Appendix B-4 - Syllabus - Engineering application

Contents

Competence field	Engineering application
Curriculum designation	C++ Programming Language
Curriculum code	9061313221
Semester(s) in which the curriculum is taught	3^{rd} Semester
Person responsible for the curriculum	Professor Li Wenguo
Lecturer	Assistant Professor Zhong Peng
Language	Chinese
The relationship between the curriculum and the major	"C++ Programming Language" is a required professional course for students majoring in Electronic Information Engineering and Artificial Intelligence, it is an applied course that integrates knowledge of software technology and development tools. The teaching objective of this course is: students will understand the object-oriented programming concept of C++ language through learning on the basis of their existing professional knowledge, understand and master the methods of procedural and object-oriented programming, be able to skillfully develop C++ applications based on classes and objects, enhance their practical abilities in program design and development, and lay a solid foundation for using advanced tool software such as P ython and Matlab in the future.
Type of teaching, contact hours	Target students: Electronic Information Engineering major Teaching method: theoretical teaching + experiment Contact hours: 48 hours Including: Theoretical teaching: 32 hours Experimental/practical teaching: 16 hours Class size: Four classes with about 160 students
Workload	Total workload = 105 hours; Contact hours = 48 hours; Self-study hours = 57 hours;
Credit points	3.5
Requirements according to the examination regulations	Only students who attend class with a attendance rate of more than 2/3 and complete their homework with a completion rate of more than 2/3 can take the exam.
Prerequisite curriculum	Computer language foundation, C language programming, data structure
curriculum objectives /expected learning outcomes	**Learning outcomes:** The main task of this course is to make students deeply understand the principles and applications of C++ object-oriented programming, and master the design and development methods of C++ programs. The specific objectives include: **Knowledge:**

	1. Master the basic syntax of C++ and the core concepts of object-oriented programming, including class and object, inheritance, polymorphism and encapsulation; 2. Familiar with common functions in the C++ standard library, such as string processing, input and output streams, dynamic memory management; 3. Understand advanced features in C++, such as templates, exception handling, application of STL standard template library, as well as basic knowledge of API, MFC and GUI. **Skill:** 1. Learn to use C++ integrated development environment (IDE) for program writing, compiling, debugging and running; 2. Be able to design and implement object-oriented programs based on C++, such as simple class design, object creation and management; 3. Master exception handling and debugging techniques in C++ programs, and be able to write robust and easy-to-maintain code. **Ability:** 1. Be able to use object-oriented methodology to conduct system requirements analysis, scheme design and implementation according to specific requirements; 2. Have the ability of C++ program debugging and optimization, can effectively solve various problems that occur during the operation of the program; 3. Be able to combine practical application scenarios, use innovative thinking, design and implement innovative C++ application systems to improve the performance and reliability of the system; 4. Be able to deeply understand the advanced functions and applications of C++, such as multi-threaded programming, network programming, database connection, etc., and use these technologies to solve complex engineering problems, improve the intelligence and automation level of the system.
Contents	**Theoretical teaching (32 contact hours, 30 self-study hours)** Chapter 1: Introduction to C++ (2 contact hours, 3 self-study hours) 1. Understand the development history, characteristics and application fields of C++ 2. Master namespaces 3. Master console input and output 4. Master type enhancements in C++ 5. Master default parameters 6. Master function overload 7. Master citations 8. Master the string class 9. Master the new/delete operator

	10. Understand forced type conversion. Chapter 2: Class and Object (5 contact hours, 4 self-study hours) 1. Understand the object-oriented programming concept 2. Master the definition of classes and the creation of objects 3. Master the this pointer 4. Master construct functions 5. Master the construction of function overload 6. Master the deconstruction function 7. Master deep copy and shallow copy 8. Understand the const keyword and the static keyword 9. Master the friend function and friend class. Chapter 3: Operator Overloading (4 contact hours, 5 self-study hours) 1. Master the syntax and rules of operator redefinition 2. Master operator overload methods 3. Master input and output operator overload 4. Master the overloaded assignment operator 5. Master the subscript operator overload 6. Understand type conversion. Chapter 4: Inheritance and Derivation (5 contact hours, 2 self-study hours) 1. The concept of inheritance and the way of inheritance 2. type compatibility 3. Derived class constructors and destructors 4. Derive class hidden base class member functions 5. Multiple inheritance methods 6. Inheritance derived class constructor and destructor 7. The problem of the dual nature of multiple inheritance 8. Virtual inheritance. Chapter 5: Polymorphism and Virtual Functions (4 contact hours, 3 self-study hours) 1. The concept of polymorphism 2. Virtual functions 3. Virtual function implements the mechanism of polymorphism 4. Construct a virtual analysis function 5. Pure virtual function 6. abstract class. Chapter 6: Templates (3 contact hours, 4 self-study hours) 1. Master the concept of templates

	2. Master the definition and instantiation of function templates 3. Master the overload of function templates 4. Master the definition and instantiation method of class template 5. Master class template derivation 6. Master class templates and friend functions 7. Master the parameters of function templates 8. Master function template specialization. Chapter 7: STL Standard Template Library (4 contact hours, 3 self-study hours) 1. Understand the composition of STL 2. Master the definition and related operations of sequence containers 3. Master the definition and related operations of associated containers 4. Understand the use of container adapters 5. Understand the classification of iterators 6. Master commonly used algorithms. Chapter 8: I/O Stream (3 contact hours, 3 self-study hours) 1. Understand the I/O stream class library 2. Master the use of standard input and standard output streams 3. Master the creation of file stream objects 4. Master the opening and closing of files 5. Master the read and write of files 6. Master random read and write of files 7. Understand string streams. Chapter 9: Abnormalities (2 contact hours, 3 self-study hours) 1. Master the way to handle exceptions 2. Understand stack unwinding 3. Understand standard anomalies 4. Understand static assertions Experimental teaching (16 contact hours, 27 self-study hours) Experiment 1: Verification experiment of classes and objects (2 contact hours, 3 self-study hours) Experimental content: master the definition of class and object, and be able to complete simple program design by calling member functions through object. Experiment 2: Design experiment of operator redefinition. (2 contact hours, 3 self-study hours)

	Experimental content: master the commonly used operator overload method; the overload rules of single and double operators; operator overload as class member and friend function. Experiment 3: Inheritance and polymorphism design experiment. (2 contact hours, 3 self-study hours) Experimental content: how to write the base class, how to write the derived class by inheriting the properties and functions of the base class; how to call the member function of the base class in the member function of the derived class. Experiment 4: Design experiment of file operation (file copy, file write and read). (2 contact hours, 4 self-study hours) Experimental content: master the C++ file operation method, master the file reading and writing methods; C++ string cut, insert and other functions. Experiment 5: Comprehensive experiment of simple window (4 contact hours, 7 self-study hours) Experimental content: master the establishment of basic window programs; master the pointer invocation method of class and object members. Experiment 6: Comprehensive experiment-design a simple parking lot management system (including three modules: car information, ordinary user and administrator user). (4 contact hours and 7 self-study hours) Experimental Content: Comprehensive and in-depth mastery of classes and objects integrated application. Implement module functions as required, design classes for each module, ordinary users can only view car information, only administrator users can add, modify, and delete car information, user and administrator users have the function to return to the main menu.
Study and examination requirements and forms of examination	1. Attendance rate (10%): Basic requirements for the course (no late arrival, no early departure, no absence without reason). 2. Assignment (30%): lab report. 3. Final assessment (60%): final examination.
Media employed	Multimedia computer, projector, laser pen, blackboard, chalk, PPT, Rain Classroom, CodeBlocks and Visual Studio software
Reading list	1. Textbooks [1] C++ Object-oriented Programming (4th Edition), Tan Haoqiang, Tsinghua University Press, 202 3 . 2. Reference books

	[1] Fundamentals of C++ Programming (6th Edition), Zhou Airu, China Machine Press, 2021. [2] C++ Programming Tutorial (2nd Edition) by Black Horse Programmer, Peoples Posts and Telecommunications Press, 2020. [3] C++ Primer, Stanley B.Lippman, Peoples Posts and Telecommunications Press, 2006.

Competence field	Engineering application
Curriculum designation	Microcontroller Principle and Application
Curriculum code	9061313171
Semester(s) in which the curriculum is taught	4^{th} Semester
Person responsible for the curriculum	Professor Li Wenguo
Lecturer	Professor Li Wenguo, Professor Xiao Weichu, Lecturer Lin Lin, Assistant Professor Mo Shiying and Assistant Professor Liu Xiongjie
Language	Chinese
The relationship between the curriculum and the major	The course "Principles and Applications of Microcontrollers" is one of the engineering application courses for the Electronic Information Engineering major. This course introduces the basic architecture, working principles, and configuration of internal resources of microcontrollers, such as timers, interrupt systems, and serial communication. At the same time, this course emphasizes practical application, conducting requirement analysis, scheme design, and system implementation for specific application scenarios, effectively enhancing students professional competence and competitiveness, laying a solid foundation for future career development in the field of electronic information engineering.
Type of teaching, contact hours	Target students: Electronic Information Engineering major Teaching method: theoretical teaching + experiment Contact hours: 56 hours Including: Theoretical teaching: 40 hours Experimental/practical teaching: 16 hours Class size: Four classes with about 160 students
Workload	Total workload = 120 hours; Contact hours = 56 hours; Self-study hours = 64 hours;
Credit points	4.0
Requirements according to the examination regulations	Only students who attend class with a attendance rate of more than 2/3 and complete their homework with a completion rate of more than 2/3 can take the exam.
Prerequisite curriculum	Advanced mathematics, circuit analysis, analog electronic technology, digital electronic technology
curriculum objectives /expected learning outcomes	**Learning outcomes:** The main task of this course is to make students deeply understand the principle and application of microcontroller, master the design and development method of microcontroller system. The specific objectives include: **Knowledge:**

	1. Master the basic architecture and working principle of microcontroller, understand the characteristics and application scenarios of different types of microcontroller; 2. Familiar with the working principle and configuration method of internal resources of microcontroller, such as I/O port, timer, interrupt, serial communication, etc.; 3. Understand the interface technology of microcontroller and external world, such as ADC, DAC, PWM, DMA, etc., and be able to use these technologies for data acquisition and processing. **Skill:** 1. Learn to use the development environment and tools of microcontroller, such as Keil, for program writing, compiling, burning and debugging; 2. Be able to design and implement simple control systems based on microcontroller, such as LED flashing, button input processing, etc.; 3. Master the application of microcontroller in embedded system, and be able to complete simple hardware interface design and software programming. **Ability:** 1. Be able to use the principle and technology of microcontroller to conduct system requirements analysis, scheme design and implementation according to specific requirements; 2. Have the ability to debug and optimize the microcontroller system, and can effectively solve various problems that occur during the operation of the system; 3. Be able to combine practical application scenarios, use innovative thinking, design and realize innovative microcontroller application systems to improve the performance and reliability of the system. 4. Be able to deeply understand the advanced functions and applications of microcontroller, such as real-time operating system (RTOS), low power design, wireless communication technology, etc., and use these technologies to solve complex engineering problems, improve the intelligence and automation level of the system.
Contents	**Theoretical teaching (40 contact hours, 46 self-study hours)** Chapter 1: Overview and preparatory knowledge (2 contact hours, 1 self-study hours) 1. Development and application of microcontroller; 2. Microcontroller model; 3. Number system, code system, etc. Chapter 2: Microcontroller hardware structure (5 contact hours, 4 self-study hours) 1. Overall structure and internal resources; 2. Power supply and external pins, control pins, input and output

	pins; 3. Clock circuit, reset circuit and timing; 4. Data storage, program storage. Chapter 3: Instruction system and assembly language programming (8 contact hours, 8 self-study hours) 1. Assembly language instruction format; 2. Assembler directive commands; 3. Addressing mode; 4. Instruction system and application; 5. Assembly language programming. Chapter 4: Introduction to C51 Language of microcontroller (2 contact hours, 2 self-study hours) 1. C51 data type and storage mode, storage type and storage relationship; 2. The definition method of C51 interrupt service function; 3. Assembly language and C51 mixed programming. Chapter 5: Hardware resources and applications (13 contact hours, 16 self-study hours) 1. Parallel I/O port and its application; 2. Interrupt system and control, interrupt programming and application; 3. Basic structure and principle of timer/counter, design related applications of timer/counter; 4. Serial interface technology and serial port communication application program. Chapter 6: Parallel expansion interface technology (8 contact hours, 12 self-study hours) 1. Bus parallel expansion method, memory interface expansion; 2. Expand input and output parallel interface, design interface expansion related programs; 3. Expand the interface of D/A and A/D converter, design interface program; 4. Display and keyboard interface expansion, design human-computer interaction program. Chapter 7: Design of single chip microcomputer practice cases (2 contact hours, 3 self-study hours) 1. Explain the basic process of microcontroller practice case design, including project selection, scheme design, hardware construction, software programming, debugging and testing, and summary report.

	2. Select typical single chip microcomputer practice cases for analysis, such as traffic light control experiment, digital tube display experiment and stepper motor control experiment. Explain the design ideas, implementation process and key technical points of each case. **Experimental teaching (16 contact hours, 18 self-study hours)** Experiment project 1: Application of I/O port and interface technology (flow light, buzzer). (2 contact hours, 2 self-study hours) Experimental Content: Familiarize with the Keil operating environment write debug and execute programs Understand the structure and function of microcontroller I/O ports and know how to configure and use I/O ports Control the electrical state of I/O ports through programming to achieve control over external devices. Experiment project 2: Application of external interruption. (2 contact hours, 3 self-study hours) Experimental content: programming the triggering mode of external interrupt, familiarize with the configuration of interrupt permission register and interrupt priority register, write the external interrupt service program to realize the display of LED lamp and digital display by button control. Experiment project 3: application of timer and interrupt. (4 contact hours, 3 self-study hours) Experimental Content: Configure registers related to the timer (such as IE, TMOD, TCON, TH0, TL0, etc.) set the initial value of the timer, working mode, interrupt enable, and interrupt priority. Use the timer to generate timing signals to achieve normal display of an electronic stopwatch. Experiment project 4: serial port communication between two machines. (4 contact hours, 4 self-study hours) Experimental Content: Understand the basic principles of serial communication including data transmission methods the concept of baud rate and the structure and functions of serial communication interfaces. Correctly configure and use the serial port of the 51 microcontroller including the serial port control registers (such as SCON) baud rate setting registers (such as TMOD TH1 TL1) etc. to achieve data transmission and reception functions. Experiment Project 5: Design of 10,000-year calendar based on 51 single chip microcomputer (4 contact hours, 6 self-study hours) Experimental Content: Conduct project requirement analysis and formulate detailed design plans including hardware circuit design

	and software program design. Build the hardware circuit according to the design plan including the connection of microcontroller sensors and other components. Write the microcontroller program according to the design plan to achieve all functions of the project. Debug and test the hardware circuit and software program to ensure the normal operation of the project and meet the design requirements. Write a project summary report including project background design plan implementation process test results etc.
Study and examination requirements and forms of examination	1. Attendance rate (10%): Basic requirements of the course (no late arrival, no early departure, no absence without reason). 2. Assignment (30%): lab report. 3. Final assessment (60%): final examination.
Media employed	Multimedia computer, projector, laser pen, blackboard, chalk, Keil and Proteus software, microcontroller experiment box
Reading list	1. Textbooks [1] Yang Huixian, Huang Huixian et al., Principles and Applications of Microcontroller[M], Xiangtan University Press, 2013. 2. Reference book [1] Xie Weicheng, Yang Jiaguo et al. Principles and Applications of Microcontroller and C51 Programming. Beijing: Tsinghua University Press, 2019. [2] Ma Zhongmei et al. C Language Application Design of Microcontroller. Beijing University of Aeronautics and Astronautics Press, 2021. [3] Liu Ruixin et al. Principles and Applications of Microcontroller[M]. China Machine Press, July 2021.

Competence field	Engineering application
Curriculum designation	PCB Design and Drawing
Curriculum code	9061312030
Semester(s) in which the curriculum is taught	5^{th} Semester
Person responsible for the curriculum	Professor Li Wenguo
Lecturer	Professor Peng Jinlin
Language	Chinese
The relationship between the curriculum and the major	"PCB Design and Drawing" is a foundational course in the field of Electronic Information Engineering. Through the study of this course, students will be able to master the basic knowledge and skills of circuit design and printed circuit board manufacturing, understand common circuit components and peripheral application circuits, comprehend the composition and manufacturing process of printed circuit boards, be familiar with commonly used circuit design and board-making software, and acquire the basic usage methods and techniques of Altium Designer circuit design software, laying a solid foundation for engaging in electronic system design and application implementation.
Type of teaching, contact hours	Target students: Electronic Information Engineering major Teaching method: theoretical teaching + experiment Contact hours: 32 hours Including: Theoretical teaching: 16 hours Experimental/practical teaching: 16 hours Class size: Four classes with about 160 students
Workload	Total workload = 60 hours; Contact hours = 32 hours; Self-study hours = 28 hours;
Credit points	2.0
Requirements according to the examination regulations	Only students who attend class with a attendance rate of more than 2/3 and complete their homework with a completion rate of more than 2/3 can participate in the assessment.
Prerequisite curriculum	circuit analysis
curriculum objectives /expected learning outcomes	**Learning outcomes:** The main task of this course is to master the basic of PCB design, be proficient in using EDA tools for schematic drawing and PCB layout and routing, and have basic circuit analysis and debugging ability. The specific objectives include: **Knowledge:** 1. PCB design principle: Understand the basic principles of circuit board design, including the selection of circuit board layers, material

	characteristics, signal integrity analysis, etc. 2. EDA tool operation: proficient in the use of electronic design automation software such as Altium Designer and JAC, and carry out schematic design and PCB layout and wiring. 3. Layout and wiring rules: Understand and follow the layout and wiring rules of PCB design, including considerations of electromagnetic compatibility, thermal design, signal integrity, etc. **Skill:** 1. Learn how to install, configure and debug software such as Altium Designer; 2. Select appropriate EDA tools for schematic design and PCB layout; 3. Build a circuit board by hand using equipment or online tools, use the right components to solder, and get a terminal device that works. **Ability:** 1. Principle diagram drawing ability: able to accurately draw circuit principle diagrams using EDA tools, including component symbol placement, connection line drawing and electrical rule checking. 2. PCB layout capability: according to the circuit function and electrical requirements, reasonably arrange the position of components on the PCB, optimize space utilization, consider heat dissipation and electromagnetic interference. 3. Cable wiring skills: proficient in PCB wiring, including signal line, power line and ground line layout, as well as special cable wiring requirements for high speed signals and analog signals.
Contents	**Theoretical teaching (32 contact hour, 28 self-study hours)** Chapter 1: Overview and preparatory knowledge (2 contact hours, 2 self-study hours) 1. History and development of PCB; 2. Installation and parameter configuration of Altium Designer software. Chapter 2: Draw circuit diagram (4 contact hours, 2 self-study hours) 1. Place and remove components; 2. Edit component properties and positions; 3. Wiring diagram —— connection and network label; 4. Placement and modification of other graphics; 5. Draw circuit diagram examples. Chapter 3: Create schematic component library (2 contact hours, 2 self-study hours) 1. Management of schematic component library; 2. Create schematic elements; 3. Call and modify the existing schematic component library.

	Chapter 4: PCB design (4 contact hours, 2 self-study hours) 1. Basic knowledge of PCB; 2. Component layout; 3. Automatic wiring and manual wiring; 4. Copper coating and tear drop on PCB; 5. Customize the shape of the PCB. Chapter 5: Create PCB package library (2 contact hours, 2 self-study hours) 1. New component packaging; 2. Create a package library using the existing package; 3. Generate and replace package instances. Chapter 6: Use of JLC-EDA to draw schematics and PCB (2 contact hours, 2 self-study hours) 1. Draw the schematic diagram with a power board as an example; 2. Draw the PCB diagram and arrange the device position properly; 3. Use the free sample function of JLC to make circuit boards. **Experimental teaching (16 contact hours, 16 self-study hours)** Experiment project 1: AD software installation and simple circuit diagram drawing. (4 contact hours, 4 self-study hours) Experimental content: 1. Master the installation, environment configuration and other functions of AD software; 2. Master the drawing of more complex circuit diagrams; 3. Master the use of wiring, network labels, color pens, text. Project 2: Making and distributing AD component libraries-using CD4017 as an example. (4 contact hours, 4 self-study hours) Experimental content: 1. Understand the shape of chip and other devices in the schematic diagram and the shape of devices on the PCB, master the drawing of more complex circuit schematics and PCB; 2. Master the method of device (schematic and PCB) packaging; 3. Use bus ports and bus connections to components in the schematic; 4. In the PCB, use alignment and other methods to neatly arrange components. Experiment 3: Draw circuit board schematics and PCB with JLC and solder them. (4 contact hours, 4 self-study hours) Experimental content: 1. Use JLC to draw circuit board schematic and PCB; 2. Use the free sample function of JLC to make circuit boards;

	3. According to the circuit diagram, correctly solder each device onto the PCB board. Project 4: Drawing of complex circuit diagram and PCB (4 contact hours, 4 self-study hours) Experimental content: 1. Use AD software to master the drawing method of the schematic diagram of a relatively complex circuit, and beautify the diagram to make it easy to read; 2. Place the device accurately, use manual or automatic wiring, and accurately cut the size of the board.
Study and examination requirements and forms of examination	1. Attendance rate (20%): Basic requirements of the course (no late arrival, no early departure, no absence without reason). 2. Assignment (20%): Offline experiment and experiment report. Final assessment (60%): final examination.
Media employed	Multimedia computer, projector, laser pen, Altium Designer software, Jialichuang software, computer room laboratory
Reading list	1. Textbooks [1] Sui Xiaohong, Liu Xin, Shi Lei. Altium Designer Principles and PCB Design. China Machine Press, September 2019. 3. Reference material [1] Altium China Technical Support Center, Altium Designer 19 PCB Design Official Guide, Tsinghua University Press, 2020. [2] https://www.icourse163.org/course/JSIT-1206734803 China MOOC

Competence field	Engineering application
Curriculum designation	High frequency electronic circuits
Curriculum code	9061313061
Semester(s) in which the curriculum is taught	5th Semester
Person responsible for the curriculum	Lecturer Xiong Jie
Lecturer	Lecturer Xiong Jie
Language	Chinese
The relationship between the curriculum and the major	"High-Frequency Electronic Circuits" is a required course for the Electronic Information Engineering major and is a core foundational professional course. This course aims to study the analysis methods and design methods of high-frequency electronic circuits, enabling students to master the basic concepts of high-frequency electronic circuits; understand the structural forms, circuit composition, working principles, and performance index calculations of basic unit circuits in high-frequency electronic circuits; possess the ability to read and analyze high-frequency electronic circuit diagrams, capable of analyzing the functions and estimating the performance indicators of general high-frequency electronic circuit schematics; have the ability to select and design circuits, able to choose appropriate circuits based on functional requirements and design circuit parameters. After studying this course, students will gain a comprehensive understanding of communication systems and will be able to design, install, and debug transmitter and receiver circuits in analog communication systems.
Type of teaching, contact hours	Target students: Electronic Information Engineering major Teaching method: theoretical teaching + experiment Contact hours: 56 hours Including: Theoretical teaching: 40 hours Experimental/practical teaching: 16 hours Class size: Four classes with about 160 students
Workload	Total workload = 120 hours; Contact hours = 56 hours; Self-study hours = 64 hours;
Credit points	4.0
Requirements according to the examination regulations	Only students who attend class with a attendance rate of more than 2/3 and complete their homework with a completion rate of more than 2/3 can take the exam.
Prerequisite curriculum	Advanced mathematics, circuit analysis, analog electronic technology, digital electronic technology

curriculum objectives /expected learning outcomes	**Learning outcomes:** This course completes the relevant experimental verification by learning the necessary basic knowledge and key technologies in high-frequency electronic circuits so that students can understand and master the key knowledge of high-frequency electronic circuits and achieve the goal of cultivating students ability in communication circuit design. The specific objectives include: **Knowledge:** 1. Be proficient in the working principle of high frequency small signal amplifier, high frequency power amplifier, sine wave oscillator and other unit circuits; 2. Master the characteristics and calculation of the amplifier circuit in high frequency state; 3. Master the application of high-frequency electronic circuits and the high-frequency characteristics of commonly used transistors; 4. Master the basic knowledge of oscillation, detection, mixing, modulation and demodulation circuits. **Skill:** 1. Learn to read, draw and design simple electronic circuits; 2. Be able to use the basic principles of high frequency electronic circuits to analyze the rationality of solutions. 3. Learn to analyze and solve practical problems in high-frequency electronic circuits, and cultivate innovative practice spirit. **Ability:** 1. Be able to use the commonly used high-frequency electronic circuit unit circuits, plus auxiliary circuits to design the high-frequency electronic circuits and their systems that meet the actual needs of the project. 2. Be able to complete the construction and debugging of communication circuits and systems or simulation verification based on the basic principles of high-frequency electronic circuits. 3. Have the ability to analyze and design the main circuits in high-frequency electronic circuits, and be able to design specific circuits.
Contents	**Theoretical teaching (40 contact hours, 44 self-study hours)** Chapter 1: Introduction (2 contact hours, 2 self-study hours) 1. History of radio development; 2. Principles of wireless signal transmission; 3. Communication section transmission medium. Chapter 2: Frequency selection network (6 contact hours, 6 self-study hours) 1. Series and parallel resonant circuit; 2. Equivalent interchange of series and parallel impedance and

	impedance transformation in loop tap; 3. Coupling circuit. Chapter 3: High frequency small signal amplifier (8 contact hours, 8 self-study hours) 1. Monotone resonant circuit resonator amplifier; 2. Multilevel monotonically resonant circuit resonator amplifier; 3. Stability and stabilization measures of resonant amplifier; 4. Noise in the amplifier. Chapter 4: Nonlinear circuits, time-varying parameter circuits and frequency converters (4 contact hours, 6 self-study hours) 1. Nonlinear circuit, time-varying parameter circuit characteristics and analysis; 2. Working principle and specific circuit of frequency converter; 3. Interference in mixers and its calculation. Chapter 5: High frequency power amplifier (8 contact hours, 8 self-study hours) 1. Working principle of high frequency power amplifier and linear approximation analysis; 2. High frequency characteristics of high frequency power amplifier; 3. Circuit composition of high frequency power amplifier; 4. Transistor multiplier. Chapter 6: Sinusoidal Oscillator (6 contact hours, 6 self-study hours) 1. The basic working principle of LC oscillator; 2. Feedback LC oscillator circuit; 3. quatrz oscillator; 4. RC agitator. Chapter 7: Amplitude modulation and demodulation (6 contact hours, 8 self-study hours) 1. Properties of amplitude modulation wave; 2. Specific amplitude modulation circuit; 3. Envelope detection and synchronous detection. **Experimental teaching (16 contact hours, 20 self-study hours)** Project 1: High frequency small signal tuning amplifier (4 contact hours, 4 self-study hours) Experimental contents: (1) the basic working principle of monotonous harmonic and double harmonic amplifier (2) engineering calculation and design of small signal resonant

	amplifier (3) circuit debugging and measurement of main performance index of small signal resonant amplifier (4) methods for measuring the amplitude-frequency characteristics of amplifiers. Project 2: High frequency resonant power amplifier (3 contact hours, 4 self-study hours) Experimental contents:(1) the working principle of class C resonant power amplifier (2) the tuning and adjustment of class C resonant power amplifier (3) the influence of input excitation voltage, collector supply voltage and load changes on the working state of amplifier. Project 3: sine wave oscillator (3 contact hours, 4 self-study hours) Experimental content:(1) the basic working principle of capacitive three-point LC oscillation circuit and crystal oscillator, familiarize with the function of each component (2) the influence of power supply voltage change on the amplitude and frequency of oscillator oscillation (3) the influence of static operating point on crystal oscillator working. Project 4: mixer (3 contact hours, 4 self-study hours) Experimental content:(1) the basic working principle of bipolar mixer and integrated mixer. (2) the method to realize mixing Project 5: Amplitude modulation (3 contact hours, 4 self-study hours) Experimental content:(1) the working principle of amplitude modulation (2) the method to realize AM and DSB, and study the relationship between the modulated wave and the modulating signal and carrier (3) the method to measure the amplitude modulation coefficient with oscilloscope
Study and examination requirements and forms of examination	1. Attendance rate (4%): All parts of this course require students to participate and are not allowed to be absent. Students who are absent will be deducted points according to the situation. 2. Assignment (12%): Complete the unit assignment according to quality and quantity, each assignment is scored separately, and the total score is weighted according to the set weight. 3. In-class test (12%): a small test will be conducted according to the chapter. The test will be conducted in an open-book form online, with a time limit. Each test will be scored separately and the total score will be weighted according to the set weight. 4. Experiment (12%): Design the experimental scheme using modern tools and scientific methods, record, analyze, interpret

	data, provide valid conclusions, and write the experimental report. Scores will be evaluated based on the completion progress, independence of work completed, correctness of the scheme, and the completion of the report. 5. Final assessment (60%): final examination.
Media employed	Multimedia computer, projector, laser pen, blackboard, chalk, Multisim software, high frequency electronic circuit experiment box, oscilloscope, multimeter
Reading list	1. Textbooks [1] High frequency Electronic Circuits (5th edition), edited by Zhang Suwen et al., Higher Education Press, 2012 [2] High frequency Electronic Circuits, edited by Jin Weizheng et al., Tsinghua University Press, 2020 4. Reference book [1] Principles and Analysis of High Frequency Circuits (6th edition), Zeng Xingwen, Liu Nianan et al., Xi an University of Electronic Science and Technology, 2017 [2] Communication Electronic Circuits (2nd edition), edited by Yan Guoping et al., Science Press, 2015 [3] Communication Electronic Circuit (4th edition), edited by Yu Hongzhen, Wang Gang et al., Tsinghua University Press, 2024

Competence field	Engineering application
Curriculum designation	Modern sensor and detection technology
Curriculum code	9061312040
Semester(s) in which the curriculum is taught	6th Semester
Person responsible for the curriculum	Associate Professor Deng Yaqi
Lecturer	Professor Li Wenguo, Associate Professor Deng Yaqi, Lecturer Lin Lin and Assistant Professor Liu Xiongjie
Language	Chinese
The relationship between the curriculum and the major	Modern Sensor and Detection Technology is a foundational course in the discipline of Electronic Information Engineering that combines theory with practice. It is an applied course that integrates knowledge of hardware technology, software technology, and development tools. This course introduces the working principles, main characteristics, error analysis, and compensation methods of sensors. Additionally, the course emphasizes practical application, focusing on requirement analysis, scheme design, and system implementation tailored to specific application scenarios, effectively enhancing students professional competence and competitiveness, laying a solid foundation for future use or design of sensor application systems.
Type of teaching, contact hours	Target students: Electronic Information Engineering major Teaching method: theoretical teaching + experiment Contact hours: 40 hours including: Theoretical teaching: 24 hours Experimental/practical teaching: 16 hours Class size: 4 classes with about 160 students
Workload	Total workload = 90 hours; Contact hours = 40 hours; Self-study hours = 50 hours;
Credit points	3. 0
Requirements according to the examination regulations	Only students who attend class with a attendance rate of more than 2/3 and complete their homework with a completion rate of more than 2/3 can take the exam.
Prerequisite curriculum	Advanced mathematics, circuit analysis, analog electronic technology, digital electronic technology
curriculum objectives /expected learning outcomes	**Learning outcomes:** The main task of this course is to make students deeply understand the principle and application of microcontroller, and master the design and development method of microcontroller system. The specific objectives include: **Knowledge:**

	1. Master the static and dynamic characteristics of sensors, and understand the performance evaluation standards of different sensors; 2. Master the basic principles and measurement circuits of various sensors, and understand the application scenarios and specific requirements of different sensors. **Skill:** 1. Learn to use sensor and detection technology experimental platform and various sensor experimental modules for circuit analysis and design; 2. Be able to reasonably select and design simple control systems based on different sensors according to specific requirements. **Ability:** 1. Be able to use the working principle of sensors to select sensors, design and realize sensor measurement lines according to the requirements of field testing; 2. Have the ability to debug and optimize the sensor system, and can effectively solve various problems that occur during the operation of the system; 3. Be able to combine practical application scenarios, use modern electronic technology, sensor technology and computer technology to realize information collection and processing in production practice, so as to improve the performance and reliability of the system.
Contents	**Theoretical teaching (24 contact hours, 30 self-study hours)** Chapter 1: Overview (2 contact hours, 2 self-study hours) 1. Development and application of sensors; 2. Sensor definition; 3. Sensor symbol, etc. Chapter 2: Basic characteristics of sensors (4 contact hours, 4 self-study hours) 1. Static characteristics of sensors; 2. Dynamic characteristics of sensors. Chapter 3: Resistive strain sensors (4 contact hours, 4 self-study hours) 1. Working principle of resistive strain gauge; 2. Temperature error compensation method of resistive strain gauge; 3. measuring circuit; 4. Several types of force sensors; Chapter 4: Capacitive sensors (4 contact hours, 4 self-study hours) 1. Capacitive sensor output characteristics; 2. Capacitive sensor measurement circuit; 3. Applications of capacitive sensors.

	Chapter 5: Inductive sensors (4 contact hours, 4 self-study hours) 1. Working principle of self-inductive sensor; 2. Self-induction sensor measurement circuit and phase sensitive detection circuit; 3. Working principle and measurement circuit of mutual sensor. Chapter 6: Hall sensors (2 contact hours, 4 self-study hours) 1. Hall effect; 2. Hall elements and applications. Chapter 7: Piezoelectric sensors (2 contact hours, 4 self-study hours) 1. The working principle and piezoelectric properties of quartz crystal and piezoelectric ceramic; 2. Voltage amplifier type measurement circuit; 3. Applications of piezoelectric sensors. Chapter 12: Thermoelectric sensors (2 contact hours, 4 self-study hours) 1. Working principle of thermocouple; 2. Two laws of thermocouples: the law of intermediate temperature and the law of intermediate conductor. **Experimental teaching (16 contact hours and 20 self-study hours)** Experiment Project 1: Single arm, half bridge and full bridge characteristics test of resistive strain sensors. (8 contact hours, 8 self-study hours) Experimental content: Familiarize with the strain gauge experimental module, understand the three types of measurement circuits of strain sensors, namely single arm, half bridge and full bridge circuits, the difference and connection between output characteristics and voltage sensitivity. Experiment Project 2: Temperature error characteristic of resistive strain gauge. (2 contact hours, 3 self-study hours) Experimental content: test the temperature error of the strain gauge, and further understand the circuit diagram, initial conditions and working principle of the compensation circuit of the bridge circuit. Experiment Project 3: Pressure measurement experiment of piezoresistive pressure sensor. (2 contact hours, 3 self-study hours) Experimental content: Familiarize with the pressure sensor experimental module, understand the principle and method of diffusion silicon pressure resistive pressure sensor to measure

	pressure. Experiment Project 4: Hall and magnetoelectric speed sensor measurement experiment. (4 contact hours, 6 self-study hours) Experimental content: Familiarize with Hall speed sensor, magnetic-electric sensor and rotating source module, understand the principle and application of Hall speed sensor and magnetic-electric measurement of speed.
Study and examination requirements and forms of examination	1. Class interaction (15%): attendance, course activity, accuracy of answers, expression and discussion. 2. Assignment (5%): completion progress, correctness 3. Experiment (20%): experiment report. 4. Final assessment (60%): final examination.
Media employed	Multimedia computer, projector, laser pen, blackboard, chalk, sensor and detection technology laboratory, sensor experimental module
Reading list	1. Textbooks [1] Wu Jianping, Peng Ying. Sensor Technology and Application [M], China Machine Press, 2020. 5. Reference book [1] Meng Lifa, Lan Jinhui et al. Principles and Applications of Sensors [M], China Machine Press, 2007. [2] Gao Xiaorong. Sensor Technology [M], Southwest Jiaotong University Press, 2019. [3] Wang Guirong. Principles and Applications of Sensors [M], Higher Education Press, 2020

Competence field	Engineering application courses
Curriculum designation	Digital Signal Processing
Curriculum code	9061313081
Semester(s) in which the curriculum is taught	6^{th} Semester
Person responsible for the curriculum	He Fei, associate professor
Lecturer	Associate Professor He Fei, Associate Professor Zhao Zhengchun, Associate Professor Deng Yaqi and Lecturer Lin Lin
Language	Chinese
The relationship between the curriculum and the major	The course "Digital Signal Processing" is a core course for undergraduate students in the Electronic Information Engineering major. It is preceded by advanced mathematics, complex functions and integral transforms, and signals and systems, providing foundational knowledge and theoretical background for courses in communication principles, D S P technology and applications, digital image processing, communication technologies, and embedded systems, including the basic theories, fundamental analytical methods, and algorithms of digital signal processing. The teaching objectives are: Through the study of this course, students need to understand the basic composition and characteristics of digital signal processing systems, comprehend the fundamental concepts of discrete-time signals and systems, master the definitions and properties of Z-transforms and Discrete-Time Fourier Transform (DTFT), grasp the definitions and properties of Discrete-Fourier Transform (DFT), understand the principles of Fast Fourier Transform (FFT) algorithms, and be able to flexibly apply the knowledge learned for signal spectrum analysis and design of digital filters according to practical needs. Through studying this course, students will learn the analytical methods and experimental techniques of digital signal processing, acquire knowledge related to digital signal processing required for engineering technology, enhance and improve their abilities in mathematical simulation, modeling, and designing digital filters, and be able to think about engineering problems using the mindset of digital signal processing.
Type of teaching, contact hours	Target students: Electronic Information Engineering major Teaching method: theoretical teaching + experiment Contact hours: 48 hours Including: Theoretical teaching: 40 hours Experimental/practical teaching: 8 hours Class size: Four classes with about 160 students
Workload	Total workload = 120 hours;

	Contact hours = 48 hours; Self-study hours = 72 hours;
Credit points	4.0
Requirements according to the examination regulations	Only students who attend class with a attendance rate of more than 2/3 and complete their homework with a completion rate of more than 2/3 can take the exam.
Prerequisite curriculum	Advanced mathematics, complex functions, signals and systems, MATLAB and system simulation
curriculum objectives /expected learning outcomes	**Learning outcomes:** Through the implementation of teaching links such as teaching, discussion and experiment, the following goals are achieved: **Knowledge:** Master the time-domain characteristics of discrete-time signals and be able to analyze the properties of linear shift-invariant systems calculate relevant performance parameters during signal sampling recovery. Master the transform-domain analysis methods of discrete-time signals deeply understand the intrinsic relationship between continuous signals and discrete signals and be able to analyze the relationship between the z-transform of sequences and the Laplace transform and Fourier transform of continuous signals. Master the principles and properties of Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) algorithms proficiently analyze the process of approximating continuous-time Fourier transforms using DFT and be able to calculate relevant performance parameters; deeply understand how FFT algorithms improve the effectiveness of DFT algorithms understand computational optimization methods and be able to perform performance comparisons. **Skill:** Master the design theory and method of digital filter; be proficient in the analysis of the differences and application methods of FIR filter and IIR filter, and be able to choose the appropriate scheme to design digital filter. **Ability:** Master the basic analytical methods and research methods of digital signal processing, use simulation tools to design simulation or experimental schemes, record, analyze, and interpret data, provide effective conclusions, and write experimental reports. This ensures that students receive rigorous training in scientific experimental skills, computational skills, and abstract thinking abilities; it cultivates students independent problem analysis and problem-solving capabilities, enhances their scientific literacy, and lays the foundation for subsequent courses and research work related

	to information processing.
Contents	**Theoretical teaching (40 hours of contact and 50 self-study hours)** Chapter 1: Introduction (2 contact hours, 2 self-study hours) 1. Overview (including course description) Chapter 2: Time domain discrete signals and time domain discrete systems (4 contact hours, 4 self-study hours) 1. Concept of sequence and common sequences; description method and basic properties of time domain discrete system; 2. Digital processing of analog signals. Chapter 3: Frequency domain analysis of time-domain discrete signals and time-domain discrete systems (6 contact hours, 8 self-study hours) 1. Z transform, Fourier transform of sequences and its properties; 2. Use Z transform to analyze the frequency response characteristics of signals and systems. Chapter 4: Discrete Fourier Transform (DFT) (10 contact hours, 10 self-study hours) 1. Fourier series (DFS) and properties of periodic sequences; 2. Discrete Fourier transform (DFT) and properties; 3. Frequency domain sampling theory and application; 4. Use DFT to calculate the Fourier transform of simulated signals. Chapter 5: Fast Fourier Transform (FFT) (6 hours of contact study, 8 self-study hours) 1. Base-2FFT algorithm extracted by time; 2. Base-2FFT algorithm selected according to frequency. 3. Other fast algorithms. Chapter 6: Network structure of discrete time systems (4 contact hours, 6 self-study hours) 1. Basic network structure and characteristics of IIR 2. Basic network structure of FIR and its characteristics Chapter 7: Design of Infinite Impulse Response (IIR) digital filters (8 contact hours, 10 self-study hours) 1. Method of designing IIR digital filter using analog filter 2. Impulse response invariant method and bilinear transformation method 3. The design method of the corresponding bandpass and high-pass filters from the low-pass prototype filter; the characteristics of the commonly used analog low-pass filter are used.

	Experimental teaching (8 hours of contact, 12 self-study hours) Experiment project 1: Generation of multiple signals and spectrum analysis of signals by FFT (4 contact hours, 4 self-study hours) Experimental content: will be able to compile the generation program of commonly used sequences; can select the transformation range of FFT to perform spectrum analysis on signals, and compare and analyze their amplitude-frequency characteristic curves. Experiment project 2: Design and software implementation of IIR DF (4 contact hours, 8 self-study hours) Experimental content: Through the spectrum analysis of composite signals, the spectrum is analyzed and a suitable DF filter is designed to realize the separation of composite signals.
tudy and examination requirements and forms of examination	1. Attendance rate (10%): Basic requirements of the course (no late arrival, no early departure, no absence without reason). 2. Course assignment (30%): lab report. 3. Final assessment (60%): final examination.
Media employed	Multimedia computer, projector, laser pen and MATLAB software
Reading list	1. Textbooks [1] Gao Xi Quan, Ding Yumei et al., Digital Signal Processing (4th Edition) [M], Xi an: Xi an University of Electronic Science and Technology Press, 2016. 2. Reference book [1] Gao Xi Quan, Ding Yumei et al., Study Guide of Digital Signal Processing (third Edition)[M], Xi an: Xi an University of Electronic Science and Technology Press, 2008 [2] MATLAB in Digital Signal Processing, edited by Xue Nianxi, Beijing: Tsinghua University Press, 200 8