and individual work. And every team gives a final presentation. Evaluation is based on students' performance and the whole team's design work, quality of students' presentation and defense. Usual performance and individual design instruction account for 40% of final score. Team report and presentation account for 60% of final score.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	[1] YAN Junmao. *Vehicle Engineering.* Beijing: China Railway Publishing House, 2007. [2] WANG Boming. *Urban Rail Transit Vehicle Engineering.* Chengdu: Southwest Jiaotong University Press, 2007. [3] WANG Xueming. *Locomotive Bogie Technology.* Chengdu: Southwest Jiaotong University Press, 2009. [4] Edited by ZHANG Zhenmiao. *Urban Rail Transit Vehicles.* Beijing: China Railway Publishing House, 2007.

Competence field	Practical Training

Module designation	Practicum for Measurement and Sensor Technology
Code, if applicable	109167
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Professor ZHENG Shubin
Lecturer	Professor ZHENG Shubin Associate Professor YAO Huiming Lecturer PENG Lele Lecturer ZHONG Qianwen
Language	Chinese
Relation to curriculum	This course is a compulsory course and one of the core courses for Vehicle Engineering (Rail Transit Vehicle) of the School of Urban Rail Transportation. The task of this course is to enable students to learn the basic knowledge of engineering, to apply the knowledge in engineering practice, to cultivate the ability of applying the knowledge of mathematics, natural science and mechanical engineering sciences, the ability to formulate experiment schemes, conduct experiments, and to analyze and interpret data, as well as calculation and testing skills and computer operation abilities. Students will acquire the basic methods of literature retrieval, data search and the use of information technology to obtain information; have the ability to use various techniques, skills and modern engineering tools in vehicle engineering practice; be able to comprehensively consider the constraints of economic, environmental, legal, safety, health, ethical and other factors; have a sense of innovation; understand vehicle engineering related occupations and industries in the production, design, research and development; have the ability to learn and adapt to the development of a variety of skills, including organizational management, communication and expression, and the ability to play a role in a team.
Type of teaching, contact hours	Target students: students of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical and practice teaching Contact hours: 120 hours Of which Theoretical teaching: 20 hours

	Experiment/practice teaching: 100 hours Size of class: up to 32 students for theoretical teaching Practice teaching: each instructor teaches 3-5 teams, each group 5-7 students.
Workload	Total workload = 360 hours Contact hours = 120 hours Self-study hours = 240 hours
Credit points	12.0
Requirements according to the examination regulations	During the project, students shall participate all the team meeting, complete all tasks carefully, listen attentively to The following is a summary of the information contained in this document
The following is a summary of the main findings and recommendations of the Joint Committee.	Measurement and Sensor Technology; Electrical Equipment of Urban Rail Transit Vehicles; Structure of Urban Railway Vehicle; C Language Programming; Microcomputer Principle and Interface Technology
Module objectives/intended learning outcomes	Module objectives: This course is a compulsory course and one of the core courses for Vehicle Engineering (Rail Transit Vehicle) of the School of Urban Rail Transportation. The task of this course is to enable students to learn the basic knowledge of engineering, to apply the knowledge in practice, and to cultivate the ability of applying the knowledge of mathematics, natural science and mechanical engineering sciences, the ability to formulate experiment schemes, conduct experiments, and to analyze and interpret data, as well as calculation and testing skills and computer operation abilities. ● **Knowledge:** 4. Basic knowledge of vehicle engineering, such as measurement and sensor technology, vehicle structure and principles, braking technology, electric traction and control, network control technology, electrical equipment, maintenance and fault diagnosis and their application in solving practical engineering problems; 5. Basic methods of literature retrieval, data searching and the use of modern information technology to obtain relevant information; 6. The basic steps and methods of engineering design, including developing experimental protocols, conducting experiments, analyzing and interpreting data, calculations, testing, etc.; ● **Skills:** 1. Ability to synthesize and apply analytical knowledge of mathematics, natural and mechanical engineering and

	professional science. 2. Ability to propose, design and implement solutions to measurement problems; 3. Ability to acquire and use a variety of inspection techniques, skills and modern engineering tools in vehicle engineering practice. ● **Competence:** Ability to consider economic, environmental, legal, safety, health, ethical and other constraints, with a certain sense of innovation; understand the guidelines for production, design, research and development in vehicle engineering related occupations and industries; ability to organize, manage, communicate and express, and play a role in a team; ability to continuously learn and adapt to development.
Contents	**Course Design for Measurement and Sensor Technology** (120 contact hours; 240 self-study hours) **Part A Theoretical teaching** (20 theoretical teaching hours; 20 self-study hours) ● Program design method: ● Hardware selection and design method; ● Software design method; ● Simulation or experimental analysis methods. **Part B Practice teaching** (100 contact hours; 220 self-study hours) **Content of the course design 1: design of speed sensors for urban rail vehicles** ● Calculation of the main parameters of the detection system, taking into account the characteristics of the bogy; ● Hardware selection and design**; ● Software design; ● Simulation or experimental analysis; ● Detection of speed parameters and communication of the bus**. **Content of the course design 2: wireless transmission based bogy vibration detection system design** ● Analysis of the characteristics of bogy vibration and calculation of main parameters of the detection system with reference to the data; ● Hardware selection and design**. ● Software design based on a hardware platform; ● Software design based on the PC platform; ● Simulation or experimental analysis; ● Collection, processing and transmission of bogy vibration parameters*.

	Content of the course design 3: design of vehicle smoothness detection system ● Analysis of the characteristics of vehicle carriage vibrations and calculation of the main parameters of the detection system; ● Hardware selection and design, and design of a reasonable parameter detection method based on the smoothness evaluation index**. ● The design of a data collection software module based on a PC platform**; ● PC-based signal conversion weighted filter software design; ● Perform simulation or experimental analysis to calculate smoothness evaluation metrics. **Content of the course design 4: design of vibration testing device for urban rail vehicles** ● Analysis of the characteristics of vehicle carriage vibrations and calculation of the main parameters of the detection system with reference to available data; ● Hardware selection and design of detection devices for the vibration characteristics of vehicle compartments, and design of reasonable parameter detection methods based on evaluation indicators*; ● Software design based on a hardware platform; ● Design of software based on PC platform, design and development of data collection and comfort analysis software; ● Simulation or experimental analysis of comfort evaluation indicators; ● Collection, processing and transmission of vehicle carriage vibration parameters*. **Content of the course design 5: simulation design of resistive braking energy consumption test device and operating resistance in urban rail vehicle.** ● Analysis of the characteristics of the vehicle braking system and calculation of the main parameters of the braking current detection system with reference to available data; ● Hardware selection and design of detection devices for vehicle braking current characteristics, and design of reasonable parameter detection methods according to requirements**; ● Design and development of software for data collection and energy consumption analysis based on PC platform **; ● Simulation or experimental analysis of energy consumption indicators;

	● Collection, processing and transmission of braking current parameters of vehicles*; ● Calculation and simulation analysis of resistance in Shanghai metro operation. **Content of the course design 6: air brake line pneumatic test system design** ● Design the distribution of air pressure parameter collection points according to the structural characteristics of the brake circuit*; ● Hardware selection and signal conditioning module design; ● LabVIEW software design **; ● Experimental parameter acquisition and analysis *. **Content of the course design 7: pantograph dynamic performance test system design** ● Design of the structure of the detection system and calculation of the main parameters**; ● Sensor selection and signal conditioning circuit design for detection systems; ● LabVIEW software design based on a hardware platform**; ● Experimental data collection and analysis**; ● Pantograph dynamic performance evaluation. **Content of the course design 8: vehicle carriage thermometer** ● Calculation of the main parameters of the detection system according to the characteristics of the vehicle carriages; ● Hardware selection and design**; ● Software design; ● Simulation or experimental analysis**; ● Detection of temperature parameters.
Study and examination requirements and forms of examination	At the end of project, every student needs to hand in design instruction, which introduce the team work and individual work. And every team gives a final presentation. Evaluation is based on students' performance and the whole team's design work, quality of students' presentation and defense. Usual performance and individual design instruction account for 40% of final score. Team report and presentation account for 60% of final score.
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	[1] ZHANG Youyun. *Modern Mechanical Measurement Technology*, Beijing: Science Press, 2005. [2] CHEN Hualing. *Mechanical Engineering Measurement*

	Technology, Beijing. Machinery Industry Press, 2006. [3] SHEN Yan, GUO Bing, YANG Ping. *Measurement and Sensing Technology*, Beijing: Tsinghua University Press, 2011. [4] XIONG Shibo, HUANG Changyi. *Fundamentals of Mechanical Engineering Testing Technology*, Beijing: Machinery Industry Press, 2007

Competence field	Practical Training

Appendix B - Syllabus - Practical Training

Module designation	Practicum for Electrical Equipment of Urban Railway Vehicle
Code, if applicable	109161
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Associate Professor YU Chaogang
Lecturer	Associate professor YU Chaogang Associate Professor SHU Yanjun
Language	Chinese
Relation to curriculum	This is a core course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle). This course allows for students to select their interested topic, and to design circuit diagram, use laboratory bench for hardware and software development, and finally completes installation and commissioning. The purpose of this course is to enable students to master the design of electrical control systems, installation of electrical components and control lines, design data collation and the use of electrical drawing software. This course aims to help students understand the general concept of urban rail vehicle electrical equipment, and lay a solid foundation for competence improvement and work adaptability through basic training of engineering practice.
Type of teaching, contact hours	Target students: seniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: Theoretical teaching and practice Contact hours: 120 hours Of which Theoretical teaching: 20 hours Practice teaching: 100 hours Size of class: up to 32 students for theoretical teaching; for practice teaching, each lecturer teaches 3-5 teams, each group 5-7 students.
Workload	Total workload = 360 hours Contact hours = 120 hours Self-study hours = 240 hours
Credit points	4.0
Requirements according to the examination regulations	During the project, students shall participate all the team meeting, complete all tasks carefully, listen attentively to instructions of teachers.
Recommended prerequisites	Electrical Technology, Electronic Technology, Electrical Traction and Control of Urban Railway Vehicle, Braking Technique of Urban Railway Vehicle, Network Control Technology of Urban Railway Train, Electrical Equipment of Urban Railway Vehicle, Fundamentals of Drawing,
Module objectives/intended learning outcomes	Module objectives: The task of this course is to enable students to learn the basic knowledge of electrical equipment of rail vehicle, to apply the

	knowledge in engineering practice, to cultivate the ability of applying the knowledge of mathematics, natural science and mechanical engineering sciences, the ability to formulate experiment schemes, conduct experiments, and to analyze and interpret data, as well as calculation and testing skills and computer operation abilities. ● **Knowledge:** 7. Demonstrate understanding of the design methods for electrical control systems; 8. Demonstrate understanding of basic use of common electrical design software; 9. Demonstrate understanding of installation and commissioning methods of electrical components and electrical control wiring. ● **Skills:** 4. Demonstrate the ability to apply programmable logic controllers for logic control and PID control; 5. Demonstrate the ability to design and draw circuits of local electrical units in rail vehicle; 6. Demonstrate the ability to install and commission electrical control equipment. ● **Competence:** Students will develop the ability to search for information and use modern information technology to obtain relevant information; to form basic ideas and methods of vehicle electrical design; to apply electrical knowledge to engineering problems and conduct electrical control system design, software/hardware development and commissioning; to consider various constraints such as engineering reality with a sense for innovation; to improve organizational and management skills, communication and expression skills and to play a role in a team.
Content	**Professional Comprehensive Course Design** (120 contact hours; 240 self-study hours) **Part A Theoretical teaching** (20 theoretical teaching hours; 20 self-study hours) ● General principles and requirements of electrical design ● Schematic design, electrical design software ● Installation and commissioning methods for electrical components and electrical control circuits ● Decomposition of objectives and tasks for different design projects **Part B Practice teaching** (100 contact hours; 220 self-study hours) Course Design I. Main-circuit over-voltage detection and fault warning circuit design for urban rail transit vehicle ● Analysis, determination, and selection of voltage detection sensors

	and design of voltage sampling circuits; ● Determination of voltage faults and design protective reaction or alarm in the event of any voltage faults; ● Feasibility analysis of microcontrollers or PLCs to determine chip selection; ● Design of circuit diagrams for microcontroller or PLC-based voltage detection; ● Design of fault warning circuits with microcontroller or PLC based fault warning circuit diagrams; ● Software programs for voltage detection; ● Software programs for fault warning; Course Design II: Temperature detection and fan control in traction or auxiliary circuits and fault alarm design ● Analyze and determine the selection of temperature detection sensors and design temperature sampling circuits; ● Determine the types of over-temperature faults and design protective reactions or alarm for over-temperature faults; ● Feasibility analysis of microcontrollers or PLCs to determine chip selection; ● Design of circuit diagrams for microcontroller or PLC-based temperature detection; ● Design of fault warning circuits with microcontroller or PLC based fault warning and protective reaction circuit diagrams; ● Software programs for temperature detection; ● Software programs for over-temperature fault warning or fan control. Course Design III: Main-circuit current detection and fault warning circuit design for urban rail transit vehicle ● Analysis of the basis for selection of current sensors, determination of the selection of current sensors and design of current sensing circuits; ● Determine the types of over-current faults and design protective reactions or alarm for over-current faults; ● Feasibility analysis of microcontrollers or PLCs to determine chip selection; ● Design of circuit diagrams for microcontroller or PLC-based current detection; ● Design of fault warning circuits with microcontroller or PLC based fault warning circuit diagrams; ● Software programs for current detection; ● Software programs for fault warning; Course Design IV: Traction/brake control circuit design for urban rail vehicle ● Basic design function planning based on the main vehicle circuit and control electric circuit. ● Design of traction direction control circuits based on the control logic; ● Design of traction/brake control circuits based on control logic; ● Design of vehicle coupled traction and slow traction control circuits based on control logic; ● Reproduce the traction direction control circuit from the circuit diagram; ● Reproduce the traction/brake control circuit from the circuit

	diagram; ● Reproduce the vehicle coupled traction and slow moving traction control circuits according to the circuit diagram; Course Design V: Pantograph and high-speed circuit breaker control circuit design for urban rail vehicle ● Basic design function planning based on the main vehicle circuit and control electric circuit. ● Design of train start control circuits based on control logic; ● Design of pantograph control circuits based on control logic; ● Design of high speed circuit breaker on-off control circuits based on control logic; ● Relay replication control logic design ● Reproduce the train start control circuit from the circuit diagram; ● Reproduce the pantograph control circuit from the circuit diagram; ● Reproduce the vehicle high-speed circuit breaker on-off control circuit from the circuit diagram. Course Design VI: Urban rail vehicle door control circuit design ● Basic design function planning based on the main vehicle circuit and control electric circuit. ● Design of one-sided door opening control circuits based on control logic ● Design of door closing control circuits based on control logic; ● Design of single door opening control circuits based on control logic; ● Reproduce the one-sided door opening control circuit from the circuit diagram; ● Reproduce the safety control circuit for door closing according to the circuit diagram; ● Reproduce the single door opening control circuit from the circuit diagram.
Study and examination requirements and forms of examination	At the end of project, every student need to hand in design instruction, which introduce the team work and individual work. And every team gives a final presentation. Evaluation is based on students' performance and the whole team's design work, quality of students' presentation and defense. Usual performance and individual design instruction account for 40% of final score. Team report and presentation account for 60% of final score
Media employed	Multimedia computers, projectors, laser pointers, blackboards, chalks
Reading list	1. Required books [1] YU Chaogang et al. *Course Design Guidelines for Electrical Equipment for Urban Rail Transit.* Lecture notes of Shanghai University of Engineering Science, 2019. 2. Reference books [1] YU Chaogang. *Elecworks 2013 Electrical Drawing*. Beijing: Tsinghua University Press, 2014 [2] Siemens (China) Co., Ltd. *Siemens S7-200 SMART PLC (2nd*

	Edition). Beijing: Beihang University Press, 2018. [3] LI Jiangquan. *35 Typical Cases for MCGS: from Introduction to Monitoring Application.* Beijing: Publishing House of Electronics Industry, 2018 [4] LI Ruirong, TONG Qiaoxin. *Analysis and Treatment of Electrical Faults in Urban Rail Transit Vehicles.* Beijing: China Railway Publishing House, 2013. [5] WANG Jingman. *Power Supply System Technology for Urban Rail Transit.* Shanghai: Shanghai Popular Science Press, 2011. [6] WANG Yanrong. *Electrical Overhaul of Urban Rail Transit Vehicles.* Shanghai: Shanghai Science and Technology Press, 2010.

Competence field	Practical Training

Appendix B - Syllabus - Practical Training

Module designation	Cognition Practice of Rail Transportation
Code, if applicable	109125
Subtitle, if applicable	
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Associate Professor WEN Yongpeng
Lecturer	Associate Professor WEN Yongpeng Lecturer HE Yu Lecturer SHU Yanjun
Language	Chinese
Relation to curriculum	The teaching process of all programs in urban rail transportation shall incorporate practical training in engineering applications. In the teaching and training program, basic practice an important component, which is conducted before professional courses in vehicle, signaling, operation, traffic engineering, urban rail transit power supply technology, etc. The practice helps enhance the awareness of junior students of the core courses and professional orientation. Urban rail transit vehicle, signaling, operation and traffic engineering is an important part of urban rail transit. Through this practice, students will have a preliminary understanding of the basic structure and principles of urban rail transit vehicle, signaling, operation and traffic engineering in Shanghai from a macro point of view. Students will also acquire a good foundation for understanding the theoretical knowledge of vehicle signaling, operation and traffic engineering. The practice will improve application skills of students and their overall development.
Type of teaching, contact hours	Target students: freshmen of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: Practice teaching Contact hours: 60 hours
Workload	Total workload = 90 hours Contact hours = 60 hours Self-study hours = 30 hours
Credit points	3.0
Requirements according to the examination regulations	Complete all required experiments and submit experimental reports.
Recommended prerequisites	Unary Calculus (1); Unary Calculus (2); Mechanics;

	Overview of Urban Rail Transit System
Module objectives/intended learning outcomes	**Learning outcomes:** This practice is designed for all programs of the School. The goal is to provide students with a good understanding of the technology and equipment of urban rail transit vehicles, communication signals, operation and management, and traffic engineering, as well as an understanding of the most basic knowledge and methods of urban rail transit operations. Specific objectives include: ● **Knowledge:** 1. Components of an urban rail transit system: 2. The relationship of each subsystem of communication signal, operation, line, vehicle and power supply in urban rail transit system. 3. Operating models of urban rail vehicle companies as well as corporate culture, strategies, goals and implementation plans. ● **Skills:** 1. Ability to identify and describe critical infrastructure such as vehicles, public works, communication signals, communication transmission, and operation electromechanical equipment. 2. Ability to conduct basic research, analysis and conclusions on rail transit systems. ● **Competence:** Through this practice, students will develop a systematic way of thinking, understand and analyze the composition of urban rail transportation systems and their relationships, and improve their engineering awareness, quality, practical skills, innovation, professional skills, professional ethics, teamwork spirit and communication skills.
Contents	**Practice teaching** (60 contact hours; 30 self-study hours) **Practice I: Safety education** (2 contact hours; 1 self-study hour) ● Internship mobilization; ● Allocation of tasks;** ● Safety education.** **Practice II: Vehicle** (12 contact hours; 6 self-study hours) ● Train electric traction process and features; ● Vehicle type and grouping mode; ● Main body parts, functions and principles;

	● Classification, function and basic principle of braking system; ● Functional characteristics and basic principle of current receiving device; ● Main composition, function and arrangement of vehicle internal equipment; ● Main composition, function and characteristics of bogy; ● Main composition, function and characteristics of wheel pair; ● Main composition, function and characteristics of elastic suspension device. **Practice III: Power supply** (11 contact hours; 5.5 self-study hours) ● Composition of the urban rail transit power supply system; ● Characteristics of urban rail power system; ● Methods of use of power supply and transformation equipment related to urban rail transit; ● Principles of power supply and distribution for urban rail transit, key parameter indicators. **Practice IV: Signaling system** (11 contact hours; 5.5 self-study hours) ● Fundamentals of urban rail signaling systems in Shanghai; ● Urban rail transit signal system hardware equipment, including track circuits, turnouts, ZD6 rerouting device, signal machines, relays, beacons, and power panels. ** **Practice V: Operations** (12 contact hours; 6 self-study hours) ● Composition of passenger equipment at rail transit stations;** ● Composition of rail traffic equipment;** ● Composition of the automatic ticketing system; ● Layout of the ticketing system at stations; ● Duties and responsibilities of various operational jobs at stations;** ● Responsibilities and job descriptions of the various operational jobs in the dispatch center; ● Equipment and content included in the vehicle control room; ● Station electromechanical equipment systems; ● Fire alarm system operating principles and equipment;

	● Working principles and equipment of the environmental control system; ● Elevator and escalator operating principles and equipment; ● Screen door equipment and operating principles. **Practice VI: Public works** (12 contact hours; 6 self-study hours) ● The form of the railway plane; ● The requirement for a straight line segment of the railway line; ● Steel rails and connecting parts; ● Connection of steel rails; ● Damage to the steel rails; ● The form, material of the sleeper; ● The form of fasteners; ● Roadbeds; ● Turnouts; ● Stop blocks.
Study and examination requirements and forms of examination	Student attendance and performance during the practice periods, records, etc. (60%). Quality of practice reports (40%); If one of the requirements is not met, the overall grade for the practice will be deemed as unsatisfactory.
Media employed	Multimedia aided teaching
Reading list	1. Required books [1] WEN Yongpeng et al. *Rail Transportation Basic Practice Guidebook.* Lecture notes of Shanghai University of Engineering Science, 2019. 2. Reference books [1] TAN Fuxing, GAO Weijun. *Overview of Urban Rail Transit System.* Shanghai University of Engineering Science, 2005. [2] FANG Yu, SHI Wei, SHI Xuan et al. *Introduction to Urban Railway Vehicle*. Beijing: China Railway Publishing House, 2012.

Competence field	Practical Training

Module designation	Cognition Practice of Urban Railway Vehicle
Code, if applicable	109164
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 LI Xiaobo Lecturer SHU Yanjun Lecturer MENG Xiaoliang Lecturer ZHONG Qianwen Lecturer WU Aizhong Lecturer HE Yu Lecturer WEN Jing
Language	Chinese
Relation to curriculum	This practice is a compulsory and concentrated practice teaching procedure for students majoring in Vehicle Engineering (Rail Transit Vehicle). Students will learn about the composition and basic operating principles of urban rail vehicles with the field staff in the rolling stock section and perform field operations to strengthen their understanding of the vehicle structure and connect theory with practice. It is expected that (1) the students will understand the basic situation, production and management process of vehicle engineering enterprises; (2) they will understand the guidelines, policies, laws and regulations on production, design, research and development, environmental protection and sustainable development of vehicle engineering related professions and industries, improve the practical application of knowledge and their comprehensive quality, and lay a foundation for their subsequent studies and work in related fields.
Type of teaching, contact hours	Target students: juniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: practice teaching Contact hours: 30 hours
Workload	Total workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	3.0
Requirements according to the examination regulations	Complete all required experiments and submit experimental reports.
Recommended prerequisites	Overview of Urban Rail Transit System; Structure of Urban Railway Vehicle

<table>
<tr><td></td><td></td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td>Module objectives: This course aims to provide students with a deeper and more intuitive understanding of the theoretical knowledge of vehicle structures studied in class, to practice operational skills in practice, and to improve practical application of knowledge and the overall quality through practice. Specific objectives include:
● Knowledge :
1. Vehicle components, characteristics and operating principles of each component;
2. Overhaul system and processes for rail vehicles;
3. Common inspection and maintenance tools for urban rail vehicle maintenance support.

● Skills:
1. Ability to apply theoretical knowledge of vehicle structure to analyze the vehicle and its working principle at the practice site.
2. Ability to ensure safety at the vehicle overhaul site.
3. Ability to elaborate the daily overhaul system and process of key vehicle components.

● Competence: Ability to operate and maintain urban rail transit vehicles, and to improve engineering awareness, quality and practice ability, innovative spirit, professional skills, professional ethics, teamwork spirit and communication ability.</td></tr>
<tr><td>Contents</td><td>Practice teaching (Contact hours: 30 hours, Self-study hours: 60 hours)
The practice teaching includes an overview of the practice (A), knowledge of the mechanical structure of the vehicle (B) and knowledge of the electrical equipment of the vehicle (C).
<table>
<tr><td>No.</td><td>Experiment</td><td>Contact hours</td><td>Self-study hours</td></tr>
<tr><td>A1</td><td>Safety regulations and onsite safety facilities*</td><td>1</td><td>2</td></tr>
<tr><td>A2</td><td>Onsite conditions and practice characteristics</td><td>1</td><td>2</td></tr>
<tr><td>B1</td><td>Basic structure of the vehicle*</td><td>2</td><td>4</td></tr>
<tr><td>B2</td><td>Basic structure of doors*</td><td>2</td><td>4</td></tr>
<tr><td>B3</td><td>Basic structure of the bogy*</td><td>4</td><td>8</td></tr>
<tr><td>B4</td><td>Basic connection and uncoupling operation of vehicle hooks</td><td>2</td><td>4</td></tr>
<tr><td>B5</td><td>Maintenance techniques for mechanical parts of vehicles</td><td>4</td><td>8</td></tr>
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	C1	Main electrical equipment in the passenger vehicle and electrical equipment in the driver's compartment	2	4	
	C2	Under-vehicle electrical equipment such as traction converters, auxiliary inverters, batteries, etc.*	4	8	
	C3	Roof electrical equipment such as pantographs, air conditioners, lightning rods, etc.	2	4	
	C4	Air lines and braking systems	2	4	
	C5	Maintenance techniques for vehicle electrical equipment	4	8	
Study and examination requirements and forms of examination	Attendance (20%): no late arrivals, no early departures, and no unauthorized absences; Practice performance (20%): practice performance (work attitude, engagement, safe conduct during practice and records), etc.; Final assessment (60%): practice report (informative, with accurate and standard terminology)				
Media employed	Multimedia aided teaching				
Reading list	1. Required books [1] LIAO Aihua et al. *Practice Guide for Basic Practice of Urban Railway Vehicle.* Lecture notes of Shanghai University of Engineering Science, 2019 2. Reference books [1] TAN Fuxing, GAO Weijun. *Overview of Urban Rail Transit System.* Shanghai University of Engineering Science, 2005. [2] FANG Yu, SHI Wei, SHI Xuan et al. *Introduction to Urban Rail Transit Vehicles.* Beijing: China Railway Publishing House, 2012. [3] LIAO Aihua, HUANG Lixin, FANG Yu. *Maintenance Technology of Urban Railway Vehicle.* Beijing: China Railway Publishing House, 2013.				

Competence field	Practical Training

Module designation	Maintenance Practice of Urban Railway Vehicle
Code, if applicable	109165
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 Lecturer WU Aizhong Lecturer ZHONG Qianwen Lecturer MENG Xiaoliang Lecturer ZHU Wenliang
Language	Chinese
Relation to curriculum	This is a compulsory practice course designed for students majoring in Vehicle Engineering (Rail Transit Vehicle). Topics covered in this course include knowledge of urban rail vehicle maintenance, introduction and usage of tools, maintenance of urban rail vehicle door system, bogie system, hook system and the brake system. This course will help students deepen their understanding of the theoretical knowledge of vehicle structure and overhaul learned in the classroom, practice their skills and improve their application and scientific experiment ability, laying a good foundation for future employment.
Type of teaching, contact hours	Target students: juniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: practice teaching Contact hours: 90 hours
Workload	Total workload = 240 hours Contact hours = 90 hours Self-study hours = 150 hours
Credit points	8.0
Requirements according to the examination regulations	Students shall complete all the practical training courses, pass the practical examinations and submit their reports on the practice in order to be considered for the appraisal of overall grade.
Recommended prerequisites	Structure of Urban Railway Vehicle; Braking Technique of Urban Railway Vehicle; Maintenance Technology of Urban Railway Vehicle; Electrical Equipment of Urban Rail Transit Vehicles
Module	Module objectives:

<table>
<tr><td>objectives/intended learning outcomes</td><td>

Knowledge:

1. Demonstrate understanding of overhaul techniques of doors, bogies, hooks and brakes of rail vehicle;
2. Demonstrate understanding of principles and use of typical tools and instruments required for rail vehicle maintenance.

Skills:

1. Demonstrate ability to operate typical tools, instruments and equipment required for vehicle maintenance;
2. Demonstrate ability to perform maintenance on rail vehicle door locks, bogie mechanical components, hooks, and brake system relay valves;
3. Demonstrate ability to perform initial diagnosis and treatment of typical urban rail vehicle faults.

Competence:

After this course, students shall acquire the ability to apply basic maintenance skills and knowledge of typical components of rail vehicles, to perform preliminary diagnosis and disposal of typical faults of rail vehicle equipment, and to improve engineering awareness, quality, practical skills, innovation, professional skills, ethics, teamwork and communication skills.
</td></tr>
<tr><td>Content</td><td>
Practice teaching (90 contact hours; 150 self-study hours)
Maintenance Practice of Urban Railway Vehicle consists of six components: A. Safety education for the maintenance practice of urban rail vehicle; B. Introduction and use of tools for urban rail vehicle practice training; C. Maintenance of urban rail vehicle door system; D. Maintenance of urban rail vehicle bogie system; E. Maintenance of urban rail vehicle hook system; F. Maintenance of urban rail vehicle brake system.
<table>
<tr><th>No.</th><th>Content</th><th>Contact hours</th><th>Self-study hours</th></tr>
<tr><td>A1</td><td>Practice discipline and precautions
Introduction of practice site and routes</td><td>3</td><td>3</td></tr>
<tr><td>A2</td><td>Mechanical safety technology for the practice
Electrical safety technology for the practice</td><td>3</td><td>3</td></tr>
<tr><td>A3</td><td>Introduction of typical incident cases and warnings</td><td>3</td><td>3</td></tr>
<tr><td>A4</td><td>Comprehensive exam for the safety education</td><td>3</td><td>3</td></tr>
<tr><td>B1</td><td>The working principle and use of torque wrenches and vernier</td><td>3</td><td>3</td></tr>
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	calipers		
B2	The working principle and use of wheel diameter measuring tape	3	3
B3	The working principle and use of inner distance measuring tape	3	3
B4	Working principle and use of wheel edge measuring tape	3	3
B5	A practical examination on the use of typical tools	3	3
C1	Disassembly of door limit switches for urban rail vehicle	3	3
C2	Adjustment of door limit switches	3	3
C3	Removal and assembly of hooks and pins for urban railcar doors	3	3
C4	Adjustment of clearance between door lock hook and pin	3	3
C5	Practice examination on comprehensive maintenance of door systems for rail vehicle	3	3
D1	Bogie inspection operation 1 (wheel pair, axle box, frame)	3	3
D2	Bogie inspection operation 2 (one tethered spring, two tethered springs, central traction device)	3	3
D3	Bogie inspection operation 3 (gearbox and its suspension, coupling, anti-roll torsion bar, hydraulic shock absorber, height adjustment valve)	3	3
D4	Bogie inspection operation 4 (sensors, gas pathway connectors and fixings, wheel rim lubricating devices, ATC brackets)	3	3
D5	Floor surface height detection and adjustment	3	3
D6	Comprehensive maintenance test for bogie systems	3	3
E1	Automatic hook removal and assembly	3	3
E2	Automatic hook lubrication	3	3
E3	Automatic hook electrical maintenance	3	3

	E4	Automatic hook adjustment	3	3
	E5	Practice examination on comprehensive maintenance of the hook system	3	3
	F1	Relay valve disassembly operation	3	3
	F2	Relay valve buffer test operation	3	3
	F3	Assembly of reducing valve	3	3
	F4	Commissioning of reducing valves	3	3
	F5	Practice examination on comprehensive brake maintenance	3	3
		Accessing information and writing practice reports	0	60

Study and examination requirements and forms of examination	The overall score consists of three components: 1. 30% class attendance and initiative in the practice process, internship records and reports; 2. 30% for practical skills and comments from the unit; 3. The quality of the practice report accounts for 40%. If one of the requirements is not met, the overall grade for the practice will be deemed as unsatisfactory.
Media employed	Multimedia aided teaching
Reading list	1. Required books [1] LIAO Aihua et al. *Guidebook for Urban Rail Transit Production Practice.* Lecture notes of Shanghai University of Engineering Science, 2019. 2. Reference books [1] LIAO Aihua. *Maintenance Technology and Equipment for Urban Rail Transit Vehicle.* Beijing: China Railway Publishing House, 2013. [2] LI Juanwei. *Car Hook Training.* Shanghai: LI Juanwei Chief Technician Workshop, 2013. [3] The Rail Transit Training Center, Shanghai Shentong Metro Group Co., Ltd. *Urban Rail Transit Vehicle Technology*. Beijing: China Railway Publishing House, 2011.

Competence field	Practical Training

Module designation	Innovation and Entrepreneurship Project Training
Code, if applicable	
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Professor ZHENG Shubin
Lecturer	All teaching staff of this program
Language	Chinese
Relation to curriculum	As a course for practical training of innovation and entrepreneurship, this course is designed for practical training at the National Engineering Practical Education Center for Vehicle Engineering (Rail Transit Vehicle), Industry-University-Research bases as well as enterprises. Under the instruction of lecturers, students will complete innovative work such as scientific research, experiments and development in vehicle engineering, and develop skills of innovation, entrepreneurship and practical application. This is an innovation and entrepreneurship oriented course, based on the basic theoretical knowledge and experimental experience that students have acquired, and requires teams of students to solve practical problems under the guidance of teachers with selected topics and independent actions. It aims to develop students' practical engineering and innovation skills.
Type of teaching, contact hours	Target students: seniors of Vehicle Engineering (Rail Transit Vehicle) Type of teaching: theoretical and practice teaching Contact hours: 64 hours Of which Theoretical teaching: 8 hours Experiment/practice teaching: 56 hours Size of class: 40 people
Workload	Total workload = 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
Requirements according to the examination regulations	Complete proposal report, project design and execution plan; carry out project and complete report; Evaluate team work and reports of other teams
Recommended prerequisites	Fundamentals of Drawing; Mechanical Design; Power Electronics Technology; Measurement and Sensor Technology; Automatic Control Theory; Structure of Urban Railway Vehicle; Braking Technique of Urban Railway Vehicle; Electrical Traction and Control of Urban Railway Vehicle; Network Control Technology for Urban Rail Transit Vehicles.
Module	Module objectives:

<table>
<tr><td>objectives/intended learning outcomes</td><td>

Knowledge:
(1) Control strategies, advanced technologies, test programs and data analysis for urban rail transit vehicle operation support and maintenance, fault diagnosis and repair;
(2) Expertise in new and cutting-edge areas of vehicle engineering.
Skills:
(1) Able to independently use innovative modules and simulation experiment teaching platform (numerical simulation) to write research project proposals and implementation plans
(2) Able to conducting innovative research and engineering practice independently. Students will be trained to develop innovative and entrepreneurial skills and engineering practice.
Competence: By taking this course, students can develop creative thinking and engage in innovative work with basic theoretical knowledge, skills and specialized knowledge. Students will be able to write innovative proposals on scientific research, experiment and product development with literature review so as to develop creative thinking and abilities in solving practical engineering problems.

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<tr><td>Contents</td><td>
1. Theoretical teaching
<table>
<tr><td>No.</td><td>Theoretical teaching</td><td>Contact hours</td><td>Self-study hours</td></tr>
<tr><td>1</td><td>Innovation teaching module and simulation experiment teaching platform introduction</td><td>3</td><td>3</td></tr>
<tr><td>2</td><td>Research on topic selection and learning proposal report development</td><td>2</td><td>2</td></tr>
<tr><td>3</td><td>Learning plan development</td><td>3</td><td>3</td></tr>
</table>
2. Experiment/practice teaching
<table>
<tr><td>Experiment 1</td><td>Research on topic selection</td><td>Contact Hours</td><td>Self-study hours</td></tr>
<tr><td>Content and requirement</td><td>1. Overview of current situation and development at home and abroad through literature search and readings (including intellectual and technical standard); economic construction and social development requirements
2. Make proposal on</td><td>12</td><td>10</td></tr>
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<table>
<tr><td></td><td><table>
<tr><td></td><td>innovative topics and technical value of innovation
3. Make proposal on complete innovation plan</td><td></td><td></td></tr>
<tr><td>Experiment 2</td><td>Evaluation by classmates on report on topic selection</td><td>Contact Hours</td><td>Self-study hours</td></tr>
<tr><td>Content and requirements</td><td>Evaluate topic selection report of three classmates
1. Whether report conforms to standard;
2. If innovative topics and technical value of innovation are convincing
3. If the innovation plan is feasible</td><td>10</td><td>8</td></tr>
<tr><td>Experiment 3</td><td>Process analysis and summary</td><td>Contact Hours</td><td>Self-study hours</td></tr>
<tr><td>Content and requirements</td><td>1. Innovation plan execution
2. Experiment analysis of uncertainty
3. Scientific criteria for innovation plan improvement
4. Summary of results</td><td>24</td><td>20</td></tr>
<tr><td>Experiment 4</td><td>Results of innovation plan execution</td><td>Contact Hours</td><td></td></tr>
<tr><td>Content and requirement</td><td>1. Application and market prediction
2. Design of implementation plan
3. Analysis of economic and social benefits</td><td>10</td><td>10</td></tr>
</table></td></tr>
<tr><td>Study and examination requirements and forms of examination</td><td>Usual performance accounts for 30% of final score (theoretical course; attendance of discussion and experiment classes; completion).
Exams account for 30% of final score (proposal 20%; evaluation of classmates proposal 10%; execution and experimental report 30%; entrepreneurship plan 10%) (oral defense).</td></tr>
<tr><td>Media employed</td><td>Multimedia computers; projectors; product models</td></tr>
<tr><td>Reading list</td><td>1. Required books
[1] Handout on innovation & entrepreneurship, SUES
2. Reference books
[1] Study, Response and Insight Regarding Entrepreneurship Plan</td></tr>
</table>

	and Competition: Exploration and Practice of College Students Innovation & Entrepreneurship Education, ZHEN Bingzhang, LIU Dezhi, JIA Dongshui, WU Hong. China Earth Press, 2005 [2] *Innovation Entrepreneurship and Employment.* FU Yun. Machinery Industry Press, 2009 [3] *Instruction Course on College Students Innovation & Entrepreneurship*, DENG Zegong, China Communication Press, 2004

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