目录

0010563 工程光学

课程编码：0010563

课程名称：工程光学

英文名称：Engineering optics

课程类型：学科基础必修课

学分： 3.0 **总学时：** 48

面向对象：测控技术与仪器专业本科生

先修课程：高等数学、大学物理

考核形式：平时成绩+实验+创新实践+期末考试

撰写人：陈洪芳

课程简介：

本课程是面向测控技术与仪器专业学生开展的学科基础必修课程，是本专业知识体系中不可或缺的部分，也是培养一流仪器科学与技术人才的重要支撑课程。本课程以培养具有坚实工程光学理论基础知识，具备运用工程光学系统知识解决光电测量领域中系统或仪器相关的复杂工程问题能力，可持续发展能力强的高素质创新型人才为目标，架构“知识—能力—创新—价值”四维度一体化高质量课堂。课程采取研究型教学手段，深度融合现代信息技术，强调启发性和研讨性，在讲授工程光学相关理论与知识的同时，培养学生能解决在光学测量、光学工艺、光学仪器的使用和设计等工程技术中的光学问题，掌握解决工程光学问题的方法和思想，并为学习近代光学理论打下良好基础。授课过程中融经典、基础、实用和前沿于一体，将我国在光学领域取得的成就蕴含于课程教学当中，帮助学生树立民族自信心和自豪感，厚植学生爱国主义情怀，培养学生致力于国产光学测量仪器研发、打造民族仪器品牌的价值取向。

本课程的内容主要包括几何光学的基本定律与成像概念、理想光学系统、光的电磁理论基础、光波的叠加与分析、光的干涉和干涉系统，共 5 章。同时，课程中包含 8 学时的实验内容，使学生在直观认识几何光学的基本定律和成像特性、理想光学系统的参数和成像关系、光的电磁性质、光在各向同性介质界面上的传播规律、光波的叠加与分析、光的干涉及典型干涉装置的应用上，培养设计解决光电测量领域中复杂工程问题实验方案的实践能力。

推荐教材或主要参考书：

[1] 郁道银，谈恒英主编，工程光学(第 4 版). 北京:机械工业出版社，2016 年
[2] 梁铨廷编著，物理光学. 北京:电子工业出版社，2018 年
[3] 宋贵才主编，物理光学. 北京:北京大学出版社，2010 年
[4] 刘翠红编著，物理光学学习指导与题解(第 2 版). 北京:电子工业出版社，2013 年

0010563 Engineering optics

Course Number: 0010563

Course Title: Engineering optics

Course Type: Compulsory basic courses

Credit: 3.0 **Total Credit Hours:** 48

Students: Undergraduate students majoring in measurement-control technology and instrument

Prerequisites: Advanced mathematics, university physics

Evaluation Method: Usual score + experiment + innovative practice + final exam

Writer: Chen Hongfang

Course Description:

This course is a basic compulsory course for students majoring in measurement and control technology and instrumentation. It is an indispensable part of the professional knowledge system and an important supporting course for cultivating first-class instrumentation science and technology talents. This course aims to cultivate high-quality innovative talents with solid theoretical knowledge of engineering optics, the ability to solve complex engineering problems related to systems or instruments in the field of optoelectronic measurement with the knowledge of engineering optical systems, and the ability of sustainable development. The four-dimensional integrated high-quality class of "knowledge - ability - innovation - value" is structured. The course adopts research-based teaching methods, deeply integrates modern information technology, and emphasizes inspiration and seminar. While teaching theories and knowledge related to engineering optics, it aims to train students to solve optical problems in engineering technologies such as optical measurement, optical technology, use and design of optical instruments, and master methods and ideas for solving engineering optical problems. It lays a good foundation for learning modern optical theory. The teaching process integrates classic, basic, practical and cutting-edge, and contains China's achievements in the field of optics in the course teaching, helping students establish national self-confidence and pride, cultivating students' patriotic feelings, and cultivating students' value orientation of committing to the research and development of domestic optical measuring instruments and building national instrument brands.

The content of this course mainly includes the basic laws of geometric optics and imaging concepts, ideal optical system, electromagnetic theory of light, superposition and analysis of light waves, light interference and interference system, a total of 5 chapters. At the same time, the course includes 8 hours of experimental content, so that students can directly understand the basic laws and imaging characteristics of geometric optics, the parameters and imaging relations of ideal optical systems, the electromagnetic properties of light, the propagation law of light on the interface of isotropic media, the superposition and analysis of light waves, and the application of

typical interference devices involving light stem. Develop the practical ability to design and solve complex engineering problems in the field of photoelectric measurement.

Recommended Textbooks/References:

1. Yu Daoyin, Tan Hengying, Ed. Engineering Optics (4th Ed.). Beijing: China Machine Press, 2016.

2. Liang Quanting, Ed. Physical Optics. Beijing: Publishing House of Electronics Industry, 2018.

3. Guicai Song, Ed. Physical Optics. Beijing: Peking University Press, 2010.

4. Cuihong Liu, Ed. Physical Optics Learning Guidance and Problem Solving (2nd Edition). Beijing: Electronic Industry Press, 2013

0011105 测控电路

课程编码：0011105

课程名称：测控电路

英文名称：Measurement and Control Circuit

课程类型：学科基础必修课

学分： 2.0 **总学时：** 32

面向对象：测控技术与仪器专业本科生

先修课程：电路分析基础, 模拟电子技术，数字电子技术

考核形式：平时成绩(30%) + 实验(20%) + 考试(50%)

撰写人：李鹏

课程简介：（250-300 字）

测控电路是为测控技术与仪器专业本科生开设的学科基础必修课。本课程的任务是围绕精、快、灵的测控需求，讲授测控系统中常用的功能电路的工作原理、以及电子器件和集成电路的外特性的分析方法，使学生在理论和实践上掌握测控系统和仪表中电子电路的分析方法、设计方法和实验调试方法，培养学生运用电子技术解决测量与控制任务中的实际问题。重点教学内容包括测控电路的传输特性、运算放大电路的特性和分析方法、信号调制与解调的基本原理、信号分离电路的基本原理与有源滤波器电路的设计、以及常用信号转换电路的工作原理等。教学内容的难点包括运算放大器的误差和补偿、调制解调电路的分析、RC 有源滤波电路的设计等。

推荐教材或主要参考书：

[1] 李醒飞 主编. 测控电路（第 6 版）. 北京：机械工业出版社，2021 年 12 月

[2] 李刚，现代测控电路，高等教育出版社，2004 年 1 月

[3] 孙传友等，测控电路与装置，北京航空航天大学出版社，2002 年 5 月

[4] 郝晓剑 主编，测控电路设计与应用（第 3 版），电子工业出版社，2017 年 3 月

0011105 Measurement and Control Circuit

Course Number: 0011105

Course Title: Measurement and Control Circuit

Course Type: Basic Major Required Course

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students majoring in measurement, control, and instrumentation.

Prerequisites: Fundamentals on Electric Circuits, Analog Electronics, Digital Electronics

Evaluation Method: Homeworks and Course participation (30%) + experiments (20%) + final exams (50%)

Writer： Li Peng

Course Description:

Measurement and Control Circuit is one of the basic major required courses for undergraduate students majored in Measurement, Control, and Instrumentation. The main target of this course is to clarify the fundamental principles of functional circuits in measure-control systems, and to analyze the properties of electronic elements and integrated circuits. Focused on the requirements on accurate, fast, and sensitive, this course is to provide students the ability to tackle practical electronic problems in measure-control systems and instruments, the capability of analysis and design of basic electric circuits and laboratory implementation of circuit designs. The main topics covered in this course include the transfer functions of measure-control circuits, analysis of operational amplifiers, principles of modulation and demodulation, principles of signal separating circuits and design of filter circuits, principles of signal converters, etc. The difficulties of teaching contents include: error and compensation method for operational amplifiers, analysis of modulation and demodulation circuits, design of RC filters, etc.

Recommended Textbooks/References:

1. XingFei Li (main editor), Measuring and controlling circuit (6th edition), *Beijing:China Machine Press*, December 2021
2. Gang Li, Modern Measurement and Control circuits, *Higher Education Press*, January 2004
3. ChuanYou Sun, et al., Measure-Control Circuits and Devices, *Beihang University Press,* May 2002
4. XiaoJian Hao (main editor), Design and Application of Measurement and Control Circuits (3rd edition), March 2017

0011108 测控电路高级实践

课程编码：0011108

课程名称：测控电路高级实践

英文名称：Advanced practice of measurement and control circuit

课程类型：实践环节必修课

学分： 2.0 **总学时：** 60

面向对象：测控技术与仪器专业本科生

先修课程：传感与测试技术、测控电路

考核形式：平时成绩 20%+实验成绩 60%+实验报告 20%

撰写人：高杰

课程简介：（250-300 字）

测控电路高级实践是为机械及测控专业本科生开设的实践环节必修课程。本课程的任务是让学生了解基于 FPGA 的高级电路设计及实验方法，教学内容重点是如何将典型测控电路在 FPGA 平台进行设计实现，教学内容的难点主要表现在 FPGA 软硬件的设计流程及实验方法。

随着社会的发展和科技的进步，电子技术和微电子领域也呈现日新月异的景象，FPGA（Field Programmable Gate Array，现场可编程门阵列）越来越被人们所熟知。近年来，FPGA 在人工智能、机器学习的浪潮中异军突起，为使教学更贴近实际工程应用，使学生具备开发大规模软硬一体测控系统的能力，本课程在先修课程《测控电路》的基础上，以 FPGA 为核心，以 Verilog HDL 为基础语言，围绕测量仪器和自动测控系统中常用的单元电路和系统算法，结合具体案例进行编程开发，使学生进一步掌握运用电子技术来解决测量与控制中的任务，同时更加深入地了解各种电子器件和集成电路的原理及特性。课程注重培养学生的软硬件编程能力、系统方案设计能力与团队协作能力。

推荐教材或主要参考书：

1. 刘军、阿东、张洋. 《原子教你玩 FPGA：基于 Intel Cyclone IV》. 北京航空航天大学出版社, 2019 年 10 月.

2. 夏宇闻. 《Verilog 数字系统设计教程》, 北京航空航天大学出版社. 2008 年 04 月.

0011108 Advanced practice of measurement and control circuit

Course Number: 0011108

Course Title: Advanced practice of measurement and control circuit

Course Type: Practice Training

Credit: 2.0 **Total Credit Hours:** 60

Students: Undergraduate students majoring in Measurement and control technology and instrument, or in Mechanical engineering

Prerequisites: Sensor and Measurement Technology, Measurement and Control Circuit

Evaluation Method: Course participation + Training Projects

Writer： Gao Jie

Course Description:

Advanced practice of measurement and control circuit is a practical compulsory course for undergraduates majoring in machinery and measurement and control. The task of this course is to let students understand advanced circuit design and experimental methods based on FPGA. The teaching content focuses on how to design and implement typical measurement and control circuits on FPGA platform. The difficulties of the teaching content are mainly reflected in the design process and experimental methods of FPGA Software and hardware.

FPGA (field programmable gate array) is more and more well known. In recent years, FPGA has sprung up in the wave of artificial intelligence and machine learning. In order to make teaching closer to practical engineering applications and enable students to develop large-scale software and hardware integrated measurement and control system, this course takes FPGA as the core and Verilog HDL as the basic language on the basis of the prerequisite course measurement and control circuit. Around the unit circuits and system algorithms commonly used in measuring instruments and automatic measurement and control systems, programming development is carried out in combination with specific cases, so that students can further master the use of electronic technology to solve the tasks in measurement and control, and have a deeper understanding of the principles and characteristics of various electronic devices and integrated circuits. The course focuses on cultivating students' software and hardware programming ability, system scheme design ability and team cooperation ability.

Recommended Textbooks/References:

1. Liu Jun, Adon, and Zhang Yang. Atom teaches you to play with FPGAs: based on Intel Cyclone IV. Beijing University of Aeronautics and Astronautics Press, 2019.

2.Xia Yuwen. Verilog Digital System Design Tutorial, Beijing University of Aeronautics and Astronautics Press. April 2008.

0011119 测控技术与仪器前沿

课程编码：0011119

课程名称：测控技术与仪器前沿

英文名称：Frontier of Measurement and Control Technology and Instrumentation

课程类型：自主课程

学分：1.0　**总学时：**16

面向对象：测控技术与仪器专业本科生

先修课程：传感与测试技术、测控电路、光电技术

考核形式：平时成绩+报告

撰写人：吕炎

课程简介：（250-300 字）

测控技术与仪器对高新技术极度敏感，各种新原理、新概念、新技术、新材料和新工艺等均在新仪器、新装置有所体现。本课程通过一系列前沿讲座，让学生了解有关测量控制与仪器仪表在信息传感与测试、模拟信号调理、数字信号处理、智能控制与系统、现代仪器仪表设计与制造五个方面的前沿技术，并了解测量控制与仪器仪表在几何量测量仪器、电子与电工测量仪器、无损检测仪器等的发展现状和趋势。引导学生对科学探索产生兴趣，提升学生对综合知识的应用能力。

推荐教材或主要参考书：

林玉池. 测量控制与仪器仪表前沿技术及发展趋势（第 2 版）. 天津大学出版社，2008.12

0011119 Frontier of Measurement and Control Technology and Instrumentation

Course Number: 0011119

Course Title: Frontier of Measurement and Control Technology and Instrumentation

Course Type: Autonomous Curriculum

Credit: 1.0 **Total Credit Hours:** 16

Students: Undergraduate students majoring in Measurement and control technology and instrument

Prerequisites: Sensing and testing technology, measurement and control circuit, photoelectric technology

Evaluation Method: Course participation + Report

Writer： Lv Yan

Course Description:

Measurement and control technology and instruments are extremely sensitive to high and new technology. Various new principles, new concepts, new technologies, new materials and new processes are reflected in new instruments and new devices. Through a series of cutting-edge lectures, this course enables students to understand the frontier technologies of measurement control and instruments in five aspects: sensing and testing, analog signal conditioning, digital signal processing, intelligent control and system, and modern instrument design and manufacturing, as well as the application, development, trend of the measurement control and instrumentation in geometric measurement instruments, electronic and electrical measurement instruments in nondestructive testing instruments, in order to guide the students to be interested in scientific exploration and to improve students' ability to apply comprehensive knowledge.

Recommended Textbooks/References:

Lin Yuchi. The Frontier techniques and development trends of Measurement and Controls and Instrumentation (the second edition). Tianjin University Press. 2008.12

0011115 超声阵列及成像技术

课程编码：0011115

课程名称：超声阵列及成像技术

英文名称：Ultrasonic array and imaging technology

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：测控技术与仪器专业本科生

先修课程：智能传感材料与结构

考核形式：平时成绩+课程报告

撰写人： 朱艳萍

课程简介：（250-300 字）

超声阵列及成像技术是为测控技术与仪器专业本科生开设的专业选修课。本课程的任务是通过课堂教学和仿真实现，使学生掌握超声阵列成像的基础知识，掌握必要的常见的成像方法，并能跟踪和学习新的理论、方法和技术。了解超声阵列成像技术的发展趋势，为从事无损检测，超声成像等方面的研究和工作打下基础。增强学生对科学知识的理解与应用，分析问题和解决问题的能力，以及理论和实际相结合的能力，培养工科类学生在实际工作过程中的责任与担当。教学内容重点：相控阵超声成像技术的实现。教学难点：超声成像的声学基础和成像原理。

推荐教材或主要参考书：

[1] 施克仁, 郭寓岷. 相控阵超声成像检测. 高等教育出版社, 2010.

[2] 杜功焕,朱哲民,龚秀芬，声学基础，南京：南京大学出版社，2002

[3] 张小飞,汪飞,徐大专，阵列信号处理的理论和应用, 北京:国防工业出版社,2010.11

[4] 郑晖, 林树青主编，超声检测. 北京：中国劳动社会保障出版社，2008

[5] 丁辉. 计算超声学[M]. 科学出版社, 2010.

0011115 Ultrasonic array and imaging technology

Course Number: 0011115

Course Title: Ultrasonic array and imaging technology

Course Type: Major Elective Courses

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students majoring in Technology and Instrument Specialty

Prerequisites: Smart materials and Structures for Sensor Technology

Evaluation Method: Course participation + curriculum design

Writer： Zhu Yanping

Course Description:

Ultrasonic array and imaging technology is an elective course for undergraduates majoring in measurement and control technology and instrument. The task of this course is to enable students to master the basic knowledge of ultrasound array imaging, master the necessary common imaging methods, and track and learn new theories, methods and technologies through classroom teaching and simulation. To understand the development trend of ultrasonic array imaging technology, and lay a foundation for the research and work of nondestructive testing, ultrasonic imaging and other aspects. To enhance the students' understanding and application of scientific knowledge, the ability to analyze and solve problems, and the ability to combine theory with practice, so as to cultivate engineering students' responsibility and responsibility in the actual work process. Emphasis of teaching content: realization of phased array ultrasonic imaging technology. Teaching difficulties: acoustic basis and imaging principle of ultrasonic imaging.

Recommended Textbooks/References:

1.Shi Keren, Guo Yumin. Phased array ultrasonic imaging detection. Higher education press, 2010.

2.Du Gonghuan, Zhu Zhemin, Gong Xiufen, Fundamentals of acoustics, Nanjing: Nanjing University Press, 2002

3.Zhang Xiaofei, Wang Fei, Xu junior college, theory and application of array signal processing, Beijing: National Defense Industry Press, 2010.11

4.Zheng Hui, Lin Shuqing, chief editor, ultrasonic testing. Beijing: China Labor and social security press, 2008

5.Ding Hui. Computational ultrasound [M]. Science Press, 2010.

0011106 传感与测试技术

课程编码：0011106

课程名称：传感与测试技术

英文名称：Sensor and Measurement Technology

课程类型：学科基础必修课

学分：3.0　　**学时：48**

适用对象：测控技术与仪器专业本科生

先修课程：工程力学、模拟电子技术、数字电子技术、自动控制原理、误差理论与数据处理

考核形式：平时成绩 10%，实验成绩 20%，期末考试 70%

撰写人：刘秀成 高翔

课程简介：（200-300 字）

传感与测试技术课程介绍测控技术与仪器、机械工程测试领域的信号采集、传输与处理等基础知识，包括信号分析基础、常见传感器工作原理、传感器与测试系统特性分析测试、数字信号处理等内容。课程强调已有专业知识的综合应用，通过基础知识讲授、案例分析、前沿讲座及课内实验等环节，使学生能够将物理、数学、电路基础、工程力学等知识应用于传感器选用和设计、测试系统的传递函数建模与分析、数字信号分析和处理等，以培养学生依据工业生产、国防建设中所面临的工程测试问题，制定传感与测试技术解决方案的能力。

推荐教材或主要参考书：

[1] 焦敬品，何存富.传感与测试技术[M].中国铁道出版社有限公司，2021 年.

[2] 熊诗波，黄长艺. 机械工程测试技术基础（第 4 版）. 北京：机械工业出版社，2019 年

[3] 樊尚春. 传感器技术及应用（第 3 版）. 北京：北京航空航天大学出版社，2016 年

[4] 贾民平, 张洪亭. 测试技术（第 3 版）. 北京：高等教育出版社，2016 年

0011106 Sensor and Measurement Technology

Course Number: 0011106

Course Title: Sensor and Measurement Technology

Course Type: Compulsory basic courses

Credit: 3.0 **Total Credit Hours:** 48

Students: Undergraduate students major in Measurement& Control Technology and Instrument, Mechanical engineer

Prerequisites: Engineering mechanics, analog and digital circuits, Automatic Control Principle, error theory and data processing

Evaluation Method: Homework (10%), experiments (20%) and final exam (70%)

Writer： Liu Xiucheng / Gao Xiang

Course Description:

The course of sensing and testing technology introduces the basic knowledge of signal acquisition, transmission and processing in the field of Measurement& Control Technology and Instrument, Mechanical Engineering Testing. The content includes foundation of signal analysis, working principle of general sensors, characteristic analysis and testing of sensors and test system, and digital signal processing. The course emphasizes the comprehensive application of existing professional knowledge. Through the teaching of basic knowledge, case analysis, frontier lectures and in class experiments, students can apply the knowledge of physics, mathematics, circuit foundation and engineering mechanics for sensor selection and design, transfer function modeling and analysis of test system, digital signal analysis and processing. The above activities are used to train students to provide proper solutions for engineering test problems in industry and defense construction.

Recommended Textbooks/References:

1. 1. Jiao Jingpin, He Cunfu. Sensing and Testing Technology [M]. China Railway Press Co., LTD.,2021.
2. 2. Xiong Shibo, Huang Changyi. Fundamentals of Mechanical Engineering Test Technology (4th Edition). Beijing: China Machine Press, 2019
3. 3. Fan Shangchun. Sensor Technology and Application (3rd edition). Beijing: Beihang University Press, 2016
4. 4. Jia Minping, Zhang Hongting. Test Technology (3rd Edition). Beijing: Higher Education Press, 2016

0011107 传感与测试技术课设

课程编码：0011107

课程名称：传感与测试技术课设

英文名称：Course Design of Sensor and Measurement Technology

课程类型：实践环节必修课

学分：2.0　　**学时：**60

适用对象：测控技术与仪器、机械工程专业本科生

先修课程：工程力学、模拟电子技术、数字电子技术、自动控制原理、误差理论与数据处理

考核形式：平时成绩 40%，期末答辩 60%

撰写人：刘秀成 高翔

课程简介：（200-300 字）

本课程设计的目的就是要使学生较全面、系统地总结和巩固所学的传感器与测试技术相关理论知识，掌握各类传感器、调理电路及至完整检测系统的工作原理，并进行主动设计与综合测试。本课程设计针对典型非电量（声、光、磁、机械、热等物理量）的测量问题，提出传感与测试技术方案。设计选题应注重与实际工程项目相结合，鼓励学生通过课程设计直接参与工程或科研项目，使学生学习和掌握正确的测试系统设计思想、方法和步骤，熟练操作和使用测试仪器，提高实验技能，培养学生分析、解决复杂工程问题的能力。

推荐教材或主要参考书：

[1] 焦敬品，何存富.传感与测试技术[M].中国铁道出版社有限公司，2021 年.

[2] 熊诗波，黄长艺. 机械工程测试技术基础（第 4 版）. 北京：机械工业出版社，2019 年

[3] 樊尚春. 传感器技术及应用（第 3 版）. 北京：北京航空航天大学出版社，2016 年

[4] 贾民平, 张洪亭. 测试技术（第 3 版）. 北京：高等教育出版社，2016 年

0011107 Course Design of Sensor and Measurement Technology

Course Number: 0011107

Course Title: Course Design of Sensor and Measurement Technology

Course Type: Practice Training

Credit: 2.0 **Total Credit Hours:** 60

Students: Undergraduate students major in Measurement& Control Technology and Instrument, Mechanical engineer

Prerequisites: Engineering mechanics, analog and digital circuits, Automatic Control Principle, error theory and data processing

Evaluation Method: Usual performance (40%), final project defense (60%)

Writer： Liu Xiucheng /Gao Xiang

Course Description:

The purpose of this course is to make students consolidate the theoretical knowledge of the sensor and testing technology by project training. Through the system design and performance test, the student can comprehensive understanding the work principle of various types of sensors, signal conditioning circuit and detection systems. The projects has to provide solutions for measuring typical non-electric quantities, such as acoustic-, optical-, magnetic-, mechanical-, thermal- and other physical quantities. The solutions should be provided for practical engineering applications. In the curriculum design, students are encouraged to directly attend engineering or scientific research projects. The course aims to help the students to learn the ideas, methods and steps for test system design, also to train the students to skillfully operate the testing equipment for solving complex engineering problems.

Recommended Textbooks/References:

1.Jiao Jingpin, He Cunfu. Sensing and Testing Technology [M]. China Railway Press Co., LTD.,2021.

2.Xiong Shibo, Huang Changyi. Fundamentals of Mechanical Engineering Test Technology (4th Edition). Beijing: China Machine Press, 2019

3.Fan Shangchun. Sensor Technology and Application (3rd edition). Beijing: Beihang University Press, 2016

4.Jia Minping, Zhang Hongting. Test Technology (3rd Edition). Beijing: Higher Education Press, 2016

0002534 光电技术 I

课程编码：0002534

课程名称：光电技术 I

英文名称：Photoelectric technology

课程类型：学科基础选修课

学分： 2.0 **总学时：** 32

面向对象：测控技术与仪器专业本科生

先修课程：工程光学、模拟电子技术、传感器与测试技术

考核形式：平时成绩+课程综合报告+企业专家授课学术报告总结+期中考试+期末考试

撰写人：陈洪芳

课程简介：

本课程是面向测控技术及仪器专业学生开展的学科基础选修课程。课程采取研究型教学手段，强调启发性和研讨性，在讲授光电技术相关理论与知识的同时，建立学生解决复杂工程中光电仪器设计相关问题的思维方法。本课程以基本光电理论为基础，讲解光电器件的工作原理及特性，使学生掌握应用这些光电器件的方法，包括光电系统概述、光辐射源、光电探测器概述、光电导探测器、光伏探测器、光电子发射探测器、热探测器、光电成像器件、典型光电系统的分析与设计，共 8 章。同时，课程中包含 4 学时的实验内容，使学生在直观认识光电现象的基础上，培养学生的设计方案能力、实验分析能力及团队写作能力。

推荐教材或主要参考书：

[1] 杨应平，胡昌奎，陈梦苇编著，光电技术. 北京：清华大学出版社，2020 年

[2] 郝群主编，光电仪器原理与设计. 北京：机械工业出版社，2019 年

[3] 刘国栋，赵辉，浦昭邦主编，光电测试技术. 北京：机械工业出版社，2018 年

[4] 周雅，胡摇，董立泉，刘明，赵跃进编著，光电测控系统设计与实践. 北京：电子工业出版社，2017 年

0002534 Photoelectric technology

Course Number: 0002534

Course Title: Photoelectric technology

Course Type: Basic elective course

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students majoring in measurement-control technology and instrument

Prerequisites: Engineering optics, analog electronic circuits, sensors and testing techniques

Evaluation Method: Usual score + course synthesis report + summary of academic report taught by enterprise experts + mid-term exam + final exam

Writer: Chen Hongfang

Course Description:

This course is a basic elective course for students majoring in measurement and control technology and instrumentation. The course adopts research-based teaching methods, emphasizing inspiration and seminar. While teaching relevant theories and knowledge of optoelectronic technology, it establishes thinking methods for students to solve problems related to the design of optoelectronic instruments in complex projects. This course is based on the basic photoelectric theory, explaining the working principle and characteristics of photoelectric devices, so that students can master the application methods of these photoelectric devices, including photoelectric system overview, optical radiation source, photoelectric detector overview, photoconductivity detector, photovoltaic detector, photoelectron emission detector, thermal detector, photoelectric imaging device, typical photoelectric system analysis and design, a total of 8 chapters. At the same time, the course includes 4 hours of experimental content, so that students can intuitively understand the photoelectric phenomenon on the basis of developing students' ability to design schemes, experiment analysis and team writing.

Recommended Textbooks/References:

1. Yang Yingping, Hu Changkui, Chen Mengwei, eds., Optoelectronic Technology. Beijing: Tsinghua University Press, 2020.

2. Hao Qun (Ed.), Principle and Design of photoelectric instruments. Beijing: China Machine Press, 2019.

3. Liu Guodong, Zhao Hui, Pu Zhaobang (Ed.), Photoelectric Test Technology. Beijing: China Machine Press, 2018.

4. Zhou Ya, Hu Yao, Dong Liquan, Liu Ming, Zhao Yuejin, Ed., Design and Practice of photoelectric measurement and control systems. Beijing: Publishing House of Electronics Industry, 2017.

0011111 计算机测控系统

课程编码：0011111

课程名称：计算机测控系统

英文名称：The computer measuring and controlling system

课程类型：专业选修课

学分：2.0　　**总学时：** 32

面向对象：测控技术与仪器专业本科生

先修课程：电路分析基础

考核形式：自学成绩 50%（自学笔记 40%，课堂讨论 10%）+实验成绩 50%（实验 40%，报告交流 10%）

撰写人：田九洲

课程简介：

计算机测控系统是为测控技术与仪器专业本科生开设的实践环节选修课。本课程的任务是培养学生自学能力，对于学生掌握相关专业知识，培养学生具有自主学习和终身学习的意识，具有分析和解决实际工程中测量与控制问题的能力、利用计算机软硬件基础知识解决测控系统与仪器中复杂工程问题能力、工程创新能力，以及不断学习和适应发展的能力，均具有重要的指导作用。

教学内容重点：围绕测控系统的组成结构与特点、设计思想、设计要点和设计过程等基本知识，系统学习测控技术的工作原理、设计原则、测控算法和实现方法等基本理论和方法，掌握计算机测控系统硬件搭建与软件调试等基本技术。

教学内容的难点：典型计算机测控系统工程应用实例的设计与实现。

推荐教材或主要参考书：（含主编，教材名，出版社，出版日期）

[1] 罗文广，计算机控制技术，机械工业出版社，2018 年 11 月

[2] 蔡建文,温秀兰,计算机测控技术,东南大学出版社,2016 年 12 月

[3] 于微波，计算机测控技术与系统，机械工业出版社，2015 年 12 月

0011111 The computer measuring and controlling system

Course Number: 0011111

Course Title: The computer measuring and controlling system

Credit:2.0 **Total Credit Hours:** 32

Students: Undergraduates major in Control Technology and Instrument and in Mechanical Engineering

Prerequisites: Theory of Circuit

Evaluation Method: The score distribution is showed as follows: Self-study performance 50% (40% self-study notes and 10% class discussion), experimental results 50% (experiment 40%, the report exchange10%)

Writer： Tian Jiuzhou

Course Description:

The computer measuring and controlling system is a practical elective course provided for undergraduates majoring in Control Technology and Instrument. The task of this course is to develop students' self-learning ability. It has an important guiding role for students to master relevant professional knowledge and cultivate students' awareness of independent learning and lifelong learning. Moreover, it helps students develop abilities to analyze and solve measurement and control problems in actual engineering, as well as using computer and hardware basic knowledge to solve complex engineering problems and engineering innovation capabilities in measurement and control systems and instruments. Furthermore, provide the ability to continuously learn and adapt to development for students.

Main focus of teaching content: Learn the basic theories and methods such as the working principle, design principles, measurement and control algorithms and implementation methods of measurement and control technology, which centers on basic knowledge of the composition and characteristics of the measurement and control system, design ideas, design points and design process.

Difficulties in teaching content: Design and implementation of typical computer measuring and controlling system engineering application examples.

Recommended Textbooks/References:

1．Wenguang Luo, Computer Control Technology, Machinery Industry Press, Nov. 2018.

2．Jianwen Cai, Xiulan Wen, Computer Measurement and Control Technology, Southeast University Press, Dec. 2016.

3．Weibo Yu, Computer Measuring and Controlling Technology and System, Dec. 2015.

0011113 计算机视觉与图像处理

课程编码：0011113

课程名称：计算机视觉与图像处理

英文名称：Computer Vision and Image Processing

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：测控技术与仪器专业本科生

先修课程：信号系统与信息处理

考核形式： 平时成绩+考试

撰写人：王昕

课程简介：（250-300 字）

计算机视觉与图像处理是为测控技术与仪器专业本科生开设的专业限选课程。本课程的任务是通过对计算机视觉与图像处理的基本理论的学习，针对图像处理中需要了解、掌握的问题向学生传授相关知识，培养学生对于图像处理的基本方法的了解与掌握。教学内容重点：要求学生掌握有关方面的基本概念、基本理论、基本方法和基本技术。本课程主要讲解关于图像处理的主流领域，所涵盖的主要领域包括强度变换，线性和非线性空间滤波，滤波频域，图像复原和定位，小波，图像数据压缩，形态学图像处理，图像分割，区域和边界表示和描述，如何进行图像识别等基础知识。教学内容的难点：如何利用 Matlab 解决图像处理的一般基础问题。

推荐教材或主要参考书：

[1] 阮秋琦，数字图像处理学（第四版），电子工业出版社，2022 年 05 月

[2] Rafael C Gonzalez, Richard E Woods. 数字图像处理（第四版）. 电子工业出版社，2018.01

0011113 Computer Vision and Image Processing

Course Number: 0011113

Course Title: Computer Vision and Image Processing

Course Type: Major Elective Courses

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students majoring in Measurement & Control Technology and Instrumentations

Prerequisites: Signals, Systems and Signal Procession

Evaluation Method: Course participation + written exams

Writer： Wang Xin

Course Description:

Computer Vision and Image Processing is one of the specialized direction courses for undergraduate students Major in Measurement & Control Technology and Instrumentations. The main target of this course is to clarify the basic principles and methods of computer digital image processing. This course is focus on the basic content of the image processing, including image spectral analysis, image enhancement, image compression coding and image restoration. The teaching contents are mainly covered by the following aspects: intensity transformation, linear and nonlinear spatial filtering, filtering frequency domain, image restoration and localization, wavelet, image data compression, morphological image processing, image segmentation, region and boundary representation and description, and how to perform image recognition. The difficulties of teaching contents are described as followings: the concept is not difficult, but the method is difficult, students should understand digital images, the human visual system and the visual characteristics, optical basic knowledge and visual models, etc.

Recommended Textbooks/References:

1． RUAN Qiuqi, Digital Image Processing (4rd Edition), *Electronic Industry Press*, 05-2022

2.Rafael C Gonzalez, Richard E Woods, Digital Image Processing (4th Edition). *Electronic Industry Press*, 2018

0011116 微磁传感与检测技术

课程编码：0011116

课程名称：微磁传感与检测技术

英文名称：Micromagnetic Sensor and Testing Technology

课程类型：专业选修课

学分：2.0　　**学时：**32

适用对象：测控技术与仪器专业本科生

先修课程：大学物理

考核形式：平时表现（10%）、设计大作业（50%）和实验（40%）

撰写人：刘秀成

课程简介：（200-300 字）

微磁传感与检测技术综合了测控技术与仪器专业所学的多门类基础知识，以面向具体工程应用的微磁传感器及仪器为对象，融合了测控电路、传感器、电磁场、信号分析与处理、人工智能、仪器系统集成等知识，是培养学生综合科研素养、深入认识传感与检测技术工程应用的一门综合性课程。

本课程主要内容包括基础知识学习、传感器与仪器技术解剖、实验操作等 3 部分，其中基础知识学习涵盖铁磁性材料及其电磁特性、磁畴理论、微磁检测原理、信号分析原理等；技术解剖涉及涡流、漏磁、多功能微磁检测传感器与仪器；实验操作是指利用已有传感器与仪器开展研究型实验。

推荐教材或主要参考书：

1. 田贵云 高斌. 电磁无损检测传感与成像. 机械工业出版社，2020

2. Lode Vandenbossche. Magnetic Hysteretic Characterization of Ferromagnetic Materials with Objectives towards Non-Destructive Evaluation of Material Degradation. PhD Thesis. Universiteit Gent, 2008.

3. Gerd DOBMAN. Physical Basics and Industrial Applications of 3MA-Micromagnetic Multiparameter Microstructure and Stress Analysis. Fraunhofer IZFP, Germany. 2007.

0011116 Micromagnetic Sensor and Testing Technology

Course Number: 0011116

Course Title: Micromagnetic Sensor and Testing Technology

Course Type: Major Elective Courses

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students major in Measurement& Control Technology and Instrument

Prerequisites: College physics

Evaluation Method: Usual performance (10%), design large homework (50%) and experiment (40%)

Writer： Liu Xiucheng

Course Description:

Micromagnetic Sensor and Testing Technology integrates many kinds of basic knowledge in major of measurement& Control Technology and Instrument. It takes the micro magnetic sensor and instrument for specific engineering application as the object and combines the knowledge of measurement and control circuit, sensor, electromagnetic field, signal analysis and processing, artificial intelligence, instrument system integration, etc. It is a comprehensive course of engineering application, which aims to cultivate students' comprehensive scientific research literacy and help the students deeply understand sensing and detection technology.

The main content of this course includes three parts: basic knowledge learning, sensor and instrument technical anatomy and experimental operation. The basic knowledge learning covers ferromagnetic materials and their electromagnetic properties, magnetic domain theory, micro magnetic detection principle, signal analysis principle, etc.; technical anatomy involves eddy current, magnetic leakage, multi-functional micro magnetic detection sensors and instruments; experimental operation refers to the use of existing sensors and instruments for research-oriented experiments.

Recommended Textbooks/References:

1. Tian GUI Yun Gao Bin. Electromagnetic nondestructive testing sensing and imaging. China Machine Press, 2020

2. Lode Vandenbossche. Magnetic Hysteretic Characterization of Ferromagnetic Materials with Objectives towards Non-Destructive Evaluation of Material Degradation. PhD Thesis. Universiteit Gent, 2008.

3. Gerd DOBMAN. Physical Basics and Industrial Applications of 3MA-Micromagnetic Multiparameter Microstructure and Stress Analysis. Fraunhofer IZFP, Germany. 2007.

0011103 无损检测技术

课程编码：0011103

课程名称：无损检测技术

英文名称：Technology of Non-destructive Testing

课程类型：专业选修课

学分： 2 **总学时：** 32

面向对象：测控技术与仪器专业本科生

先修课程：传感与测试技术，大学物理

考核形式： 平时成绩+考试

撰写人：焦敬品

课程简介：

无损检测技术是为测控技术与仪器专业本科生开设的专业任选课程。本课程的任务是讲述无损检测技术的基本概念、基本方法及在工业领域中的应用。通过课程学习，使学生了解无损检测领域的前沿技术和发展动态，培养学生掌握各种常规无损检测仪器设备的使用，掌握各种检测技术对被检对象的缺陷作进行定性及定量分析的方法。本课程主要讲述常见无损检测技术的基本原理、特点、适用范围、基本检测方法及在工业中的典型应用，并注重超声检测技术和电磁检测技术最新发展的介绍。教学内容的难点在于超声检测中检测参数及方案设计。

推荐教材或主要参考书：[1]魏坤霞. 无损检测技术. 北京：中国石化出版社，2016 年

[2]沈玉娣. 现代无损检测技术. 西安交通大学出版社，2010 年

[3]施克仁. 无损检测新技术. 清华大学出版社，2007 年

[4]Giuseppe Acciani，Ultrasonic Nondestructive Evaluation Systems: Industrial Application Isues，Springer International Publishing，2012

0011103 Technology of Non-destructive Testing

Course Number: 0011103

Course Title: Technology of Non-destructive Testing

Course Type: Major Elective Courses

Credit: 2 **Total Credit Hours:** 32

Students: Undergraduate students majoring in Measurement and control technology and instruments

Prerequisites: Sensing and test technology, physics

Evaluation Method: Course participation + written exams

Writer：Jiao Jingpin

Course Description:

Non-Destructive Testing Technology is one of the optional courses offered by the Department of Materials and Manufacturing for undergraduate students in Measurement and Control Technology. The main task of this course is to clarify the basic concepts, basic methods and applications of NDT techniques in industry. Through the course, students will learn about the cutting-edge technology and developments in the field of nondestructive testing, train students to master the use of various conventional nondestructive testing instruments and equipment, and master various testing techniques to perform qualitative and quantitative analysis of defects in samples. This course is focus on the basic principles, characteristics, scope of application, basic inspection methods and typical applications in industry of common non-destructive testing techniques, and focuses on the introduction of the latest developments in ultrasonic and electromagnetic inspection techniques. The difficulties of teaching contents are described as followings: detection parameters and the design of the protocol in the ultrasound test.

Recommended Textbooks/References:

1.Wei Kuixia, Non-destructive testing technology, Sinopec Press, 2016

2.Shen Yudi, Modern non-destructive testing technology, Xi'an Jiaotong University Press.,2010

3.Shi Keren, New technology for non-destructive testing, Tsinghua University Press. ,2007

4.Giuseppe Acciani，Ultrasonic Nondestructive Evaluation Systems: Industrial Application Isues，Springer International Publishing，2012

0011102 误差理论与数据处理

课程编码：0011102

课程名称：误差理论与数据处理

英文名称：Error Theory and Data Processing

课程类型：学科基础必修课

学分：2.0　　**学时：**32

适用对象：测控技术与仪器专业本科生

先修课程：概率论与数理统计

考核形式：平时成绩（30%）、课程设计大作业（70%）

撰写人：吴斌 王孝然

课程简介：（200-300 字）

本课程涉及误差基本理论知识，以及利用误差理论对实际数据进行误差分析和处理的方法。通过理论与实践相结合的方式，使学生清晰认识到工程测试中存在的误差问题，能够针对具体工程案例进行误差来源、误差性质分析，对测量误差进行合理评定。进一步地，能够从测试系统、测试手段和测量数据处理等角度，提出减小和控制误差的方法。

本课程是实践性较强的一门专业基础课，通过一定数量的习题和软件编程实践等环节掌握必要知识，为后续专业课学习打下坚实基础。本课程通过调研、编程实践、报告撰写和研讨等系列形式，培养学生综合分析问题和解决问题的能力。

推荐教材或主要参考书：

[1] 费业泰. 误差理论与数据处理. 机械工业出版社（第 7 版），2017

[2] 钱政.误差理论与数据处理. 科学出版社, 2015

[3] 王春艳, 张宁. 公差与误差理论. 清华大学出版社, 2015

[4] 平鹏. 机械工程测试与数据处理. 冶金工业出版社，2008

0011102 Error Theory and Data Processing

Course Number: 0011102

Course Title: Error Theory and Data Processing

Course Type: Compulsory basic courses

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students major in Measurement& Control Technology and Instrument,

Prerequisites: Probability theory and mathematical statistics

Evaluation Method: Homework and research report (30%) and course design work (70%)

Writer： Wu Bin / Wang Xiaoran

Course Description:

This course covers the basic theoretical knowledge of error, and methods for error analysis and processing of actual data based on error theory. Through the combination of theory and practice, this course can enable students to clearly recognize the error problems in engineering test, to analysis the source and property of error and to evaluate the error. Furthermore, the students can provide methods to reduce and control the measurement error considering the factors of testing system and data processing method.

This course is a practical major basic course, which provides solid foundation for the following major courses through a certain number of exercises and software programming practices. This course is to cultivate students' ability to analyze problems and solve problems by means of survey, programming, report writing and discussions.

Recommended Textbooks/References:

1. Fei Yetai. Error theory and data processing. China Machine Press (7th Edition), 2017

2. Qian Zheng. Error theory and data processing. Science Press, 2015

3. Wang Chunyan, Zhang Ning. Tolerance and error theory. Tsinghua University Press, 2015

4. Ping Peng. Mechanical engineering test and data processing. Metallurgical Industry Press, 2008

0009394 新生研讨课

课程编码：0009394

课程名称：新生研讨课

英文名称：Freshman Seminar

课程类型：自主课程

学分：1.0　　**学时：**16

适用对象：测控技术与仪器专业本科生

先修课程：无

考核形式：考查

撰写人：刘秀成 吕炎

课程简介：（200-300 字）

本课程针对大学新生特点，通过课堂讲授、研讨、参观、实践，引导学生理解测控系统与仪器在社会、经济发展中的地位与作用，增强专业认识，培养专业意识和专业兴趣。了解专业培养目标、毕业要求、专业知识体系，明确课程之间的衔接关系，以合理安排学习规划。让学生了解专业主要文献的来源和获取方法，培养学生文献检索和分析的能力，掌握正确的学习方法。此外，通过典型案例分析，课堂讨论等方式，培养学生理解和评价针对测控系统与仪器中复杂工程问题的工程实践对环境、社会可持续发展的影响的能力。使学生了解专业的应用和发展过程、发展前景、毕业去向和可能的职位。

推荐教材或主要参考书：

[1] 陈毅静.测控技术与仪器专业导论（第 3 版）. 北京：电子工业出版社，2019 年 11 月

[2] 王庆友.测控技术与仪器专业导论. 北京：机械工业出版社，2015 年 5 月

[3] 徐熙平，张宁.测控技术与仪器专业导论. 北京：电子工业出版社，2018 年 3 月

0009394 Freshman Seminar

Course Number: 0009394

Course Title: Freshman Seminar

Course Type: Independent course

Credit: 1.0 **Total Credit Hours:** 16

Students: Undergraduate students major in Measurement& Control Technology and Instrument

Prerequisites: None

Evaluation Method: Homework and research report

Writer： Liu Xiucheng/ Lv Yan

Course Description:

Based on the characteristics of freshmen, this course aims at, through classroom teaching, seminars, visits, practice, guiding students to understand the position and role of measurement and control systems and instruments in the social and economic development, and enhancing professional awareness, professional awareness and professional interest. The course will help students understand the professional training objectives, graduation requirements, professional knowledge system, clear the connection between the courses to rationalize the learning plan. It will also help students understand the source of the major professional literature and access methods to develop the ability of literature retrieval and analysis, and master the correct learning methods. In addition, through typical case analysis, classroom discussion, etc., it will help students understand and evaluate the impact of environmental and social sustainable development of complex systems for the measurement and control systems engineering and engineering practice . So that students understand the professional application and development process, development prospects, the whereabouts of the graduation and possible job positions.

Recommended Textbooks/References:

1. Chen Yijing. Introduction to Measurement & Control Technology and Instruments(3rd Edition).. Beijing：Beijing University Press，2019
2. Wang Qingyou. Introduction to Measurement & Control Technology and Instruments. Beijing：Machinery Industry Press，2015
3. Xu Xiping，Zhang Ning. Introduction to Measurement & Control Technology and Instruments. Beijing：Electric Industry Press, 2018

0011110 信号系统与信息处理

课程编码：0011110

课程名称：信号系统与信息处理

英文名称：Signal System and Information Processing

课程类型：学科基础选修课

学分： 2 **总学时：**32

面向对象：测控技术与仪器专业本科生

先修课程：高等数学，自动控制原理

考核形式：平时成绩+考核

撰写人：李跃娟

课程简介：（250-300 字）

信号系统与信息处理是机械与电子工程学院（部）为测控技术与仪器专业本科生开设的学科基础选修课。本课程的任务是通过对信号与系统的基本理论的学习，针对连续、离散信号与系统的时域、频域的分析与讨论向学生传授相关知识，培养学生对于一般信号的基本信号处理的一般方法。要求学生掌握有关方面的基本概念、基本理论、基本方法和基本技术。具体知识包括：信号与系统的基本概念.教学内容重点包括信号与信号的运算、系统与系统函数。连续信号的时域分解与卷积积分，系统微分方程的经典解，LTI 连续系统的时域响应。周期信号的连续时间傅里叶级数。LTI 系统的频域分析。典型离散信号及其基本运算，LTI 离散系统及其响应。离散系统的 Z 域分析，包括 Z 正变换与逆变换。Z 域系统函数与系统特性。教学内容的难点：基本信号的性质、傅里叶级数和变换、卷积积分、卷积和、离散系统的 Z 域分析等。

推荐教材或主要参考书：

[1] 杜宇波. 信号与系统. 重庆：重庆大学出版社，2006 年 8 月

[2] 吴大正，杨林耀，张永瑞，王松林，郭宝龙.信号与线性系统分析(第 4 版).北京：高等教育出版社，2010 年

[3] 宋琪，陆三兰. 信号与系统. 北京：电子工业出版社，2018 年 7 月

[4] 陈后金，胡健，薛健. 信号与系统. 北京：高等教育出版社，2015 年 12 月

0011110 Signal System and Information Processing

Course Number: 0011110

Course Title: Signal System and Information Processing

Course Type: fundamental optional course

Credit: 2 **Total Credit Hours:** 32

Students: undergraduate students majoring in measurement and control technology and instrument

Prerequisites: Math, Automatic Control Principle

Evaluation Method: Course participation + reports

Writer： Li Yuejuan

Course Description:

SIGNAL SYSTEM AND INFORMATION PROCESSING is one of the fundamental optional courses for undergraduate students Major in measurement and control technology and instrument. The main target of this course is to clarify the basic concepts, theories, methods, and techniques of signal processing to students. This course is focus on studying of signal and systems. The teaching contents are mainly covered by the following aspects: signal operation, systems and system functions; decomposition and convolution of the continuous signals in time domain; Classical solutions of the LTI system; the time domain response of the LTI system; Fourier series of continuous time periodic signal; frequency domain analysis of LTI systems; typical discrete signal and its basic operations, the LTI discrete system and its response; Z-domain analysis of discrete systems, including the Z transform and inverse transform, Z-domain system functions and features.. The difficulties of teaching contents are described as followings: Fourier transform, convolution, frequency domain analysis of LTI.

Recommended Textbooks/References:

1. Yubo DU. Signal and Systems. Chongqing University Press,2006
2. Dazheng WU, Linyao YANG, Yongrui ZHANG, Songlin WANG, Baolong GUO. Signal and Linear System Analysis (fourth Edition). Higher Education Press,2010
3. Qi SONG, Sanlan LU, Signal and Systems, Publishing House of Electronics Industry,2018
4. Houjin CHEN, Jian HU, Jian XUE, Signal and Systems, Higher Education Press,2015

0011120 学术写作

课程编码：0011120

课程名称：学术写作

英文名称：Academic Writing

课程类型：自主课程

学分：1.0　　**学时：**16

适用对象：测控技术与仪器专业本科生

先修课程：新生研讨课、测控技术与仪器前沿、智能仪器的奥秘

考核形式：平时成绩 40%，期末答辩 60%

撰写人：刘秀成

课程简介：（200-300 字）

学术写作是科技工作者必修的一门课程，是表达学术思想、技术方案的重要方式。课程旨在教授学生认识学术写作的重要性，掌握学术写作的基本规范。通过作业练习和课堂研讨，使学生了解高水平学术写作的标准和需要具备的基本要求。课程采用讲授、练习和大作业形式开展。讲授部分内容包括学术写作的意义、基本规范、文献检索方法和案例分析。练习部分包括文献检索、写作纠错、图表绘制、观点的文字陈述等内容。大作业内容为撰写一篇测控技术与仪器相关的综述短文，综合考查学生学术写作规范的掌握程度以及学术写作能力。

推荐教材或主要参考书：

[1] 梁福军. 科技论文规范写作与编辑（第 3 版）. 北京：清华大学出版社，2017 年

[2] 黄军左，丁书江，周红军，李锦兰编. 文献检索与科技论文写作（第三版）. 北京：中国石化出版社，2018 年

0011120 Academic Writing

Course Number: 0011120

Course Title: Academic Writing

Course Type: Major Autonomous Curriculum

Credit: 1.0 **Total Credit Hours:** 16

Students: Undergraduate students major in Measurement& Control Technology and Instrument

Prerequisites: Freshmen seminar, measurement and control technology and instrument frontier, the mystery of intelligent instrument

Evaluation Method: Usual performance (40%), final project defense (60%)

Writer： Liu Xiucheng

Course Description:

Academic writing is a compulsory course for science and technology workers, and an important way to express academic ideas and technical solutions. The course aims to teach students to understand the importance of academic writing and master the basic norms of academic writing. Through homework exercises and classroom discussions, students can understand the standards and basic requirements of high-level academic writing. The course is conducted in the form of lectures, exercises and large assignments. The teaching content includes the significance of academic writing, basic norms, literature retrieval methods and case analysis. The exercises include literature retrieval, writing error correction, chart drawing, and text statement of opinions. The content of the assignment is to write a summary of the measurement and control technology and instrument, and to comprehensively test the students' mastery of academic writing standards and their academic writing ability.

Recommended Textbooks/References:

1. Liang Fujun. Standard writing and editing of scientific papers (3rd Edition). Beijing: Tsinghua University Press, 2017

2. Huang junzuo, Ding Shujiang, Zhou Hongjun, Li Jinlan. Literature retrieval and scientific paper writing (Third Edition). Beijing: China Petrochemical Press, 2018

0011114 压电材料与声波电子元件

课程编码：0011114

课程名称：压电材料与声波电子元件

英文名称：Piezoelectric materials and acoustic electronics

课程类型：专业选修课

学分： 2 **总学时：** 32

面向对象：测控技术与仪器专业本科生

先修课程：工程力学，大学物理

考核形式： 平时成绩+考试

撰写人：焦敬品

课程简介：

压电材料与声波电子元件是为测控技术与仪器专业本科生开设的专业选修课程。本课程的任务是讲述压电材料的基本原理和性能参数、压电器件的典型结构及工程应用。通过课程学习，使学生了解压电材料与声波电子元件领域的前沿技术和发展动态，培养学生的分析和解决复杂工程问题的能力。本课程主要讲述压电材料的基本原理和性能参数、压电器件的典型结构及工程应用，并注重压电材料及器件的新发展。教学内容的难点在于压电声波电子器件的设计及性能参数。

推荐教材或主要参考书：

[1]栾桂冬,张金铎,王仁乾.压电换能器和换能器阵.北京:北京大学出版社,2005 年

[2]秦庆华.压电材料高等力学.北京：高等教育出版社，2012 年.

[3]刘梅冬,许毓春.压电铁电材料与器件.武汉:华中理工大学出版社,1990 年.

0011114 Piezoelectric materials and acoustic electronics

Course Number: 0011114

Course Title: Piezoelectric materials and acoustic electronics

Course Type: Optional course

Credit: 2 **Total Credit Hours:** 32

Students: Undergraduate students majoring in Measurement and control technology and instruments

Prerequisites: engineering mechanics, physics

Evaluation Method: Course participation + written exams

Writer： Jiao Jingpin

Course Description:

Piezoelectric materials and acoustic electronics is one of the optional courses offered by the Department of Materials and Manufacturing for undergraduate students in Measurement and Control Technology. The main task of this course is to clarify the principles and performance parameters of piezoelectric materials, typical structures and engineering applications of piezoelectric devices. Through the course, students will learn about the cutting-edge technology and developments in the field of piezoelectric materials and acoustic electronic components, train students to develop the student's ability to analyze and solve complex engineering problems. This course clarifies the principles and performance parameters of piezoelectric materials, typical structures and engineering applications of piezoelectric devices, and focuses on the introduction of the latest developments in piezoelectric materials and acoustic electronics. The difficulties of teaching contents are described as followings: design and performance parameters of piezoelectric acoustic wave electronics.

Recommended Textbooks/References:

[1] Luan Guidong, Zhang Jinze, Wang Renqian. Piezoelectric transducers and transducer arrays. Beijing: Beijing University Press,2015.

[2] Qin Qinghua. Advanced mechanics of piezoelectric materials. Beijing: Higher Education Press,2012.

[3] Liu Meidong, Xu Yuchui.Piezoelectric Ferroelectric Materials and Device. Wuhan: Huazhong University of Science and Technology Press, 1990.

0011112 仪器智能化技术

课程编码：0011112

课程名称：仪器智能化技术

英文名称：Intelligent Instrument Technology

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：机械工程、测控技术及仪器专业本科生

先修课程：传感与测试技术，测控电路

考核形式： 平时成绩+实验成绩+考试

撰写人：吕炎

课程简介：（250-300 字）

仪器智能化技术是为机械及测控专业本科生开设的专业选修课程。本课程的任务是让学生了解智能仪器的特点及设计思路。教学内容重点是如何将传统仪器教学融入智能仪器设计中，教学内容的难点主要表现在理解智能仪器的模块化设计思路。

仪器仪表是信息获取的重要工具，它能获得准确的测量数据，用数值描述客观事物，使人们从数量关系上认识客观世界。在自动化、信息化社会浪潮中，仪器仪表的作用越来越重要。智能化是仪器仪表的发展方向，本课程在讲解智能仪器工作原理的基础上，介绍智能仪器的设计思路与方法，讲述如何根据功能指标要求进行智能仪器总体设计、电路设计及器件的选择，讲述智能仪器设计的软件结构设计与方法，介绍抗干扰措施等。课程中包含 8 学时的实验内容，注重培养学生的实验技能、方案设计能力与团队协作能力。

推荐教材或主要参考书：

[1] 史健芳. 《智能仪器设计基础》. 电子工业出版社, 2012 年 09 月. （教材）

[2] 李泓. 《智能仪器设计基础》, 清华大学出版社, 2010 年 12 月.

[3] 胡向东、唐贤伦、胡蓉. 《现代检测技术与系统》, 机械工业出版社. 2015 年 2 月.

[4] 胡仁喜. 《LabVIEW 2013 中文版虚拟仪器从入门到精通》, 机械工业出版社. 2014 年 4 月.

[5] Robert. B. Northrop.《Introduction to Instrumentation and Measurements》. CRC Press. 2014

0011112 Intelligent Instrument Technology

Course Number: 0011112

Course Title: Intelligent Instrument Technology

Course Type: Major Elective Courses

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students majoring in Mechanical Engineering, Measurement and control technology and instrument

Prerequisites: Sensor and Measurement Technology, Measurement and Control Circuit

Evaluation Method: Course participation + Experiments participation + Written exams

Writer： Lv Yan

Course Description:

Intelligent instrument technology is an elective course offered for undergraduates majoring in Mechanical Engineering, Measurement and control technology and instrument. The task of this course is to let students understand the characteristics and design ideas of intelligent instruments. The key point of the teaching content is how to integrate the traditional instrument teaching into the design of intelligent instrument, and the difficulty of teaching content is to understand the modular design idea of intelligent instrument.

Instrument is an important tool for information acquisition. It can obtain accurate measurement data, describe objective things with numerical values, and make people understand the objective world from the quantitative relationship. In the tide of automation and information society, the function of instrument is more and more important. Intellectualization is the development direction of instruments and meters. Based on explaining the working principle of intelligent instruments, this course introduces the design ideas and methods of intelligent instruments, describes how to carry out the overall design, circuit design and device selection of intelligent instruments according to the functional index requirements, describes the software structure design and method of intelligent instrument design, and introduces anti-interference measures. The course includes 8 class hours of experimental content, focusing on the cultivation of students' experimental skills, scheme design ability and team cooperation ability.

Recommended Textbooks/References:

Robert. B. Northrop. 《Introduction to Instrumentation and Measurements》. CRC Press. 2014

0011117 智能传感材料与结构

课程编码：0011117

课程名称：智能传感材料与结构

英文名称：Smart materials and Structures for Sensor Technology

课程类型：专业选修课

学分：2.0　　**学时：**32

适用对象：测控技术与仪器专业本科生

先修课程：大学物理

考核形式：平时表现（5%）、方案解析或设计作业（35%）和期末考试（60%）

撰写人：王钰珏

课程简介：（200-300 字）

智能材料与结构是一门多学科高度交叉的新兴前沿学科，智能材料与结构在驱动、传感技术中的应用是国际上的研究热点之一。智能器件或系统集成了传感器、控制电路、信号处理器、精密机械等，通过机械、热、光、化学、电、磁等激励与控制，实现特定功能，如测取外界物理量及控制系统状态等。

本课程主要内容包括基础知识学习与方案剖析（或设计）两部分，其中基础知识学习涵盖材料与智能引论、智能材料与智能器件介绍、智能材料结构与智能结构系统剖析等；方案剖析（或设计）部分包括应用上述知识，解构（或提供）智能结构或器件的技术设计方案。

推荐教材或主要参考书：

[1] 张光磊，杜彦良主编. 智能材料与结构系统. 北京大学出版社，2010

[2] 杨大智主编. 智能材料与智能系统. 天津大学出版社，2000

[3] 杜善义，冷劲松，王殿富著. 智能材料、系统和结构. 科学出版社，2001

[4] 周浩敏，钱政编著. 智能传感技术与系统. 北京航空航天大学出版社，2008

0011117 Smart materials and Structures for Sensor Technology

Course Number: 0011117

Course Title: Smart materials and Structures for Sensor Technology

Course Type: Major Elective Courses

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students major in Measurement& Control Technology and Instrument

Prerequisites: College physics

Evaluation Method: Homework (5%), solution design (35%) and final exam(60%)

Writer： Wang yujue

Course Description:

Smart materials and structures is a new interdisciplinary frontier subject. The application of smart materials and structures in driving and sensing technology is one of the hot topics in the world. Intelligent devices or systems integrate sensors, control circuits, signal processors, precision machinery, etc., through mechanical, thermal, optical, chemical, electrical, magnetic excitation and control, to achieve specific functions, such as measuring external physical quantities and controlling system status.

The main content of this course includes two parts: basic knowledge learning and scheme analysis (or design). The basic knowledge learning covers introduction of materials and intelligence, introduction of intelligent materials and intelligent devices, analysis of intelligent material structure and intelligent structure system, etc.; scheme analysis (or design) part includes the application of the above knowledge to deconstruct (or provide) the technical designers of intelligent structures or devices Case.

Recommended Textbooks/References:

1.Zhang Guanglei, Du Yanliang. Smart Material and Structure System. Peking University press. 2010.

2.Yang Dazhi. Smart Materials and Structure. Tianjin University Press. 2000.

3.Du Shanyi, Leng Jinsong, Wang Dianfu. et al. Smart Materials, Systems and Structures. Science Press. 2001.

4.Zhou Haomin, Qian Zheng, et al. Intelligent sensing technology and system. Beihang University press. 2008.

0011118 智能仪器的奥秘

课程编码：0011118

课程名称：智能仪器的奥秘

英文名称：Intelligent Instrument

课程类型：自主课程

学分： 1 **总学时：** 16

面向对象：测控技术与仪器专业本科生

先修课程：高等数学 3

考核形式： 平时成绩+实训报告

撰写人：刘秀成

课程简介：

智能仪器的奥秘是为测控技术与仪器专业本科生开设的自主课程类型。本课程的任务是通过课堂教学和实训项目，使学生掌握智能仪器的基本结构、典型智能化处理方法，了解智能仪器与常规仪器的本质区别，通过具体智能仪器的实例介绍，并设计实训项目，增加学生的感性认识，加深对理论知识的理解，提高学生对智能仪器的实际应用和维护能力。教学内容重点：1、掌握智能仪器的组成原理、基本结构及主要性能特点；2、掌握基本数据处理算法；3、掌握个人仪器、虚拟仪器以及现场总线仪器等的基本原理及特点。教学内容的难点：1、掌握工程软件设计流程、基本设计方法及软件测试技术；2、掌握智能仪器软、硬件调试方法及步骤；3、掌握智能仪器软、硬件抗干扰的基本原理及实用方法。

推荐教材或主要参考书：

[1] 赵茂泰主编，智能仪器原理及应用. 北京：电子工业出版社，2015 年

[2] 曲兴华主编，仪器制造技术. 北京：机械工业出版社，2019 年

[3] 曹建平主编，智能化仪器原理及应用. 西安：西安电子科技大学出版社，2017 年

0011118 Intelligent Instrument

Course Number: 0011118

Course Title: Intelligent Instrument

Course Type: Independent course

Credit: 1 **Total Credit Hours:** 16

Students: Undergraduate students majoring in measurement-control technology and instrument

Prerequisites: Advanced Mathematics 3

Evaluation Method: Course participation + written exams

Writer： Liu Xiucheng

Course Description:

Intelligent Instrument is one of the independent courses for undergraduate students Major in measurement-control technology and instrument. The main target of this course is to clarify basic structure of intelligent instrument, typical intelligent processing method, essential difference between intelligent instrument and conventional instrument. This course is focus on how to increase students' perceptual knowledge, deepen their understanding of theoretical knowledge, and improve their practical application and maintenance ability of intelligent instruments. The teaching contents are mainly covered by the following aspects: 1.Master the composition principle, basic structure and main performance characteristics of the intelligent instrument; 2.Master the basic data processing algorithm; 3.Master the basic principles and characteristics of personal instruments, virtual instruments and fieldbus instruments. The difficulties of teaching contents are described as followings: 1.Master the engineering software design process, basic design methods and software testing technology; 2.Master software and hardware debugging methods and steps of intelligent instruments; 3.Master the basic principles and practical methods of software and hardware anti-interference of intelligent instruments.

Recommended Textbooks/References:

1.Zhao Maotai,Principle and Application of Intelligent Instrument, *Beijing: Electronic Industry Press*, 2015

2.Qu Xinghua,Instrument Manufacturing Technology, *Beijing: Machinery Industry Press*, 2019

3.Cao Jianping,Principle and Application of Intelligent Instrument, *Xi 'an: Xidian University Press*, 2017

0011104 走近传感器 B

课程编码：0011104

课程名称：走近传感器 B

英文名称：Approaches to Sensors B

课程类型：自主课程

学分： 1 **总学时：** 16

面向对象：测控技术与仪器专业本科生

先修课程：大学物理

考核形式：平时成绩+调研报告

撰写人：焦敬品

课程简介：

《走近传感器》是为仪器科学与技术专业开设的、门逻辑性、理论性与应用性兼备的一门通识课程。本课程主要讲述常见传感器的基本原理、测量方法及在工业中的典型应用，并注重传感技术的新发展。课程采取研究型教学手段，强调启发性和研讨性。在讲授传感器的基础理论和典型实例的基础上，凝练出共性分析方法和科学研究工作的步骤，达到培养学生的基本逻辑思维方式和科学研究方法的目的。课程内容的重点放在常见传感技术的原理、特点及工业应用上，具有较宽的知识面和很强的实用价值。

推荐教材或主要参考书：

[1]传感器技术案例教程，樊尚春，机械工业出版社，2020.01

[2]传感器技术及应用（第 4 版），樊尚春，北京航空航天大学出版社，2022.8

[3]新型传感技术及应用（第 3 版），樊尚春，刘广玉，高等教育出版社，2022.7

0011104 Approaches to Sensors B

Course Number: 0011104

Course Title: Approaches to Sensors B

Course Type: Independent course

Credit: 1 **Total Credit Hours:** 16

Students: Undergraduate students majoring in Measurement and control technology and instruments

Prerequisites: Physics

Evaluation Method: Course participation + research report

Writer： Jiao Jingpin

Course Description:

Approaching Sensors is a general course for Instrumentation Science and Technology majors, and it is highly logical, theoretical and practical. The course clarifies the basic principles, measurement methods and typical applications of sensors in industry and focuses on new developments in sensing technology. The course adopts a research-based approach to teaching and learning, with an emphasis on stimulation and seminars. In the process of teaching the basic theories and typical examples of sensors, the common analytical methods and steps of scientific research work are condensed to achieve the purpose of cultivating students' basic logical way of thinking and scientific research methods. The course content focuses on the principles, characteristics and industrial applications of common sensing technologies, with a broad knowledge base and strong practical value.

Recommended Textbooks/References:

1.Case Studies in Sensor Technology, Fan shangchui, Mechanical Industry Press, 2020.01

2.Sensor technology and applications，Fan shangchui, Beijing University of Aeronautics and Astronautics Press, 2022.8

3.Novel Sensing Technologies and Applications, Fan shangchui，Liu guangyu, Higher Education Press, 2022.7

0008111 毕业设计

课程编码：0008111

课程名称：毕业设计

英文名称：Graduation Design

课程类型：实践环节必修课

学分：8　**总学时：** 480

面向对象：测控技术与仪器专业本科生

先修课程： 测控技术与仪器专业课程

考核形式： 毕业论文评审及答辩

撰写人：刘秀成

课程简介：（250-300 字）

“毕业设计”是测控技术与仪器专业培养方案中最重要的实践性教学环节,是对学生进行工程师基本训练的重要途经，通过毕业设计使学生受到理论联系实际的综合训练，培养学生综合运用所学理论知识和基本技能解决复杂工程问题的能力，培养学生创新意识和能力。“毕业设计”的教学总体目标是是让学生巩固和加深已学过的基础和专业知识，提高综合运用这些知识独立进行分析和解决复杂工程问题的能力。掌握测控系统与仪器设计的基本程序和方法，正确使用本专业的各种技术规范和标准。学会针对要解决的问题，广泛地搜集国内外有关资料，了解国内外的发展水平和状况。培养深入细致调查研究，理论联系实际，从经济、技术的观点全面分析和解决问题的方法及阐述自己观点的能力。培养学生在公众场合进行口头陈述，并就相关提问进行解释的能力。

推荐教材或主要参考书：

根据毕设题目选择。

0008111 Graduation Design

Course Number: 0008111

Course Title: Graduation Design

Course Type: required course

Credit: 8 **Total Credit Hours:**480

Students: Undergraduate students majoring in Measuring & Control Technology and Instrumentations subject

Prerequisites: Required curriculum in Measuring & Control Technology and Instrumentations subject

Writer： Liu Xiucheng

Evaluation Method: Undergraduate thesis evaluation+ Thesis defense

Course Description:

"Graduation design" is a professional training scheme of Measuring & Control Technology and Instrumentations subject, which is the most important practical teaching link, and one of the important through basic training for students. Through the graduation design, the main contents are to train the students comprehensive abilities by the theory with practice, cultivate students' integrated use of theoretical knowledge and basic skills, the ability to solve the problem of complex engineering, cultivating students' innovative consciousness. The overall goal of "graduation design" is to enable students to consolidate and deepen the basic and professional knowledge they have learned, and to improve their ability to independently analyze and solve complex engineering problems by comprehensively using those knowledge. In view of the problems to be solved, the institute extensively collects relevant information at home and abroad to understand the level and status of development at home and abroad. Cultivate the ability to conduct in-depth and detailed investigation and research, combine theory with practice, comprehensively analyze and solve problems from the perspective of economy and technology, and expound their own viewpoints.

Recommended Textbooks/References:

Choose according to the thesis title of the graduation design

0011109 测控技术与仪器系统实训

课程编码：0011109

课程名称：测控技术与仪器系统实训

英文名称：Training in Practice of Measuring & Control Technology and Instrumentations

课程类型：实践环节必修课

学分：2　**总学时：** 60

面向对象：测控技术与仪器专业本科生

先修课程：测控电路、自动控制原理、模拟电子技术、微机原理与接口技术

考核形式：过程考核，平时成绩+结课答辩

课程简介：（250-300 字）

本课程是测控技术与仪器专业的实践环节必修课，旨在继《测控电路》、《自动控制原理》、《模拟电路》、《微机原理与接口技术》等课程之后，引导并提升学生在仪器集成开发和仪器性能测试等方面的实践性和创新性。本课程围绕典型无损检测仪器的集成开发和性能测试专题，开展一系列综合训练，培养学生的实践动手能力和研究能力。系统实训主要包括如下内容：功能模块电路调试、软硬件联调测试、仪器集成及性能测试、实验研究、综合实训总结报告撰写等。教学过程中，以超声、超声导波、涡流和漏磁等无损检测仪器样机为载体，提供仪器集成开发所需的功能电路模块、基础软件等，学生分组自主选择一类仪器进行集成开发，并利用自主开发的仪器开展实验研究。

推荐教材或主要参考书：

[1] 章皓. 《测控技术与仪器专业综合实训教程》. 浙江大学出版社, 2012 年 01 月. （教材）

[2] 胡仁喜. 《LabVIEW 2013 中文版虚拟仪器从入门到精通》, 机械工业出版社. 2014 年 4 月.

[3] Robert. B. Northrop. 《Introduction to Instrumentation and Measurements》. CRC Press. 2014

0011109 Training in Practice of Measuring & Control Technology and Instrumentations

Course Number: 0011109

Course Title: Training in Practice of Measuring & Control Technology and Instrumentations

Course Type: Compulsory course in practice

Credit: 2 **Total Credit Hours:** 60

Students: Undergraduate students majoring in Measuring & Control Technology and Instrumentations subject

Prerequisites: Measurement and Control Circuit, Principles of Automatic Control, Analog Circuit, Microcomputer Principles and Interface Technology

Evaluation Method: Course participation, Regular grades+Closing defense

Course Description:

This course is a compulsory practical course in the field of measurement and control technology and instruments. It aims to guide and enhance students' practicality and innovation in instrument integration development and instrument performance testing, following courses such as "Measurement and Control Circuit", "Automatic Control Principles", "Analog Circuit", and "Microcomputer Principles and Interface Technology". This course focuses on the integrated development and performance testing of typical non-destructive testing instruments, and conducts a series of comprehensive training to cultivate students' practical and research abilities. The system training mainly includes the following contents: functional module circuit debugging, software and hardware joint debugging testing, instrument integration and performance testing, experimental research, and writing of comprehensive training summary reports. During the teaching process, non-destructive testing instrument prototypes such as ultrasound, ultrasonic guided waves, eddy current, and magnetic flux leakage are used as carriers to provide functional circuit modules, basic software, etc. required for instrument integration and development. Students are divided into groups to independently select a type of instrument for integration and development, and experimental research is conducted using self-developed instruments.

Recommended Textbooks/References:

[1] Zhang Hao. "Comprehensive Practical Training Course for Measurement and Control Technology and Instrumentation Major". Zhejiang University Press, January 2012. (Textbook)

[2] Hu Renxi. "LabVIEW 2013 Chinese Version Virtual Instrument from Novice to Expert", Machinery Industry Press. April 2014.

[3] Robert. B. Northrop. "Introduction to Instrumentation and Measurements". CRC Press. 2014

0007256 工作实习

课程编码：0007256

课程名称：工作实习

英文名称：Professional Practice

课程类型：实践环节必修课

学分： 4 **总学时：** 120

面向对象：测控技术与仪器专业本科生

先修课程：大学物理、工程光学、测控电路、传感与测试技术

考核形式： 实习日志+工作实习报告成绩

课程简介：

《工作实习》课程是为测控技术与仪器专业本科生开设的实践环节必修课程。本课程的任务是通过让学生深入专业相关企业进行实习，将所学的专业知识与生产实践相结合，做到融会贯通。使其具有从事专业相关工作的工程师能力与素质，理解工程师的职业性质、工程职业道德的含义及影响，并能遵守工程职业道德和规范，履行责任。并培养其在后续的毕业设计和毕业后的工作中解决专业相关复杂工程问题时，自觉考虑工程活动对环境、社会可持续发展的影响，理解并掌握测控系统与仪器中涉及的工程管理原理与经济决策方法。本课程的重点是参与实习单位的生产经营、科研开发、技术创新等方面的工作，理解并掌握测控系统与仪器中涉及的工程管理原理与经济决策方法。本课程的难点是学生通过实习能理解并评价测控系统与仪器中复杂工程问题的工程实践对环境、社会可持续发展的影响，理解工程师的职业性质、工程职业道德的含义及影响，履行责任。

推荐教材或主要参考书：

[1] 郝晓剑主编，测控电路设计与实践. 北京：电子工业出版社，2017 年

[2] [美] 雅各布·弗雷登（Jacob Fraden） 著，宋萍，隋丽 译，现代传感器手册设计、原理及应用. 北京：机械工业出版社，2019 年

0007256 Professional Practice

Course Number: 0007256

Course Title**:** Professional Practice

Course Type: Compulsory course in practice

Credit:4 **Total Credit Hours:** 120

Students: Undergraduate students majoring in measurement-control technology and instrument

Prerequisites: College physics, Engineering optics, Measurement and control circuit, Sensing and testing technology

Evaluation Method: Intern log + Report grades for the Professional Practice

Course Description:

Professional Practice is one of the compulsory courses in practice for undergraduate students Major in measurement-control technology and instrument in Materials and manufacturing division. The main target of this course is to integrate the professional knowledge with the production practice by allowing students to go deep into the professional enterprises for internship, make them have the ability and quality of engineers engaged in professional related work, understand the nature of engineers' profession, the meaning and influence of engineering professional ethics, and can abide by the engineering professional ethics and norms, perform responsibilities, train them to consciously consider the impact of engineering activities on the sustainable development of the environment and society, and to understand and master the engineering management principles and economic decision-making methods involved in measurement and control systems and instruments when solving complex engineering problems related to his specialty in subsequent graduation design and work after graduation. The teaching contents are mainly covered by the following aspects: participate in the production and operation, scientific research and development, technological innovation and other aspects of the internship unit, understand and master the engineering management principles and economic decision-making methods involved in measurement and control systems and instruments. The difficulties of teaching contents are described as followings: whether students can understand and evaluate the impact of engineering practice on environmental and social sustainable development of complex engineering problems in measurement and control systems and instruments, understand the professional nature of engineers, the meaning and influence of engineering professional ethics, and fulfill their responsibilities..

Recommended Textbooks/References:

1.Hao Xiaojian, Measurement and Control Circuit Design and Practice, *Beijing: Electronic Industry Press*,2017

2.Jacob Fraden, Design, Principle and Application of Modern Sensor Manual, *Beijing: Machinery Industry Press*,2019

0007260 认识实习

课程编码：0007260

课程名称：认识实习

英文名称：Cognition Practice

课程类型：实践环节必修课

学分： 1 **总学时：** 30

面向对象：测控技术与仪器专业本科生

先修课程：高等数学、大学物理、模拟和数字电路

考核形式： 认识实习报告成绩

撰写人：刘秀成

课程简介：

《认识实习》课程是为测控技术与仪器专业本科生开设的实践基础必修课程。本课程的任务是通过让学生进入企业一线或专业实验室，深入相关行业的生产、销售、应用企业，了解相关产品的生产过程或工作原理、制造工艺及其在生产中的使用情况、发挥的作用等，理解各环节对环境、社会可持续发展的影响，初步具备评估专业工程实践和测控系统与仪器复杂问题解决方案对社会、健康、安全、法律及文化的影响的能力，并理解应承担的责任。本课程的重点是了解测控系统与仪器的生产工艺、及企业所生产仪器的服务行业及在行业中所发挥的作用，理解各环节对环境、社会可持续发展的影响。本课程的难点是评估专业工程实践和测控系统与仪器复杂问题解决方案对社会、健康、安全、法律及文化的影响。

推荐教材或主要参考书：

[1] 王伯雄. 《测控技术与仪器概论》, 清华大学出版社, 2016 年 01 月.

[2] 雅各布·弗雷登（Jacob Fraden） 著，宋萍，隋丽 译，现代传感器手册设计、原理及应用. 北京：机械工业出版社，2019 年

0007260 Cognition Practice

Course Number: 0007260

Course Title**: Cognition Practice**

Course Type: Compulsory course in practice

Credit: 1 **Total Credit Hours:** 30

Students: Undergraduate students majoring in measurement-control technology and instrument

Prerequisites: Advanced mathematics, College physics, Analog and digital circuits

Evaluation Method: Report grades for the Cognition Practice

Writer： Liu Xiucheng

Course Description:

Cognition Practice is one of the compulsory courses in practice for undergraduate students Major in measurement-control technology and instrument in Materials and manufacturing division. The main target of this course is to let students enter the first-line or professional laboratory of an enterprise, to go deep into the production, sales and application enterprises of relevant industries, and to understand the production process or working principle of relevant products, manufacturing technology and its usage or its role in production, understand each link of the sustainable development of environment, social impact, a preliminary assessment of professional engineering practice and measurement and control system and instrument complex solutions to problems of social, health, safety, legal and cultural influence of ability, and understand the responsibilities. The teaching contents are mainly covered by the following aspects: understand the production process of measurement and control system and instrument, the service industry of the instrument produced by the enterprise and its role in the industry, and to understand the impact of each link on the sustainable development of the environment and society. The difficulties of teaching contents are described as followings: assess the social, health, safety, legal, and cultural impact of professional engineering practices and complex problem solutions for measurement and control systems and instruments.

Recommended Textbooks/References:

1. Wang Boxiong. "Introduction to Measurement and Control Technology and Instrumentation". Tsinghua University Press, January 2016.

2.Jacob Fraden, Design, Principle and Application of Modern Sensor Manual, *Beijing: Machinery Industry Press*,2019

0010073 电路分析基础-2

课程编码：0010073

课程名称：电路分析基础-2

英文名称：Circuit Analysis Foundation-2

课程类型：学科基础必修课

学分： 3.0 **总学时：** 48

面向对象：自动化、测控技术与仪器专业本科生

先修课程：电路分析基础-1，高等数学（工），大学物理Ⅰ、线性代数（工）

考核形式： 平时成绩+考试

撰写人：宋建国

课程简介：（250-300 字）

电路分析基础-2 是为自动化、测控技术与仪器专业本科生开设的学科基础必修课。本课程的任务是使学生掌握正弦交流电路和三相对称电路的计算、交流电路的串并联谐振、非正弦交流电路的一般分析方法、对称三相电路和二端口电路的计算方法。教学内容重点：正弦周期交流电路中相量和交流电功率的概念与计算，交流电路中谐振频率的概念，非正弦交流电路分析中的傅里叶级数求解和时域叠加，互感电路中互感系数和转移阻抗的概念与计算，三相对称电路中三相对称电源和星三角接法的求解，二端口电路中的 Z 参数、Y 参数、T 参数计算。教学内容的难点：正弦周期交流电路中阻抗和相量图的计算与分析，交流电路中品质因数、串联谐振、并联谐振的概念，非正弦交流电路分析中平均功率的计算，互感电路中互感电压的计算，三相对称电路中三相功率的计算。

推荐教材或主要参考书：

[1] 邱关源，罗先觉主编，电路（第 5 版），高等教育出版社，2006

[2] 李翰逊，简明电路分析基础，高等教育出版社，2002

0010073 Circuit Analysis Foundation-2

Course Number: 0010073

Course Title: Circuit Analysis Foundation-2

Course Type: Basic compulsory course

Credit: 3.0 **Total Credit Hours:** 48

Students: Undergraduate students majoring in Automation, Measurement& Control Technology and Instrument

Prerequisites: Circuit Analysis Foundation-1, advanced mathematics, college physics, linear algebra

Evaluation Method: Course participation + written exams

Writer： Song Jianguo

Course Description:

Circuit Analysis Foundation-2 is a compulsory course of subject basis for Undergraduate majoring in Automation, Measurement& Control Technology and Instrument. The main target of this course is to make students grasp calculation of sinusoidal alternating current (AC) circuit and three-phase symmetrical circuit, series and parallel resonance of AC circuit, general analysis method of non-sinusoidal AC circuit, calculation method of symmetrical three-phase circuit and two port circuit. The teaching contents are mainly covered by the following aspects: concept and calculation of phasor and AC power in sinusoidal periodic AC circuit, concept of resonance frequency in AC circuit, Fourier series and time-domain superposition in non-sinusoidal AC circuit analysis, concept and calculation of mutual inductance coefficient and transfer impedance in mutual inductance circuit, solution of three-phase symmetrical power supply and star-delta connection in three-phase relative symmetric circuit, calculation of Z parameter, Y parameter and T parameter in two-port circuit. The difficulties of teaching contents are described as followings: calculation and analysis of impedance and phasor diagram in sinusoidal periodic AC circuit, concepts of quality factor, series resonance and parallel resonance in AC circuit, calculation of average power in non-sinusoidal AC circuit analysis, calculation of mutual inductance voltage in mutual inductance circuit, calculation of power in three-phase symmetrical circuit.

Recommended Textbooks/References:

1.Guanyuan Qiu, Xianjue Luo, Electric Circuit (5th Edition), *Higher Education Press*, 2006

2.Hanxun Li, Concise Circuit Analysis Foundation, *Higher Education Press*, 2002

0010734 模拟电子技术

课程编码：0010734

课程名称：模拟电子技术

英文名称：Analog Electronic Technology

课程类型：学科基础必修课

学分：2　　**学时：**32

面向对象：自动化、测控技术与仪器专业本科生

先修课程：高等数学（工）、大学物理Ⅰ、电路分析基础

考核形式：平时成绩+考试

撰写人：雷飞

课程简介：

模拟电子技术是为自动化、测控技术与仪器专业本科生开设的学科基础必修课。模拟电子技术是入门性质的技术基础课。模拟电路是多种电子产品、电子设备必不可少的基本组成单元，是物理量在转换成数字信号之前所必经的关键电路，该课程为培养自动化专业或仪器专业人才的电路分析与设计技能奠定基础，为提高其工程应用与创新能力做铺垫。课程主要内容：常用半导体器件原理、基本放大电路、场效管及放大电路、功率放大电路、模拟集成电路基础、反馈放大电路、信号产生电路、直流稳压电源等。重点是各类放大电路的原理分析和计算，难点是负反馈放大器、集成运算放大器等。为较好的掌握本课程，应在理解各类器件的工作原理基础上，熟练掌握晶体管三种基本放大器的分析与计算，继而掌握其它的放大器或模拟电子电路。

推荐教材或主要参考书：

[1] 孙景琪，雷飞，闫慧兰. 模拟电子技术基础. 高等教育出版社，2016 年 7 月

[2] 华成英. 模拟电子技术基础（第五版）. 高等教育出版社，2015 年 7 月

[3] 桑森（Willy M.C.Sansen）著，陈莹梅译. 模拟集成电路设计精粹（电子信息前沿技术丛书）. 清华大学出版社，2020 年 12 月

[4] 康华光. 电子技术基础（模拟部分）. 高等教育出版社，2006 年

[5] Robert L. Boylestad, Louis Nashelsky. Electronic Devices and Circuit Theory(Ninth Edition). 电子工业出版社，2010 年

0010734 Analog Electronic Technology

Course Number: 0010734

Course Title: Analog Electronic Technology

Course Type: Basic compulsory course

Credit: 3.5 **Total Credit Hours:** 56

Students: Undergraduate students majoring in Automation, Measurement& Control Technology and Instrument

Prerequisites: Advanced mathematics、General Physics、Circuit analysis element

Evaluation Method: Course participation + written exams

Writer： Lei Fei

Course Description:

Analog electronic technology is a compulsory course of subject basis for Undergraduate majoring in Automation, Measurement& Control Technology and Instrument. Analog electronic technology is a basic technical course for beginners. Analog circuit is an essential basic unit of a variety of electronic products and electronic equipment. It is the key circuit that physical quantities must pass before they are converted into digital signals. This course lays the foundation for cultivating circuit analysis and design skills of automation professionals, and paves the way for improving their engineering application and innovation ability. Main contents of the course: principles of common semiconductor devices, basic amplifying circuit, FET and amplifying circuit, power amplifying circuit, analog integrated circuit foundation, feedback amplifying circuit, signal generating circuit, DC regulated power supply, etc. The key point is the principle analysis and calculation of all kinds of amplifier circuits, and the difficulty is the negative feedback amplifier, integrated operational amplifier, etc. In order to master this course, we should be familiar with the analysis and calculation of three basic amplifiers of transistors on the basis of understanding the working principles of various devices, and then master other amplifiers or analog electronic circuits.

Recommended Textbooks/References:

1. Sun Jingqi，Lei fei，Yan Huilan, Analog Electronic Technolog, *Higher Education Press*, 7-2016

2.Hua Chengying, Analog Electronic Technolog（Fifth Edition）, *Higher Education Press*, 7-2015

3. Willy M.C.Sansen Written, Chen Yingmei Translated, The essence of analog integrated circuit design（Electronic information frontier technology series）, *Beijing: Tsinghua University Pres*s, 12-2020

4. Kang Huaguang, Electronic Technology（Part of Analog）, *Higher Education Press,* 2006

5. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory(Ninth Edition), *Electronic Industry Press,* 2010

0011122 数字电子技术

课程编码：0011122

课程名称：数字电子技术

英文名称：Digital Electronic Technology

课程类型：学科基础必修课

学分： 2 **总学时：** 32

面向对象：自动化、测控技术与仪器专业本科生

先修课程：大学物理Ⅰ、电路分析基础-1、电路分析基础-2

考核形式：平时成绩+期末考试

撰写人：江捷

课程简介：（250-300 字）

数字电子技术是为自动化、测控技术与仪器专业本科生开设的学科基础必修课。数字电子技术是学科基础必修课，是一门入门性质的技术基础课。本课程的任务是讲述数字电子技术领域的基本概念、基本理论和基本方法，培养学生在该领域的分析、设计、综合与创新能力，了解可编程逻辑器件的基本原理与应用，学习硬件描述语言的设计思路和方法，为后续专业课程的学习打下良好基础。教学内容重点是组合逻辑电路和时序逻辑电路的分析和设计方法，以及典型数字集成电路的功能与应用。教学内容的难点是逻辑门电路的外部特性以及不同系列门电路的接口等。

推荐教材或主要参考书：

[1] 江捷，马志成. 数字电子技术基础. 北京工业大学出版社，2009 年 10 月

[2] 江捷. 数字电子技术基础学习指导（第二版）. 北京工业大学出版社，2018 年 10 月

[3] 阎石. 数字电子技术基础（第六版）. 高等教育出版社，2016 年 4 月

[4] Thomas L. Floyd 著，余璆，熊洁译. 数字电子技术（第十一版）. 电子工业出版社, 2019 年 7 月.

0011122 Digital Electronic Technology

Course Number: 0011122

Course Title: Digital Electronic Technology

Course Type: Basic compulsory course

Credit: 2 **Total Credit Hours:** 32

Students: Undergraduate students majoring in Automation, Measurement& Control Technology and Instrument

Prerequisites: College physics, Circuit Analysis Foundation -1、Circuit Analysis Foundation-2

Evaluation Method: Course participation + Final exam

Writer： Jiang Jie

Course Description:

Digital Electronics Technology is a compulsory course of subject basis for Undergraduate majoring in Automation, Measurement& Control Technology and Instrument. Digital Electronics Technology is one of the subject-based compulsory courses and also an introductory technical one .The tasks of the course are to explain the basic concepts, theories and methods in the field of digital electronic technology, to cultivate students' capabilities of analysis, design, synthesis and innovation in this field. After learning the course, students could understand the basic principles and applications of programmable logic devices, grasp the basic ideas and methods for designing hardware by using hardware description language, which would lay good foundation for the subsequent professional courses. The teaching content would focus on the analysis and design methods of combinational logic circuits and sequential logic circuits, and the functions and applications of those typical digital integrated circuits. The challenges of the content would be the external characteristics of logic gate circuits and the interfaces between different series of gate circuits, etc.

Recommended Textbooks/References:

1.JIANG Jie, MA Zhicheng. Digital Electronic Technique Fundamentals. *Beijing University of Technology Press*, Oct-2009.

2.JIANG Jie. Learning Guild to Digital Electronic Technique Fundamentals (the 2nd edition). *Beijing University of Technology Press*, Oct-2018.

3.YAN Shi. Digital Electronic Technique Fundamentals (the 5th edition). *Higher Education Press*, May-2006.

4.Michael Hassen. Fundamentals of Digital Logic Design with VHDL. *Innovate LLC*, Jan-2013.

0010686 微机原理与接口技术

课程编号：0010686

课程名称：微机原理与接口技术

英文名称：Microcomputer Principle and Interface Technology

课程性质：学科基础必修课

学分：3.5　　**学时：**56

面向对象：测控技术与仪器专业本科生

先修课程：数字电子技术、模拟电子技术

考核形式：平时成绩+考试

撰写人：左国玉

课程简介：

微机原理与应用主要是在数字电路等课程的基础以 80x86/Pentium 为背景，通过对计算机系统的内部结构、组成、工作原理等方面的讲授，以及对学生设计能力的训练，使学生从理论和实践上掌握计算机的基本原理、基本组成、微处理器的结构及工作原理、指令系统、汇编语言程序设计、存储器及其接口电路设计、计算机接口技术的概念、数据传输方式以及部分简单智能接口电路的设计及软件编程等，为学习后续课程以及开发、设计、使用计算机应用系统打下良好的基础。

教材及参考书：

[1] 余春暄，左国玉，80x86/Pentium 微机原理及接口技术(第 3 版)，机械工业出版社，2015

[2] 左国玉，余春暄等，80x86 微机原理及接口技术——习题解答与实验指导(第 2 版)，机械工业出版社，2018

[3] 王晓萍 编著，微机原理与接口技术，浙江大学出版社，2019

0010686 Microcomputer Principle and Interface Technology

Course Number: 0010686

Course Title: Microcomputer Principle and Interface Technology

Course Type: Basic compulsory course

Credit: 3.5 **Total Credit Hours:** 56

Students: Undergraduate students majoring in measurement-control technology and instrument

Prerequisites: Digital Electronics, Analog Electronics

Evaluation Method: Course participation + written exams

Writer： Zuo Guoyu

Course Description:

This course is a basic course for the professional electric undergraduates, and it is also an introductory course for the undergraduates to learn and master the knowledge of computer hardware as well as assembler language design. It can make the students master the related knowledge of computer by means of teaching the internal structure of computer and its working principle. The related knowledge includes the following: the basic principle and components of computer, the structure and working principle of the microprocessor, the instruction set, the assembler language design, the memory and its interface circuit design, the concept of computer interface, data transmission, as well as some simple intelligent interface circuit design and software programming.

Recommended Textbooks/References:

1. Yu Chunxuan, Zuo Guoyu, 80x86 / Pentium microcomputer principle and Interface Technology (3rd Edition), *Machinery industry press*, 2015
2. Zuo Guoyu, Yu Chunxuan, et al., 80x86 microcomputer principle and interface technology - exercise solution and experimental guidance (2nd Edition), *Machinery industry press*, 2018

Wang Xiaoping, Microcomputer principle and interface technology, *Zhejiang University Press*, 2019

0000131 自动控制原理

课程编码：0000131

课程名称：自动控制原理

英文名称：Principles of Automatic Control

课程类型：学科基础必修课

学分： 4.0 **总学时：** 64

面向对象：测控技术与仪器专业本科生

先修课程：复变函数，电路分析基础-1，电路分析基础-2，模拟电子技术

考核形式：平时成绩+考试

撰写人：于建均

课程简介：（250-300 字）

自动控制原理是为测控技术与仪器专业本科生开设的学科基础必修课。本课程的任务是通过讲述自动控制原理理论知识和解决问题的办法，使学生理解掌握反馈控制的基本思想，掌握自动控制系统的一般分析方法。在此基础上，能够进行并完成一般控制系统的校正设计，进而使学生掌握运用自动控制原理的理论与方法解决实际问题的本领，为后续课程学习打下良好的基础。教学内容重点：自动控制、闭环控制的基本概念、控制系统的数学模型，控制系统的时域、复域、频域分析方法，系统控制器及校正环节的设计，非线性系统以及离散控制系统分析。教学内容难点：掌握反馈控制思想方法；一般物理对象系统传递函数的求取；理解高阶线性定常系统的分析方法及思路；时域、复域、频域的对应关系；系统固有特性、校正装置特性。

推荐教材或主要参考书：

[1] 孙亮，《自动控制原理》第三版， 高等教育出版社，2011 年 6 月

[2] 胡寿松，《自动控制原理》第七版， 科学出版社，2019 年 1 月

0000131 Principles of Automatic Control

Course Number: 0000131

Course Title: Principles of Automatic Control

Course Type: Basic compulsory course

Credit: 4.0 **Total Credit Hours:** 64

Students: Undergraduate students majoring in measurement-control technology and instrument

Prerequisites: Complex Functions, Circuit Theory Foundation-1, Circuit Theory Foundation-2, Electronics Technique

Evaluation Method: Course participation + written exams

Writer： Yu Jianjun

Course Description:

Principles of Automatic Control is a basic compulsory course for undergraduate students majoring in measurement-control technology and instrument. This course aims to make students understand and master the basic idea of feedback control and the general analysis method of automatic control systems by telling the theoretical knowledge of automatic control principles and the solution of problems. On this basis, students can complete the calibration design of general control systems and then enable students to master the theory and methods of automatic control principles to solve practical problems, and lay a good foundation for subsequent courses. Teaching content focus: automatic control, the basic concept of closed-loop control, the mathematical model of control system, time domain, complex domain, frequency domain analysis of control system, the design of system controller and calibration link, nonlinear system and discrete control system analysis. Difficulties of teaching content: mastering the idea and method of feedback control; finding the transfer function of general physical object system; understanding the analysis method and concepts of the higher-order linear constant system; correspondence of time domain, complex domain, and frequency domain; inherent characteristics of system and characteristics of correction device.

Recommended Textbooks/References:

1.Sun Liang, Automatic Control Theory 3th, *Beijing: Higher Education Press*, June-2011

2.Hu Shousong, The Principles of Automatic Control 7th. *Beijing: Science Press*, January-2019

0010115 智能机器人系统

课程编码：0010115

课程名称：智能机器人系统

英文名称：Intelligent Robot Systems

课程性质：专业选修课

学分：3.0　　**总学时：**48

面向对象：测控技术与仪器专业本科生

先修课程：线性代数（工）、大学物理Ⅰ、自动控制原理、高级语言程序设计、运动控制系统

考核形式：平时成绩 30%+期末考试 70%

撰写人：余攀

课程简介：

《智能机器人系统》是为测控技术与仪器专业的本科生开设的专业选修课，以顺应当前机器人技术的快速发展以及人才的迫切需求。它是一门涉及自动控制、计算机编程、传感器技术、人工智能等的多学科融合技术课程。通过课程的学习，要求学生理解掌握机器人基础原理，掌握机器人的数学建模方法。在此基础上，能够对机器人系统进行轨迹规划和运动控制，培养学生综合运用所学专业知识解决实际工程问题的能力，为从事机器人工程领域的工作奠定基础。教学内容重点包括空间描述及变换、机器人运动学和动力学分析、轨迹规划、机器人运动控制、智能机器人系统的基本结构和组成等。教学内容难点有机器人运动学和动力学、轨迹规划和机器人运动控制。实验内容包括空间描述与变换、机器人正运动学/逆运动学、轨迹规划。

推荐教材及参考书：

[1] 实宗英. 机器人智能控制电子课件. 清华大学自动化系, 2012

[2] 蔡自兴, 谢斌. 机器人学（第三版）. 清华大学出版社，2015

[3] Craig J.J. 机器人学导论（中文版）. 北京: 机械工业出版社，2005

[4] Nika S.-B. 机器人学导论-分析、系统及应用. 北京: 电子工业出版社, 2004

[5] Spong Mark W, Vidyasagar M. Robot Dynamics and Control. John Wiley & Sons, 2008

0010115 Intelligent Robot Systems

Course Number: 0010115

Course Title: Intelligent Robot Systems

Course Type: Professional elective course

Credit: 3.0 **Total Credit Hours:** 48

Students: Undergraduate students majoring in measurement-control technology and instrument

Prerequisites: Linear Algebra、College Physics、Automatic Control Theory、Computer Programming、Motion Control System

Evaluation Method: Usual performance (30%) + Final exam (70%)

Writer： Yu Pan

Course Description:

《Intelligent Robot Systems》is one of the professional elective courses for undergraduate students majoring in Measurement-control technology and instrument, to comply with the current rapid development of robotics technology and the urgent need for talents. It is a multi-disciplinary technology course involving Automation, Computer programming, Sensor technology, Artificial Intelligence, etc. The main target of this course is to clarify intelligent robot systems, enable students having a complete understanding of robots and their control systems, and help to build a foundation of Measurement& Control Technology and Instrument. The capacity to solve practical problems is also cultivated. The teaching contents are mainly covered by the following aspects: spatial description and transformation, robotic kinematics and dynamics, trajectory planning, robotic motion control, basic structure and composition of intelligent robot systems. The difficulties of teaching contents are described as followings: robotic kinematics and dynamics, trajectory planning, and robotic motion control. The experimental contents include spatial description and transformation, robotic kinematics/inverse kinematics experiment, and robotic path planning.

Recommended Textbooks/References:

1. Shi Zongying. Electronic Courseware for Robot Intelligent Control. Department of Automation, Tsinghua University, 2012

2. Cai Zixing, Xie Bin. Robotics (Third Edition). Tsinghua University Press, 2015

3. Craig J.J. Introduction to Robotics (Chinese Edition). Beijing: Mechanical Industry Press, 2005

4. Nika S-B. Introduction to Robotics-Analysis, System and Application. Beijing: Electronic Industry Press, 2004

5. Spong Mark W, Vidyasagar M. Robot Dynamics and Control. John Wiley & Sons, 2008

0010108 机器学习与模式识别

课程编码：0010108

课程名称：机器学习与模式识别

英文名称：Machine Learning and Pattern Recognition

课程类型：专业选修课

学分： 3.5 **总学时：** 56

面向对象：测控技术与仪器专业本科生

先修课程：高等数学（工），线性代数（工），概率论与数理统计（工），高级语言程序设计

考核形式：平时成绩+考试

撰写人：施云惠、李敬华

课程简介：（250-300 字）

机器学习与模式识别是为测控技术与仪器专业本科生开设的专业选修课程类型。本课程的任务是以理论为基础，以工程应用为目标，充分培养学生理论与实际相结合的能力、分析问题、解决问题和编程实践的能力。通过本课程的学习，将使学生掌握机器学习与模式识别的基本概念、基本原理和基本方法，特别是回归、分类、聚类、特征表示等常用算法的主要思想和应用方法。教学内容重点：线性回归、支持向量机、贝叶斯分类器、K 均值聚类、神经网络、主成分分析与降维以及稀疏表示算法的原理和应用。教学内容的难点：对算法思想的理解、算法的数学模型建模、参数求解及性能分析。

推荐教材或主要参考书：

[1]. 周志华，机器学习，清华大学出版社，2016 年 1 月

[2]. Cristopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006 年

[3]. Aurelien Geron. Hands-On Machine Learning with Scikit-Learn & TensorFlow, Oreilly, 2017 年 3 月

0010108 Pattern Recognition and Machine Learning

Course Number: 0010108

Course Title: Pattern Recognition and Machine Learning

Course Type: Professional elective course

Credit: 3.5 **Total Credit Hours:** 56

Students: Undergraduate students majoring in measurement-control technology and instrument

Prerequisites: Advanced mathematics, Linear algebra, Probability and statistics, Advanced Language Programming

Evaluation Method: Course participation + written exams

Writer： Shi Yunhui, Li Jinghua

Course Description:

Pattern Recognition and Machine Learning is one of the professional elective courses for undergraduate students Major in Measurement-control technology and instrument. The main target of this course is to clarify basic concept, basic foundation and basic method of Pattern Recognition and Machine Learning for engineering application, especially the main idea and application of commonly used methods including regression, classification, clustering and feature representation, which is useful for cultivating the students' ability of analyzing and solving problems for engineering application. The teaching contents are mainly covered by the following aspects: linear regression, support vector machine, Bayes classifier, K-means clustering, neural network, principal component analysis and dimension reduction, and sparse representation. The difficulties of teaching contents are described as followings: the idea, mathematical modeling process, parameters solution and performance analysis for each method.

Recommended Textbooks/References:

1.Zhou zhihua, Machine Learning, Tsinghua University Press, 1-2016.

2.Cristopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

3.Aurelien Geron. Hands-On Machine Learning with Scikit-Learn & TensorFlow, Oreilly, 3- 2017.

0010695 先进控制理论

课程编码：0010695

课程名称：先进控制理论

英文名称：Advanced Control Theory

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：自动化、测控技术与仪器专业本科生

先修课程：自动控制原理，现代控制理论

考核形式：平时成绩+考试

撰写人：于建均

课程简介：（250-300 字）

先进控制理论是为自动化专业以及测控技术与仪器专业本科生开设的专业选修课。本课程的任务旨在巩固、深化、拓展学生自动控制系统的理论知识与技能，培养训练学生综合运用控制的理论与方法进行反馈控制系统分析与设计的能力，使学生较为全面了解、掌握当前在工程应用中成功或颇具前景的控制方法，为学生在本专业领域的进一步发展打下良好的理论基础与技能。教学内容重点：控制系统数学模型，控制系统的性能分析，输出反馈控制系统设计与校正，状态反馈系统设计，非线性控制系统分析与设计，数字控制系统分析与设计。教学内容的难点：掌握先进控制理论的思想方法；一般物理对象系统的数学模型的建立；综合运用先进的控制理论与方法进行控制系统的分析与设计。

推荐教材或主要参考书：

[1] 孙亮.自动控制原理（第三版）. 高等教育出版社，2011.06

[2] 多尔夫（美），毕晓普（美）.现代控制系统(第十二版)(英文版).电子工业出版社，2012 年 7 月

[3] 胡寿松. 自动控制原理(第七版).科学出版社，2019 年 2 月

[4] 于建均. 控制理论学习指导与习题精解. 北京工业大学出版社，2007 年 6 月

0010695 Advanced Control Theory

Course Number: 0010695

Course Title: Advanced Control Theory

Course Type: Professional elective course

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students majoring in Automation and Measurement& Control Technology and Instrument

Prerequisites: Automatic Control Theory, Modern Control Theory

Evaluation Method: Course participation + written examination

Writer： Yu Jianjun

Course Description:

Advanced Control Theory is one of the elective courses offered for undergraduate students Major in both Automation and Measurement& Control Technology and Instrument. The main target of this course is to consolidate, deepen and expand the students' theoretical knowledge and skills of automatic control system, to cultivate and train the students' ability of analyzing and designing feedback control system, so that the students can comprehensively understand and master the successful or promising control methods for current engineering application, and lay a good theoretical foundation and skills for their further professional development. The main teaching contents include: the mathematical model of control system, control system performance analysis, output feedback control system design and correction, state feedback system design, nonlinear control system analysis and design, digital control system analysis and design. The difficulties of teaching contents include: to master the thoughts of the advanced control theory; to construct the mathematical model of any general physical object system; to apply the advanced control theories and methods for analyzing and designing any control system.

Recommended Textbooks/References:

1.Sun Liang, Principles of Automatic Control (Third Edition), Higher Education Press, 2011.06

2.Dorf (United States), Bishop (United States), Modern Control System (Twelfth Edition) (Chinese Edition), Electronic Industry Press, July 2012

3.Hu Shousong, Principles of Automatic Control (Seventh Edition). Science Press, February 2019

4.Yu Jianjun, Control theory study guidance and detailed exercises, Beijing University of Technology Press, June 2007

0008702 Python 编程基础

课程编码：0008702

课程名称：Python 编程基础

英文名称：Introduction of Python

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：测控技术与仪器专业本科生

先修课程：高级语言程序设计、高等数学（工）

考核形式：平时成绩+实验+闭卷考试

撰写人：庞俊彪

课程简介：（250-300 字）

《Python 编程基础》是 “简单”、“高效”、“开源”的语言，在信息科学中的编程语言中有着重要的作用。Python 是一个结合了解释性、编译性、互动性和面向对象的语言。Python 的设计具有很强的可读性。本课程系统讲述 Python 的基础理论、基本技术和基本方法。内容包括：基础语法、变量类型、循环条件、列表、元组，面向对象技术等。本课程是测控技术与仪器专业本科生的专业任选课之一，既是进行更高学历教育的起点之一，也是学习人工智能其它专题课程的基础。教学内容的难点：对算法思想的理解、面向对象建模。

推荐教材或主要参考书：

[1] 《Python 编程 从入门到实践 第 2 版》，Eric Matthes 著，袁国忠 译 人民邮电出版社，2020.

[2] 《笨办法学 Python 3》，泽德 A 肖 著，王巍巍 译，人民邮电出版社，2018

0008702 Introduction of Python

Course Number: 0008702

Course Title: Introduction of Python

Course Type: Professional elective course

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students majoring in Measurement& Control Technology and Instrument

Prerequisites: C programming and advanced mathematics

Evaluation Method: Course participation + experiments + closed examination

Writer： Pang Junbiao

Course Description:

Python programming foundation is a "simple", "efficient" and "open source" language, which plays an important role in the programming language of information science. Python is a combination of interpretive, compiler, interactive and object-oriented language. Python is designed to be very readable. This course systematically describes the basic theory, basic technology and basic methods of Python. The content includes: basic syntax, variable type, loop condition, list, tuple, object-oriented technology, etc. This course is one of the optional courses for undergraduates majoring in measurement-control technology and instrument. It is not only one of the starting points for higher education, but also the basis for learning other special courses of artificial intelligence. The difficulties of teaching content are: the understanding of algorithm thought, object-oriented modeling.

Recommended Textbooks/References:

1. Python programming from introduction to practice, 2nd Edition, written by Eric Matthes, translated by Yuan Guozhong, people's Posts and Telecommunications Press, 2020

2. Python 3, written by Zede a Xiao, translated by Wang Weiwei, people's Posts and Telecommunications Press, 2018

0010674 通信原理（双语）

课程编码：0010674

课程名称：通信原理（双语）

英文名称：Principle of Communications

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：测控技术与仪器专业本科生

先修课程：高等数学（工）、线性代数（工）

考核形式：平时成绩+考试

撰写人：傅安琪

课程简介：

通信原理是为测控技术与仪器专业本科生开设的专业选修课。本课程的任务是结合测控技术与仪器专业背景，介绍通信技术中物理层通信的最基本原理，使学生能了解通信的基本问题和内容，建立起点到点通信系统的基本知识框架，为解决自动化领域复杂工程问题提供良好的知识基础。学生应掌握的基本知识有：信道、模拟调制系统、数字基带传输、数字带通传输、模拟信号的数字传输、数字信号的最佳接收、同步原理、通信网，以及通信系统在自动化中的应用。通过本课程的学习，学生能够了解和掌握不同的通信技术的工作原理和特点，以及使用方法；能够针对涉及到通信交叉领域的自动化领域复杂工程问题，选用满足需求的通信技术，并使用相关工具进行适配，使用相关模拟仿真工具进行分析和预测。

推荐教材或主要参考书：

[1] 樊昌信. 通信原理 第 6 版. 国防工业出版社，2009 年 5 月

[2] 周炯槃. 通信原理 第 3 版. 北京邮电大学出版社，2008 年 8 月

[3] Leon W. Couch. Digital and Analog Communication Systems. Pearson，2013

0010674 Principle of Communications

Course Number: 0010674

Course Title: Principle of Communications

Course Type: Professional elective course

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students majoring in measurement-control technology and instrument

Prerequisites: Linear Algebra, Calculus

Evaluation Method: Course participation + written exams

Writer： Fu Anqi

Course Description:

Principle of Communications is one of the professional electives courses for undergraduate students Major in measurement-control technology and instrument. The main target of this course is to clarify the basic principles of communications. With this course, students are supposed to have a basic idea of the problems and contents about the physical layer of communications and thus has a frame of point-to-point communications. As a result, the students can have basic ideas about communications when facing complex and cross-discipline control engineer problems. This course focus on modulation and demodulation. The teaching contents are mainly covered by the following aspects: channels, analog modulation systems, digital baseband transmission, digital band transmission, digital transmission of analog signals, best reception of digital signals, synchronization principle, communication network, and applications of communications in networked control systems. After this course, the students can specify different communication technologies, and their applications. With the help of related toolboxes, students can analyze the communications in a control system and estimate its performances.

Recommended Textbooks/References:

1.Changxin Fan, Principle of Communications, National Defense Industry Press, 2009

2.Jiongpan Zhou, Principle of Communications, Beijing University of Posts and Telecommunications Press, 2008

3.Leon W. Couch. Digital and Analog Communication Systems. Pearson, 2013

0010653 数据库原理及应用

课程编码：0010653

课程名称：数据库原理及应用

英文名称：Principles and applications of database systems

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：测控技术与仪器专业本科生

先修课程：高级语言程序设计

考核形式：平时成绩+考试

撰写人：黄佳进

课程简介：（250-300 字）

数据库原理及应用是为机器人专业本科生开设的专业任选课课程类型。本课程的任务是深刻理解数据库系统的基本原理，了解数据库管理系统涉及和实现的基本方法和技术，并能高水平地开展数据库应用。教学内容重点：数据库的查询语言；关系理论及数据库的设计方法；对数据库的安全性、完整性、并发控制及数据恢复的应用。教学内容的难点：关系代数和关系数据理论、数据库查询语言和数据库设计。

推荐教材或主要参考书：

[1]王珊, 萨师煊, 数据库系统概论（第 5 版）, 高等教育出版社, 2014-9

[2]王能斌，数据库系统教程（第 2 版），电子工业出版社，2008-5

[3] 袁冠，葛欣，雷小锋，谢红. 数据库原理与应用（MySQL 版），清华大学出版社，2019-2

0010653 Principles and applications of database systems

Course Number: 0010653

Course Title: Principles and applications of database systems

Course Type: Professional elective course

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students majoring in Measurement& Control Technology and Instrument

Prerequisites: High level language programming

Evaluation Method: Course participation + written exams

Writer： Huang Jiajin

Course Description:

Principles and applications of database systems is one of the professional elective courses for undergraduate students major in Measurement& Control Technology and Instrument. The main target of this course is to clarify the basic principles of database system, the basic methods and technologies involved in database management system, and how to apply database at a high level. This course is focus on Principles and applications of database systems. The teaching contents are mainly covered by the following aspects: The data models, SQL Language, the security and integrity constrains of database, concurrency control and recovery in database. The difficulties of teaching contents are described as followings: The data model, the SQL language, key principles of database management systems, and database design procedure.

Recommended Textbooks/References:

1.Shan Wang, Shixuan Sa. Introduction to Database System（5th Edition）, High Education Press, 2014-9

2.Nengbin Wang，Textbook of Database System (2nd Edition)，Electronic Industry Press，2008-5

3.Guan Yuan, Xin Ge, Xiaofeng Lei, Hong Xie. Principles and applications of database systems (MySQL), Tsinghua University Press, 2019-2.

0011121 人工智能基础

课程编码： 0011121

课程名称：人工智能基础

英文名称：Fundamentals of Artificial Intelligence

课程类型：自主课程

学分： 2.0 **总学时：** 32

面向对象：测控技术与仪器专业本科生

先修课程：面向对象程序设计与实践

考核形式：平时成绩+考试

撰写人：王昕

课程简介：（250-300 字）

本课程是面向测控技术与仪器专业学生开展的自主必修课程。“人工智能”是 21 世纪计算机科学发展的主流，为了培养国家新世纪建设的有用人才，提高测控技术与仪器专业学生在解决复杂工程问题中的软件开发“智能”观念，开设人工智能基础课程是非常必要的。本课程的内容为人工智能理论的基础部分，包括绪论、通过搜索进行问题求解、超越经典搜索、对抗搜索、知识推理与规划、学习，共 6 章。课程采取研究型教学手段，强调启发性和研讨性，了解人工智能的基本理论、基本方法和基本技术，为今后的继续深造和智能仪器系统研制，以及进行相关的工作打下人工智能方面的基础。

推荐教材或主要参考书：

[1] Stuart J. Russell, Peter Norvig 著，人工智能：一种现代的方法（第 3 版）. 北京：清华大学出版社，2017 年

[2] 高济 著，人工智能基础，北京：高等教育出版社，2004 年

[3] Stephen Lucci，Danny Kopec 著，人工智能（第 2 版）. 北京：人民邮电出版社，2018 年

0011121 Fundamentals of Artificial Intelligence

Course Number: 0011121

Course Title: Fundamentals of Artificial Intelligence

Course Type: Independent course

Credit: 2.0 **Total Credit Hours:** 32

Students: Undergraduate students major in Measurement& Control Technology and Instrument

Prerequisites: High level language programming

Evaluation Method: Course participation + reports

Writer： Wang Xi

Course Description:

This course introduces the basic principles and methods of artificial intelligence, which focuses on the basic content of the artificial intelligence, including intelligence Agent, problem-solving Agent, local search, adversarial search problems, knowledge & reasoning & planning, learning. The course emphasizing enlightenment and discussion, understanding the basic theories, methods and technologies of artificial intelligence, and laying the foundation for artificial intelligence in the future for further study and development of intelligent instrument systems and related work.

Recommended Textbooks/References:

1. Stuart J. Russell, Peter Norvig, Artificial Intelligence：A modern approach (3rd Edition). Tsinghua University Press, 2017

2. GAO Ji. Fundamentals of Artificial Intelligence. Higher Education Press, 2004

3. Stephen Lucci, Danny Kopec, Artificial Intelligence (2nd Edition). Posts & Telecom Press, 2018