目录

0010089 复变函数

课程编码：0010089

课程名称：复变函数

英文名称：Function of the Complex Variable

课程类型：公共基础必修课

学分： 2.0 **总学时：** 36

面向对象：机器人工程专业本科生

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：奥顿

课程简介：（250-300 字）

复变函数是人工智能与自动化学院为机器人工程专业本科生开设的公共基础必修课。复变函数的理论和方法在数学、自然科学和工程技术中有着广泛应用，是解决诸如电磁学、流体力学、弹性理论中平面问题的有力工具，其基础内容已成为理工科很多专业的必修课程。课程的主要任务：教学过程中采用启发式、理论联系实际等教学方式，使学生掌握复变函数的基本理论，掌握傅里叶变换的主要性质。同时通过本课程的教学，提高学生的数学抽象思维，逻辑推理能力和计算能力。教学内容重点：复数与复变函数，解析函数，级数，留数，傅里叶变换。教学内容难点：解析函数，留数，以及傅里叶变换。

推荐教材或主要参考书：

[1] 西安交通大学高等数学教研室编. 工程数学-复变函数（第四版）. 高等教育出版社，1996 年 5 月

[2] 钟玉泉编. 复变函数论（第五版）. 高等教育出版社，2021 年 3 月

[3] 孙妍，刘向丽，解文龙，黄静静. 复变函数与积分变换. 机械工业出版社，2016 年 1 月

自主查阅和论坛内容相关的学术文献。

0010089 Function of the Complex Variable

Course Number: 0010089

Course Title: Function of the Complex Variable

Course Type: Compulsory Common Basic Course

Credit: 2.0 **Total Credit Hours:** 36

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Advanced mathematics, Linear algebra

Evaluation Method: Course participation + exam

Writer： Ao Dun

Course Description:

Function of the Complex Variable is a compulsory common basic course for undergraduate majoring in robotic engineerig in the College of artificial intelligence and automation. The theory and method of complex function is widely used in mathematics, natural science and engineering technology. It is a powerful tool to solve plane problems such as electromagnetics, fluid mechanics and elastic theory. Its basic content has become a compulsory course for many majors of science and engineering. The main task of the course is to adopt heuristic and practical teaching methods during the teaching process, so that students can master the basic theory of complex variable functions and master the main properties of Fourier transform. At the same time, through the teaching of this course, students' mathematical abstract thinking, logical reasoning ability, and computational ability will be improved. The course focuses on complex numbers and functions of complex variables, analytical functions, series, residues, Fourier transform. The challenges of the course: Analytic functions, residues, and Fourier transforms.

Recommended Textbooks/References:

1. Department of advanced mathematics, Xi'an Jiaotong University. Engineering mathematics complex variable function (Fourth Edition). *Higher education press*, May 1996
2. Zhong Yuquan. Theory of complex function (5th Edition). *Higher education press*, March 2021
3. Sun Yan, Liu Xiangli, Xie Wenlong, Huang Jingjing. Complex variable function and integral transformation. *China Machine Press*, January 2016

0010120 离散数学

课程编码：0010120

课程名称：离散数学

英文名称：Discrete Mathematics

课程类型：学科基础必修课、公共基础必修课

学分： 2.0 **总学时：** 36

面向对象：自动化、机器人工程专业本科生

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：李建更

课程简介：（250-300 字）

离散数学是研究离散结构和离散数量关系的数学分支的统称，是信息学部为自动化专业本科生开设的学科基础必修课，，为机器人工程专业本科生开设的公共基础必修课。。课程主要内容包括：数理逻辑、集合和关系、图论、及代数结构等。课程的主要任务，一方面关注于离散对象的数学结构及其证明、演算与推理理论研究，为基于二进制编码的计算机相关学科提供理论研究基础；另一方面，将基础数学与应用数学的多个不同分支集成，承担起了理论模型向实用模型转化的纽带功能，因而对培养学生分析、建模、解决问题能力的培养具有重要作用。对于自动化专业的本科生而言，通过该课程的学习，将有助于学生深入洞察应用问题的本质属性，并可进一步选择恰当的离散结构对问题进行模型的表达及求解。

推荐教材或主要参考书：

[1] 贲可荣，袁景凌，谢茜. 离散数学（第三版）. 清华大学出版社，2021 年 2 月

[2] 贲可荣，袁景凌，高志华编著，离散数学解题指导，清华大学出版社，2016 年 11 月

[3] 耿素云，屈婉玲，张立昂. 离散数学（第五版）. 清华大学出版社，2013 年 7 月

[4] 牛连强. 工科离散数学. 电子工业出版社，2017 年 2 月

[5] 肯尼思 H 罗森著，徐六通等译，离散数学及其应用，机械工业出版社，2021 年 1 月

0010120 Discrete Mathematics

Course Number: 0010120

Course Title: Discrete Mathematics

Course Type: Basic compulsory course、Compulsory Common Basic Course

Credit: 2.0 **Total Credit Hours:** 36

Students: Undergraduate students majoring in Automation, Robotic Engineering

Prerequisites: Advanced Mathematics, Linear Algebra,

Evaluation Method: Course participation + written exams

Writer： Li Jiangeng

Course Description:

Discrete Mathematics is one of the basic compulsory courses for undergraduate students major in automation and one of the compulsory common basic courses for undergraduate students major in robotic engineering. The main target of this course is to clarify the theories related to the discrete topologies and discrete quantitative relationship. This course is focus, on the one hand, the mathematical structure of discrete objects and its proof, calculus and reasoning theory, which is the theoretical research basis of computer related disciplines based on binary coding; on the other hand, integrating with many different branches of basic mathematics and applied mathematics, as a result undertaking the link function of transforming theoretical model into practical model, which plays an important role in cultivating students' ability of analysis, modeling and problem solving. The teaching contents are mainly covered by the following aspects: mathematical logic, set and relation, graph theory, and algebraic structure. For the undergraduates majoring in automation, the study of this course will help students to have a deep insight into the essential attributes of application problems, and further select the appropriate discrete structure to model and solve the problems.

Recommended Textbooks/References:

1.Ben Kerong, Yuan jingling, Xie Xi. Discrete Mathematics (Third Edition). Tsinghua University Press, February 2021 (in chinese)

2.Ben Kerong, Yuan jingling, Gao Zhihua, discrete mathematics problem solving instruction Tsinghua University Press, November 2016 (in chinese)

3.Geng Suyun, Qu Wanling, Zhang Liang. Discrete Mathematics (Fifth Edition). Tsinghua University Press, July 2013 (in chinese)

4.Niu Lianqiang. Discrete mathematics of engineering. Electronic Industry Press, February 2017 (in chinese)

5.Kenneth h. Rosen, translated by Xu Liutong, et al. Discrete mathematics and its application, China Machine Press, January 2021 (in chinese)

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、机器人工程、电子科学与技术（实验班）、微电子科学与工程（实验班）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 是人工智能与自动化学院为自动化、机器人工程、电子科学与技术（实验班）、微电子科学与工程（实验班）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, Robotic Engineering, Electronic Science and Technology, and Microelectronics Science and Engineering

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-2is a compulsory course of subject basis for Undergraduate majoring in Automation, Robotic Engineering, Electronic Science and Technology, and Microelectronics Science and Engineering in the College of artificial intelligence and automation. 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

0008127 数字电子技术

课程编码：0008127

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： 3.5 **总学时：** 56

面向对象：自动化、机器人工程、电子科学与技术（实验班）、微电子科学与工程（实验班）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）

数字电子技术是人工智能与自动化学院为自动化、机器人工程、电子科学与技术（实验班）、微电子科学与工程（实验班）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.

0008127 Digital Electronic Technology

Course Number: 0008127

Course Title: Digital Electronic Technology

Course Type: Basic compulsory course

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

Students: Undergraduate students majoring in Automation, Robotic Engineering, Electronic Science and Technology, and Microelectronics Science and Engineering

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, and Robotic Engineering, Electronic Science and Technology, and Microelectronics Science and Engineering in the College of artificial intelligence and automation. 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.

0004333 模拟电子技术

课程编码：0004333

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：3.5　　**学时：**56

面向对象：自动化、机器人工程、电子科学与技术（实验班）、微电子科学与工程（实验班）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：

模拟电子技术是人工智能与自动化学院为自动化、机器人工程、电子科学与技术（实验班）、微电子科学与工程（实验班）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

0004333 Analog Electronic Technology

Course Number: 0004333

Course Title: Analog Electronic Technology

Course Type: Basic compulsory course

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

Students: Undergraduate students majoring in Automation, Robotic Engineering, Electronic Science and Technology, and Microelectronics Science and Engineering

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, Robotic Engineering, Electronic Science and Technology, and Microelectronics Science and Engineering in the College of artificial intelligence and automation. 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 Press, 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

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：机器人工程专业本科生

先修课程：计算机软件基础、数字电子技术、模拟电子技术

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、软件基础等课程的基础以 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 Robotic Engineering

Prerequisites: Digital Electronics, Analog Electronics, Fundamentals of Computer Software

Evaluation Method: Written Exam

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
3. 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：机器人工程专业本科生

先修课程：复变函数与积分变换，电路分析基础，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）

自动控制原理是人工智能与自动化学院为机器人工程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 Robotic Engineering

Prerequisites: Complex Functions and Integral Transformation, Circuit Theory, Electronics Technique

Evaluation Method: Course participation + written exams

Writer： Yu Jianjun

Course Description:

'Principles of automatic control' is a basic compulsory course for undergraduates majoring in robotic engineering in the College of artificial intelligence and automation. 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

0010102 机器人基础原理

课程编码：0010102

课程名称：机器人基础原理

英文名称：Basic Principles of Robotics

课程类型：学科基础必修课

学分： 2.5 **总学时：** 40

面向对象：机器人专业本科生

先修课程：高等数学（工），线性代数（工），大学物理Ⅰ

考核形式：平时成绩+考试

撰写人：裴福俊

课程简介：（250-300 字）

机器人基础原理是人工智能与自动化学院为机器人专业本科生开设的专业必修课程型。本课程的任务是以简单、直观的方式讲解机器人学的基础知识，介绍机器人发展的最新科技和发展现状，使学生系统掌握机器人基本概念、体系结构、基础知识、运动学建模、规划与导航等基础知识，培养综合运用机器人知识对具体的工程问题进行分析、解决和表达的能力，初步具备机器人系统分析和设计能力，为以后从事机器人相关的科学研究和技术工作做好准备。教学内容重点：机器人体系结构、数学基础知识、运动学建模与规划。教学内容的难点：运动学建模与规划。

推荐教材或主要参考书：

[1] 朗佐·凯利（Alonzo Kelly） 著，王巍 崔维娜 等译 . 《移动机器人学：数学基础、模型构建及实现方法》，机械工业出版社，2020

[2] 约翰 J. 克雷格（John J. Craig）著，贠超，王伟译，《机器人学导论（第四版）》，机械工业出版社，2018

0010102 Basic Principles of Robotics

Course Number: 0010102

Course Title: Basic Principles of Robotics

Course Type: Basic compulsory course

Credit: 2.5 **Total Credit Hours:** 40

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Advanced Mathematics, Linear Algebra, College Physics

Evaluation Method: Course participation + written exams

Writer： Pei Fujun

Course Description:

Basic Principles of Robotics is one of the basic compulsory courses for undergraduate students major in robotic engineering. The main target of this course is to clarify the basics of robotics by the simple and intuitive way, and introduces the recent development of robot technology and the present situation. Through the study of this course, students can master the basic architecture of robot, basic mathematics knowledge, kinematic modeling of robot, planning and navigation of robot, and other basic knowledge of robotics. And develop the ability to analyze, solve and express specific engineering problems by comprehensive application of robot knowledge. This course will make the students master the preliminary ability of robot system analysis and design and prepare related scientific research and technology of robot for students in future work. This course is focus on XXX. The teaching contents are mainly covered by the following aspects: the basic architecture of robot, the basic mathematics knowledge and kinematic modeling and planning. The difficulties of teaching contents are described as followings: kinematic modeling and planning.

Recommended Textbooks/References:

1. Alonzo Kelly. Mobile Robotics Mechanics, Model and Methods, China Machine Press, 2020

2. John J. Craig，Introduction to Robotics, Mechanics and Control (Fourth Edition), China Machine Press, 2018

0008688 电机驱动与运动控制

课程编码：0008688

课程名称：电机驱动与运动控制

英文名称：Electric Machine and Motion Control

课程类型：学科基础必修课

学分： 3.5 **总学时：** 56

面向对象：机器人工程专业本科生

先修课程：电路分析基础，模拟电子技术，自动控制原理

考核形式： 平时成绩+考试

撰写人：许家群

课程简介：

电机驱动与运动控制是信息学部为机器人工程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机器人动力系统所必需的电机、电力电子及运动控制基础理论。教学内容包括直流电机、异步电机、同步电机的工作原理、运行特性和调速方法，电力电子器件、电力电子电路及其控制原理与实现方法，开环及闭环控制的交流调速系统和直流调速系统的结构组成、控制原理、性能分析和工程设计方法。教学内容的重点难点在于直流电机调速系统、异步电机调速系统和同步电机系统的理论与综合。

推荐教材或主要参考书：

[1] 杨耕. 电机与运动控制系统. 清华大学出版社，2014 年 3 月

[2] 刘锦波. 电机与拖动. 清华大学出版社，2015 年 6 月

[3] 王兆安. 电力电子技术. 机械工业出版社，2013 年 6 月

[4] 阮毅. 运动控制系统. 机械工业出版社，2016 年 11 月

0008688 Electric Machine and Motion Control

Course Number: 0008688

Course Title: Electric Machine and Motion Control

Course Type: Basic compulsory course

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

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Electric Circuit; Electronics; Automatic control

Evaluation Method: Course participation + written exams

Writer： Xu Jiaqun

Course Description:

Electric Machine and Motion Control is one of the basic compulsory course for undergraduate students major in robotic engineering. The main task of this course is to make students master the basic theories of motor, power electronics and motion control necessary for robotic power systems. The teaching contents are mainly covered by the following aspects: the working principle, operation characteristics and speed control methods of DC motor, asynchronous motor and synchronous motor; power electronic circuit and control principle and implementation methods; the structure composition, control principle, performance analysis and engineering design methods of AC and DC motor system with open-loop and closed-loop control. The key and difficulty of teaching contents are the theory and synthesis of DC motor system, asynchronous motor system and synchronous motor system.

Recommended Textbooks/References:

1. Yang Geng. Electrical Machinery and Motion Control Systems. Tsinghua University Press, 2014
2. Liu Jinbo. Electric Machinery and Electric Drives (The second edition). Tsinghua University Press, 2015
3. Wang Zhaoan. Power Electronics. China Machine Press, 2013
4. Ruan Yi. Motion Control Systems. China Machine Press, 2016

0010100 机器人感知技术

课程编码：0010100

课程名称：机器人感知技术

英文名称：Robot Sensing Technology

课程类型：学科基础必修课

学分： 2.5 **总学时：** 40

面向对象：机器人工程专业本科生

先修课程：概率论与数理统计，大学物理Ⅰ，机器人基础原理，高级语言程序设计，机器人系统仿真

考核形式：平时成绩+考试

撰写人：徐喆、刘春芳

课程简介：（250-300 字）

机器人感知技术是信息学部为机器人工程专业本科生开设的学科基础必修课。本课程的任务是引导学生认识感知系统在机器人系统中的作用，理解和掌握感知系统获取数据的原理和方法，掌握评价感知系统不确定性的方法，以及了解感知系统信息融合的基本方法，还包括梳理目前各类机器人感知应用的研究成果和进展。教学内容重点：感知系统获取数据原理和方法。教学内容的难点：把机器人感知系统的数据获取与机器人应用场景下感知的目标紧密结合。

推荐教材或主要参考书：

[1]讲义

[2]郭彤颖，张辉，机器人传感器及其信息融合技术，化学工业出版社，2016

[3]机器人翻译委员会译，《机器人手册第 2 卷机器人技术》（第 1 版），机械工业出版社，2016

[4]王耀南，梁桥康，朱江，“中国制造 2025”出版工程-机器人环境感知与控制技术，化学工业出版社，2018

0010100 Robot Sensing Technology

Course Number: 0010100

Course Title: Robot Sensing Technology

Course Type: Basic compulsory course

Credit: 2.5 **Total Credit Hours:** 40

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Probability theory and mathematical statistics, College physics I, Basic principles of robot, High level language programming, Robot system simulation

Evaluation Method: Course participation + written exams

Writer： Xu Zhe, Liu Chunfang

Course Description:

Robot Sensing Technology is one of the subject basic required courses for undergraduate students Major in Robot Engineering. The main target of this course is to clarify the principle and method to acquire data in robot sensing system in robot applications. This course is focus on principle and method to acqire data and sensing. The teaching contents are mainly covered by the following aspects: Introduction of sensor and sensing in robot applications, evaluation index, sensing system for force/movement/vision/touch etc.. The difficulties of teaching contents are described as followings: combine principle of acquiring data with sensing in robot applications.

Recommended Textbooks/References:

1,Lecture notes

2. Guo Tongying, Zhang Hui, Robot sensor and its information fusion technology, *Chemical industry press*, 2016

3. Translated by robot translation Committee, Robot manual, Volume 2, Robotics (1st Edition), *China Machine Press*, 2016

4. Wang Yaonan, Liang Qiaokang, Zhu Jiang, "Made in China 2025" publishing project - robot environment perception and control technology, *Chemical industry press*, 2018

0010696 现代控制理论

课程编码：0010696

课程名称：现代控制理论

英文名称：Modern Control Theory

课程类型：学科基础必修课

学分： 2.0 **总学时：** 32

面向对象：机器人工程专业本科生

先修课程：高等数学（工）、线性代数（工）、自动控制原理

考核形式：平时成绩+考试

撰写人：陈阳舟、龚道雄

课程简介：（250-300 字）

现代控制理论是信息学部为机器人工程专业本科生开设的学科基础课程。本课程以线性状态空间模型为基础，系统地阐述了控制系统的一些基本的分析方法和控制设计思想，是控制类后续课程的基础。

本课程的任务是使机器人工程专业的本科生掌握现代控制理论的基本知识、基础理论和基本方法，学会用状态空间设计和分析自动控制系统，具有完成一般控制系统分析和设计任务的能力，为后续课程学习打下良好的基础。教学内容重点包括：控制系统的状态空间数学模型，控制系统的运动分析、能控性和能观测性、李雅普洛夫稳定性、系统的极点配置、解耦控制、线性二次型最优控制、全维观测器的设计等。难点包括：系统建模、模型标准化、运动分析和计算、能控标准型和能观测标准型、李雅普诺夫函数、控制器和观测器设计等。

推荐教材或主要参考书：

[1] 张嗣瀛，高立群，现代控制理论，清华大学出版社，2017 年；

[2] 高立群，郑艳，井元伟，现代控制理论习题集，清华大学出版社，2007 年；

[3] R.L. Williams and D.A. Lawrence, Linear State-Space Control Systems, John Wiley & Sons, 2007

0010696 Modern Control Theory

Course Number: 0010696

Course Title: Modern Control Theory

Course Type: Basic compulsory course

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

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Advanced Mathematics, Linear Algebra, Principle of Automatic Control

Evaluation Method: Course participation + written exams

Writer： Chen Yangzhou, Gong Daoxiong

Course Description:

"Modern Control Theory" is one of the basic compulsory courses for undergraduate students major in robotic engineering. The main target of this course is to clarify some basic analysis approaches and control design methods of control system based on the state space method. This course focuses on the linear state-space model as well as corresponding analysis and control design methods of continuous/discrete time-invariant linear systems. The teaching contents include the following aspects: modeling and standardization of state-space model, system analysis (state trajectory analysis, controllability and observability, stability analysis based on Lyapunov stability theorem), controller design (pole placement, stabilization, linear quadratic regulator) and state observer design. The difficulties of teaching contents include: modeling and its standardization, motion analysis, controllability canonical form and observability canonical form, Lyapunov function, controller and observer design.

Recommended Textbooks/References:

1.ZHANG Siying, GAO Liqun, Modern Control Theory, Tsinghua University Press, 2017

2.GAO Liqun, ZHENG Yan, JING Yuanwei, Exercise for Modern Control Theory, Tsinghua University Press, 2007

3.R.L. Williams and D.A. Lawrence, Linear State-Space Control Systems, John Wiley & Sons, 2007

0008114 电子技术实验-1

课程编码：0008114

课程名称：电子技术实验-1

英文名称：The Electronic Technology Experiment-1

课程类型：实践环节必修课

学分： 1.0 **总学时：** 32

面向对象：自动化、机器人工程、电子科学与技术（实验班）、微电子科学与工程（实验班）专业本科生

先修课程：模拟电子技术, 数字电子技术

考核形式：平时成绩+考试

撰写人：石婷

课程简介：（250-300 字）

电子技术实验-1 是信息学部为自动化、机器人工程、电子科学与技术（实验班）、微电子科学与工程（实验班）专业本科生开设的实践环节必修课。本课程的任务是通过电子实验知识、概念的学习，实验操作能力的培养，使学生加深对相关理论知识的理解，初步具备进行电子技术实验的能力。通过本课程，学生能够学会电子元器件、集成电路的识别、测试和使用知识，掌握常用电子设备和工具的使用方法，在完成几个单元实验的过程中，加深对理论知识的理解，建立实验的概念，为今后进行综合性设计和专业实验奠定坚实的基础。通过对实验中出现或可能出现的故障的分析和排除，培养学生分析问题、分解问题和解决问题的方法。教学内容重点是基础实验操作。教学内容的难点是焊接技术、电子设备元器件、单元实验。

推荐教材或主要参考书：

[1] 华成英，模拟电子技术基本教程，清华大学出版社，2018 年 7 月；

[2] 林涛、林彬、杨照辉，数字电子技术基础，清华大学出版社，2018 年 1 月；

[3] 摆玉龙，电子技术实验教程，清华大学出版社，2015 年 12 月；

0008114 The Electronic Technology Experiment-1

Course Number: 0008114

Course Title: The Electronic Technology Experiment-1

Course Type: Practice compulsory course

Credit: 1.0 **Total Credit Hours:** 32

Students: Undergraduate students majoring in Automation, Robotic Engineering, Electronic Science and Technology, and Microelectronics Science and Engineering

Prerequisites: Analog Electronics, Digital Electronics

Evaluation Method: Course participation + written exams

Writer： Shi Ting

Course Description:

Electronic Technology Experiment-1 is a practice compulsory course of information department for undergraduates majoring in automation, robotic engineering, electronic science and technology, and microelectronics science and engineering. The goal of this course is to deepen students' understanding of relevant theoretical knowledge. Make students have the initial ability to conduct electronic technology experiments through the study of theoretical knowledge of electronic experimental and the cultivation of experimental operation ability. Through this course, students can learn about the identification, testing and use of electronic components and integrated circuits, and master to use common electronic devices and tools. In the process of completing several typical experiments, students have deeper understanding of theoretical knowledge and build the concept of experimentation, which lays a solid foundation for comprehensive design and professional experiments in the future. Through the analysis and elimination of faults that appear or may occur during the experiment, students are cultivated to analyze, decompose and solve problems.

Teaching content focus: Basic experimental operation.

Difficulties in teaching content: Welding technology, Electronic equipment components, Unit experiments.

Recommended Textbooks/References:

1.Chengying Hua, Fundamentals of Analog Electronics, *Tsinghua University Press*, 07-2018

2.Tao Lin, Bin Lin, Zhaohui Yang, Fundamentals of Digital Electronics, *Tsinghua University Press*, 01-2018

3.Yulong Bai, The Course of Electronic Technology Experiment, *Tsinghua University Press*, 12-2015

0008115 电子技术实验-2

课程编码：0008115

课程名称：电子技术实验-2

英文名称：The Electronic Technology Experiment-2

课程类型：实践环节必修课

学分： 1.5 **总学时：** 48

面向对象：自动化专业、机器人工程专业本科生

先修课程：模拟电子技术, 数字电子技术

考核形式：平时成绩+考试

撰写人：石婷

课程简介：（250-300 字）

电子技术实验-2 是信息学部为自动化、机器人工程专业本科生开设的实践环节必修课。本课程的任务是通过讲课和实验，使学生进一步熟悉电子原材料的知识和电子仪器的使用方法，熟练掌握电子技术实验的方法，在设计实现综合型模块化题目的过程中，学会测量、记录、分析和调试，提高学生解决实际问题的能力，获得感知，积累经验。

教学内容重点：分别完成一个基于数字电子技术和模拟电子技术的课题设计。

教学内容的难点：学生综合运用电子技术知识解决工程问题的综合能力。

推荐教材或主要参考书：

[1] 华成英，模拟电子技术基本教程，清华大学出版社，2018 年 7 月；

[2] 林涛、林彬、杨照辉，数字电子技术基础，清华大学出版社，2018 年 1 月；

[1] 姚福安，徐向华，电子技术实验，清华大学出版社，2015 年 8 月；

0008115 The Electronic Technology Experiment-2

Course Number: 0008115

Course Title: The Electronic Technology Experiment-2

Course Type: Practice compulsory course

Credit: 1.5 **Total Credit Hours:** 48

Students: Undergraduate students majoring in Automation and Robotic Engineering

Prerequisites: Analog Electronics, Digital Electronics

Evaluation Method: Course participation + written exams

Writer： Shi Ting

Course Description:

Electronic Technology Experiment-2 is a practice compulsory course of information department for undergraduates majoring in automation and robotic engineering. The goal of this course is to make students further familiar with knowledge of electronic raw materials, the use of electronic instruments and master the method of electronic technology experiment through lectures and experiment. In the process of designing and implementing integrated modular topics, students learn how to measure, record, analyze and debug, improve the ability of solving practical problems, gain perception and accumulate experience.

Teaching content focus: Course design based on digital electronic technology and analog electronic technology.

Difficulties in teaching content: The comprehensive ability of students to solve engineering problems using electronic technical knowledge.

Recommended Textbooks/References:

1.Chengying Hua, Fundamentals of Analog Electronics, *Tsinghua University Press*, 07-2018

2.Tao Lin, Bin Lin, Zhaohui Yang, Fundamentals of Digital Electronics, *Tsinghua University Press*, 01-2018

3.Fuan Yao, Xianghua Xu, The Electronic Technology Experiment, *Tsinghua University Press*, 08-2015

0007260 认识实习

课程编码：0007260

课程名称：认识实习

英文名称：Cognitive Practice

课程类型：实践环节必修课

学分： 1.0 **总学时：** 30

面向对象：自动化专业、机器人工程专业本科生

先修课程：新生研讨课

考核形式： 平时成绩+报告

撰写人：奥顿

课程简介：（250-300 字）

认识实习是人工智能与自动化学院为自动化、机器人工程专业本科生开设的实践环节必修课，旨在学生学习专业课之前，让学生初步了解专业相关行业特色，及对专业知识的需求，激发学生学习专业课程的兴趣，增强学生学习的主观能动性，是学生在专业课学习中能够联系行业实际应用，为专业知识的学习奠定基础。认识实习通过报告、参观等活动，使学生了解专业相关的公司企业工作环境、工作内涵等，了解相关企业的市场情况及其与国内外同类企业的竞争能力，了解国内外行业的发展趋势，从而培养学生的社会责任感、职业道德和国际化视野。增强学生对专业前景的感知，为后继更好地规划学业，规划人生，奠定基础。

推荐教材或主要参考书：

[1] 戴先中，赵光宙. 自动化学科概论（第二版）. 高等教育出版社，2016 年 6 月

[2] 中国科学技术协会. 自动化学科路线图. 中国科学技术出版社，2020 年 10 月

0007260 Cognitive Practice

Course Number: 0007260

Course Title: Cognitive Practice

Course Type: Practice compulsory course

Credit: 1.0 **Total Credit Hours:** 30

Students: Undergraduate students majoring in Automation and Robotic Engineering

Prerequisites: Freshman Seminar

Evaluation Method: Course participation + report paper

Writer： Ao Dun

Course Description:

Cognition practice is a compulsory practical course for automation and robotic engineering undergraduates in the College of artificial intelligence and automation. It aims to enable students to preliminarily understand the characteristics of relevant industries and their needs for professional knowledge before learning professional courses, stimulate students' interest in learning professional courses and enhance students' subjective initiative in learning. It is that students can contact the practical application of the industry in the study of professional courses, so as to lay the foundation for the study of professional knowledge. Through reports, visits and other activities, students can understand the working environment and work connotation of companies and enterprises related to their majors, understand the market situation of relevant enterprises and their competitiveness with similar enterprises at home and abroad, and understand the development trend of industries at home and abroad, so as to cultivate students' sense of social responsibility, professional ethics and international vision. Enhance students' perception of professional prospects and lay a foundation for future generations to better plan their studies and life.

Recommended Textbooks/References:

1.Dai Xianzhong, Zhao Guangzhou, Introduction to automation (Second Edition). *Higher education press,* June 2016

2.China Association for science and technology, Road map of automation discipline. *China Science and Technology Press*, October 2020

0010071 电机驱动与运动控制实验

课程编码：0010071

课程名称：电机驱动与运动控制实验

英文名称：Motor Drive and Motion Control Experiment

课程类型：实践环节必修课

学分： 1.0 **总学时：** 32

面向对象：机器人工程专业本科生

先修课程：模拟电子技术、数字电子技术、自动控制原理、电机驱动与运动控制

考核形式： 平时成绩+考试

撰写人：郑榜贵

课程简介：（250-300 字）

电机驱动与运动控制实验是信息学部为机器人工程专业本科生开设的实践环节必修课。通过本课程教学，要求学生理解交直流电机的结构和工作原理、交直流调速系统原理和控制方法，掌握交直流调速系统的控制方案设计和系统软硬件调试方法。培养学生理论联系实际，运用电子技术、自控原理和电机及运动控制等相关知识，验证分析交直流调速系统，掌握一定的工程设计方法。通过对交直流调速系统的单元部件测试、参数测定、控制器设计、系统仿真和调试，提高学生独立的实验设计能力，培养学生分析问题、解决问题和编制实验报告的能力。应用微机原理与接口技术、现代控制理论等相关知识，设计高性能的交流变频调速系统，培养学生延伸学习和科学研究的能力。

推荐教材或主要参考书：

[1] 自动化实验中心，电机驱动与运动控制实验指导书

0010071 Motor Drive and Motion Control Experiment

Course Number: 0010071

Course Title: Motor Drive and Motion Control Experiment

Course Type: Practical Compulsory Course

Credit: 1.0 **Total Credit Hours:** 32

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Electronic Technology, Principle of automatic control, Motor Drive and Motion Control

Evaluation Method: Course participation + Final exams

Writer： Zheng Banggui

Course Description:

Motor Drive and Motion Control Experiment is one of the practical compulsory courses for undergraduate students Major in Robotic Engineering. Through the course teaching, students are required to understand the structure and working principle of AC and DC motor, the principle and control method of AC and DC speed regulation system, and master the control scheme design and system software and hardware debugging methods of AC and DC speed regulating system. The students should be trained to connect theory with practice, and use the relevant knowledge of electronic technology, automatic control principle and motor and motion control to verify and analyze the AC and DC speed regulating system and master certain engineering design methods. Through the unit component test, parameter measurement, controller design, system simulation and debugging of AC and DC speed regulating system, the students' independent experimental design ability is improved, and the students' ability to analyze problems, solve problems and prepare experimental reports is cultivated. The high-performance AC frequency conversion speed control system is designed by applying the relevant knowledge of microcomputer principle and interface technology, and modern control theory, so as to cultivate students' ability of extended learning and scientific research.

Recommended Textbooks/References:

1.Automation Experiment Center, Experimental Instruction for Motor Drive and Motion Control

0008691 机器人感知技术实验

课程编码：0008691

课程名称：机器人感知技术实验

英文名称：Experiment of Robot Sensing Technology

课程类型：实践环节必修课

学分： 1.0 **总学时：** 32

面向对象：机器人工程专业类本科生

先修课程：概率论与数理统计（工），大学物理Ⅰ，机器人技术基础，高级语言程序设计

考核形式：平时成绩+考试

撰写人：徐喆、刘春芳

课程简介：（250-300 字）

机器人感知技术实验课是信息学部人工智能与自动化学院为机器人工程专业本科生开设的实践环节必修课。本课程的任务是培养学生针对机器人应用场景中，自身感知和环境感知相关的问题，开展实验分析的能力；对机器人应用场景中的自身状态和环境情境进行数据分析、问题预测的能力。教学内容重点：掌握机器人应用场景中典型传感器的数据获取和处理的原理步骤，以及数据的评价模型；理解 4 自由度机器人自身状态和典型应用环境情境的表达/处理的常用模型，熟悉 4 自由度机器人及仿真平台，能正确观察分析处理各相关传感器的实验数据。教学内容的难点：根据不同的应用需求，选择和使用该实验平台不同工具，通过实验设计和编程调试，完成传感器数据的获取和机器人的基本控制操作。

推荐教材或主要参考书：

[1] 机器人感知技术实验指导书，2019 年 9 月

[2] 表允晢，赵汉哲等，ROS 机器人编程(ROS Robot Programming)，ROBOTIS Co., Ltd.，2017 年 12 月

0008691 Experiment of Robot Sensing Technology

Course Number: 0008691

Course Title: Experiment of Robot Sensing Technology

Course Type: Practical Compulsory Course

Credit: 1.0 **Total Credit Hours:** 32

Students: Undergraduate students majoring in Robot Engineering

Prerequisites: Probability theory and mathematical statistics, College physics I, Basic principles of robot, High level language programming, Robot system simulation

Evaluation Method: Course participation + written exams

Writer： Xu Zhe, Liu Chunfang

Course Description:

Experiment of Robot Sensing Technology is one of the practical compulsory courses for undergraduate students majoring in robotic engineering. The main target of this course is to cultivate students' ability of experimental analysis on problems related to self-sensing and environment perception in robot application scenarios. This course focuses on principle of data acquisition from typical sensors, on evaluation index of the acquired data, and on the operation models of 4-freedom robot arms. The difficulties of teaching contents are described as follows: acquiring data by different tools of the experimental platforms, experiment design and debug for different applications of robot manipulation.

Recommended Textbooks/References:

1.Experiment Instruction of Experiment Course of Robot Sensing Technology， Sep, 2019

2.YoonSeok Pyo，HanCheol Cho，etc., ROS Robot Programming，ROBOTIS Co., Ltd.，Dec, 2017

0010750 嵌入式系统综合实践

课程编码：0010750

课程名称：嵌入式系统综合实践

英文名称：Embedded System Practice

课程类型：实践环节必修课

学分：2.0　**总学时：**60

面向对象：自动化专业、机器人工程专业本科生

先修课程：电路分析基础-1，电路分析基础-2，模拟电子技术，数字电子技术，微机原理与接口技术，高级语言程序设计

考核形式：平时成绩+实验+小课题实践开发考试

撰写人：陈双叶

课程简介：

“嵌入式系统综合实践”是信息学部为自动化专业和机器人工程专业本科生开设的实践环节必修课程。本课程的任务是使学生掌握必需的嵌入式系统设计理论、主流嵌入式系统硬件架构和嵌入式软件编程的技术、方法和工具，基本具备本领域分析问题解决问题的能力，具备一定的工程实践能力,成为从事嵌入式系统设计与开发的应用型人才。

课程除要求学生掌握嵌入式系统的基本概念、理论及嵌入式系统的设计开发方法外，重点要求学生掌握面向实际应用需求的嵌入式系统软硬件设计技术，掌握分析、解决具体问题的思路和方法。继电工基础、模拟电子技术、数字电子技术、微机原理、C 语言程序设计方法等课程后，本课程从系统级要求学生以 ARM 嵌入式处理器为核心，综合利用所学专业课知识，针对每一特定问题设计具体的应用系统并通过实践验证，提高学生综合利用所学专业知识解决实际问题的能力。知识包括：GPIO 原理与综合应用；NVIC 原理与应用；TIMER 定时器原理与应用，USART 串行通讯原理与应用；PWM 原理与应用；A/D 与 D/A 原理、接口技术与综合应用；IIC 总线技术原理与应用；SPI 总线技术原理与应用；嵌入式系统综合创新课题设计。

推荐教材或主要参考书：

[1] 苏李果，宋丽著. STM32 嵌入式技术应用开发全案例实践. 北京: 人民邮电出版社, 2020.4

[2] 冯新宇著. ARM Cortex-M3 嵌入式系统原理及应用——STM32 系列微处理器体系结构、编程与项目实战. 北京: 清华大学出版社, 2020.6

[3] 王文成，胡应坤，胡智著. ARM Cortex-M4 嵌入式系统开发与实战. 北京: 北京航空航天大学出版社, 2021.4

[4] 王祖麟，陈明计，严寒亮，张斌等著，周立功编. ARM 嵌入式系统基础教程（第 2 版）. 北京: 北京航空航天大学出版社, 2018.9

[5] 喻金钱等编著. STM32F 系列 ARM Cortex-M3 核微控制器开发与应用. 北京: 清华大学出版社, 2011.4

[6] 廖义奎编著. STM32F207 高性能网络型 MCU 嵌入式系统设计. 北京: 北京航空航天大学出版社, 2012.9

[7] STM32F103XX 数据手册，意法半导体，2007.

[8] STM32F2XX 用户手册，意法半导体，2010.

0010750 Embedded System Practice

Course Number: 0010750

Course Title: Embedded System Practice

Course type: Practice compulsory course

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

Students: Undergraduate students major in Automation and Robotic Engineering

Prerequisites: Fundamentals of circuit analysis, Analog electronic technology, Digital electronic technology, Microcomputer Principle and Interface Technology, High Level Language Programming

Evaluation Method: Usual performance, Experiment & Examination

Writer： Chen Shuangye

Course Description:

"Embedded system design and practice" is a Practice compulsory course offered by the Department of information science for undergraduates majoring in automation and robotic engineering. The task of this course is to enable students to master the necessary embedded system design theory, mainstream embedded system hardware architecture and embedded software programming technologies, methods and tools, basically have the ability to analyze and solve problems in this field, have certain engineering practice ability, and become application-oriented talents engaged in embedded system design and development.

In addition to requiring students to master the basic concepts and theories of embedded systems, as well as the design and development methods of embedded systems, the course focuses on requiring students to master the software and hardware design techniques of embedded systems that meet practical application needs, and to master the ideas and methods of analyzing and solving specific problems. After courses such as Electrical Fundamentals, Analog Electronic Technology, Digital Electronic Technology, Microcomputer Principles, and C Language Programming Methods, this course requires students to use ARM embedded processors as the core at the system level, comprehensively utilize their professional course knowledge, design specific application systems for each specific problem, and improve their ability to comprehensively use their professional knowledge to solve practical problems through practical verification. Knowledge includes: GPIO principles and comprehensive applications; NVIC principles and applications; TIMER timer principle and application, USART serial communication principle and application; PWM principle and application; A/D and D/A principles, interface technology, and comprehensive applications; The principle and application of IIC bus technology; The principle and application of SPI bus technology; Design of integrated innovation project for embedded systems.

Recommended Textbooks/References:

1. Su Liguo, Song Li. The Full Case Practice of Application and Development of STM32 Embedded Technology. Beijing: People's Posts and Telecommunications Press, April 2020.

2. Feng Xingyu. Arm Cortex-M3 Embedded System Principle and Application -- STM32 Series Microprocessor Architecture, Programming and Project Practice. Beijing: Tsinghua University Press, June 2020.

3. Wang Wencheng, Hu Yinkun, Hu Zi. Arm Cortex-M4 Embedded System Development and Actual Combat. Beijing: Beijing University of Aeronautics and Astronautics Press, April 2021.

4. Wang Zulin, Chen Mingji, Yan Hanliang, Zhang Bin, et al., edited by Zhou Ligong. ARM Embedded System Basic course (2nd Edition). Beijing: Beijing University of Aeronautics and Astronautics Press, September 2018.

5. Yu Jingqian et al. The Development and Application of STM32F Series Arm Cortex-M3 Core Microcontroller. Beijing: Tsinghua University Press, April 2011.

6. Liao Yikui. The Design of STM32F207 High Performance Network MCU Embedded Sstem. Beijing: Beijing University of Aeronautics and Astronautics Press, September 2012.

7. STM32F103xx Data Book, STMicroelectronics, 2007.

8. STM32F2xx user manual, STMicroelectronics, 2010.

0010106 机器人综合设计与实践

课程编码：0010106

课程名称：机器人综合设计与实践

英文名称：Comprehensive Design and Practice of Robot

课程类型：实践环节必修课

学分： 2.0 **总学时：** 60

面向对象：机器人工程专业本科生

先修课程：机器人基础原理，机器人感知技术，机器人操作系统基础等

考核形式：作品成果+课程报告+项目答辩

撰写人：刘旭东、郑榜贵

课程简介：（250-300 字）

机器人综合设计与实践是信息学部为机器人工程专业本科生开设的实践环节必修课。本课程着眼于机器人技术综合能力的训练与提高，培养学生机器人系统综合设计与实践能力。通过完成课程设置的机器人实训项目，使学生了解机器人工程设计和产品开发的一般流程，熟悉机器人操作系统及常用开发工具，掌握机器人基础理论和算法，积累机器人设计开发的实际经验。在此过程中，进一步深入理解和掌握所学的知识和技能，提高信息、资料的获取能力，学会与人交往、善于合作，能够充分表达与交流，培养分析和解决实际工程问题的能力，并强化创新意识、提高工程实践能力，为学生毕业设计打下坚实的实践基础，也为学生参加学科竞赛创造有利条件。通过本课程的实施，学生应具备机器人系统综合设计的能力。

推荐教材或主要参考书：

无。

0010106 Comprehensive Design and Practice of Robot

Course Number: 0010106

Course Title: Comprehensive Design and Practice of Robot

Course Type: Practical Compulsory Course

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

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Fundamentals of Robotics, Robot Perception Technology, Robot Operating System Foundation, etc.

Evaluation Method: Robot achievements + Course Report + Project Defense

Writer： Liu Xudong, Zheng Banggui

Course Description:

Comprehensive Design and Practice of Robot is one of the practical compulsory courses for undergraduate students Major in robotic engineering. This course focuses on the training and improvement of the comprehensive ability of robotics technology, and cultivates students' comprehensive design and practical ability of robotic systems. By completing the robot training project of the course, students will understand the general process of robot engineering design and product development, be familiar with robot operating systems and common development tools, master the basic theory and algorithms of robots, and accumulate practical experience in robot design and development. In the process, students may further understand and master the knowledge and skills learned, improve the ability to acquire information and materials, learn to communicate with others, be good at cooperation, be able to fully express and communicate, cultivate the ability to analyze and solve practical engineering problems, and strengthen innovation consciousness, improve engineering practice ability. It lays a solid practical foundation for students' graduation design, and create favorable conditions for students to participate in subject competitions. Through the implementation of this course, students should have the comprehensive ability to design robot systems.

Recommended Textbooks/References:

None.

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： 4.0 **总学时：** 120

面向对象：自动化专业、机器人工程专业本科生

先修课程：新生研讨课，认识实习，模拟电子技术，数字电子技术，微机原理与接口技术，高级语言程序设计，自动控制原理

考核形式： 平时成绩+报告

撰写人：奥顿

课程简介：（250-300 字）

工作实习是人工智能与自动化学院为自动化、机器人工程专业本科生开设的实践环节必修课。学生通过为期四周的企业实习，熟悉企业文化和规章制度，强化人际交往能力和劳动纪律，了解企业运行模式，体会产品设计、生产或推广过程中需要考虑的成本、质量、品牌或法律问题等。熟悉自动化领域对人才知识构架的需求，为将来更好地适应社会和工作奠定基础。

推荐教材或主要参考书：

教材或参考资料根据实际实习内容选择

0007256 Professional Practice

Course Number: 0007256

Course Title: Professional Practice

Course Type: Practice compulsory course

Credit: 4.0 **Total Credit Hours:** 120

Students: Undergraduate students majoring in Automation and Robotic Engineering

Prerequisites: Freshman Seminar, Cognitive Practice, Analog electronic technology, Digital electronic technology, Microcomputer Principle and Interface Technology, High Level Language Programming, Automatic control principle

Evaluation Method: Course participation + report paper

Writer： Ao Dun

Course Description:

Work practice is a compulsory practical course for automation and robotic engineering undergraduates in the College of artificial intelligence and automation. Through a four week enterprise internship, students are familiar with the enterprise culture, rules and regulations, strengthen interpersonal communication ability and labor discipline, understand the enterprise operation mode, and experience the cost, quality, brand or legal issues that need to be considered in the process of product design, production or promotion. Be familiar with the demand for talent knowledge framework in the field of automation, so as to lay a foundation for better adapting to society and work in the future.

Recommended Textbooks/References:

Textbooks/Reference selected based on the actual practice content

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： 8.0 **总学时：** 480

面向对象：自动化专业、机器人工程专业本科生

先修课程：新生研讨课，模拟电子技术，数字电子技术，微机原理与接口技术，高级语言程序设计，自动控制原理，认识实习，工作实习

考核形式： 平时成绩+报告

撰写人：奥顿

课程简介：（250-300 字）

毕业设计是人工智能与自动化学院为自动化、机器人工程专业本科生开设的实践环节必修课，是本科教育阶段最后、但也是最重要的环节之一。它通过一个真实或虚拟课题的立项、调研、实施、总结（毕业论文）、汇报（毕业答辩），在对学生专业知识与实践能力进行综合考核基础上，完成对本专业学生专业相关工程项目能力的训练。 通过具有一定复杂性的自动化工程实际问题的解决，培养学生综合运用所学知识、理论和技能，问题抽象、建模、分析和解决的能力。通过考虑工程实践中的约束条件而设计方案，培养学生的学生独立思考、团队协作能力，及社会责任感和创新能力。通过毕业论文的撰写，使学生掌握科技论文撰写规范，强化学生归纳、总结与文字表达的能力。

推荐教材或主要参考书：

教材或参考材料根据具体课题选择

0008111 Graduation Design

Course Number: 0008111

Course Title: Graduation Design

Course Type: Practice compulsory course

Credit: 8.0 **Total Credit Hours:** 480

Students: Undergraduate students majoring in Automation and Robotic Engineering

Prerequisites: Freshman Seminar, Analog electronic technology, Digital electronic technology, Microcomputer Principle and Interface Technology, High Level Language Programming, Automatic control principle, Cognitive Practice, Professional Practice

Evaluation Method: Course participation + report paper

Writer： Ao Dun

Course Description:

Graduation design is a practical compulsory course set up by the College of artificial intelligence and automation for undergraduates majoring in automation and robotic engineering. It is the last but also one of the most important links in the undergraduate education stage. It completes the training of students' professional related engineering project ability on the basis of comprehensive assessment of students' professional knowledge and practical ability through the project establishment, investigation, implementation, summary (graduation thesis) and report (graduation defense) of a real or virtual subject. Through the solution of practical problems in automation engineering with certain complexity, cultivate students' ability to comprehensively use their learned knowledge, theory and skills and abstract, model, analyze and solve problems. The scheme is designed by considering the constraints in engineering practice to cultivate students' ability of independent thinking, teamwork, social responsibility and innovation. Through the writing of graduation thesis, students can master the writing standard of scientific and technological thesis and strengthen their ability of induction, summary and written expression.

Recommended Textbooks/References:

Textbooks/References selected according to specific topics

0004924 信号与系统III

课程编码：0004924

课程名称：信号与系统III

英文名称：Signals and SystemsIII

课程类型：专业选修课、学科基础选修课

学分： 2.0 **总学时：** 32

面向对象：自动化专业、机器人工程专业本科生

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：代桂平

课程简介：（250-300 字）

信号与系统III是信息学部人工智能与自动化学院为自动化专业和本科生开设的专业选修课、机器人工程专业的学科基础选修课。本课程的任务是讨论信号的分析方法以及线性时不变系统对信号的各种求解方法，通过一定的实例分析，向学生介绍一些工程应用中非常重要的概念、理论和方法。教学内容重点：学生应该能够掌握基本的信号分析的基本理论和方法，掌握线性时不变系统的各种描述方法，掌握线性时不变系统的时域和频域分析方法，掌握有关系统的稳定性、频响、因果性等工程应用中的一些重要结论。通过这门课程的学习，提高学生的分析问题和解决实际问题的能力。教学内容的难点：系统频域分析方法。

推荐教材或主要参考书：

[1] 郑君里，应启珩，杨为理，信号与系统（第 3 版），高等教育出版社，2011 年 3 月

[2] 奥本海姆，刘树棠译，信号与系统（第 2 版），电子工业出版社， 2013 年 9 月

[3] 张延华，刘鹏宇，信号与系统（第 2 版），机械工业出版社，2017 年 6 月

0004924 Signals and SystemsⅢ

Course Number: 0004924

Course Title: Signals and SystemsⅢ

Course Type: Professional elective courses、Basic Elective Course

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

Students: Undergraduate students majoring in Automation, Robotic Engineering,

Prerequisites: Advanced mathematics、Linear algebra

Evaluation Method: Course participation + written exams

Writer： Dai Guiping

Course Description:

Signals and Systems is one of the professional elective courses for undergraduate students Major in Automation and one of the basic elective courses for undergraduate students major in robotic engineering. The main target of this course is to discuss signal analysis methods and various solutions of linear time invariant system to signals. Through certain case analysis, some very important concepts, theories and methods in engineering application are introduced to students. Key teaching content: students should be able to master the basic theory and method of signal analysis, various description methods of linear time invariant system, time-domain and frequency-domain analysis methods of linear time invariant system, and some important conclusions in engineering applications such as system stability, frequency response and causality. Through the study of this course, improve the students' ability to analyze and solve practical problems. The difficulty of teaching content: system frequency domain analysis method.

Recommended Textbooks/References:

1.Zheng Junli, Ying Qiheng, Yang Weili, signals and systems (3rd Edition), higher education press, 3-2011

2.Oppenheim, translated by Liu Shutang, signals and systems (Second Edition), electronic industry press, 9-2013

3.Zhang Yanhua, Liu pengyu, signals and systems (Second Edition), china machine press, 6-2017

0010149 数据结构与算法

课程编码：0010149

课程名称：数据结构与算法

英文名称：Data Structure and Algorithms

课程类型：学科基础必修课、学科基础选修课

学分： 2.0 **总学时：** 32

面向对象：自动化专业、机器人工程专业本科生

先修课程：高级语言程序设计，高级语言程序设计训练

考核形式：平时成绩+实验+考试

撰写人：王亮

课程简介：

数据结构与算法是信息学部为自动化专业本科生开设的学科基础必修课、机器人工程专业本科生开设的学科基础选修课。本课程的任务是给学生介绍各种数据在计算机中的存储、传递和转换，使学生掌握数据结构与算法的基础理论和基本方法，提高学生对各种数据结构与算法的程序设计能力，以及提高学生对数据结构与算法的实际运用能力。教学内容重点是线性表、栈和队列、串、二叉树、树、图、排序和查找的相关概念、方法、理论、基本操作和常用算法。教学内容的难点是让学生在理解概念、理论的基础上用 C 语言进行算法实现，并将相关知识应用于解决具体的复杂工程问题之中。

推荐教材或主要参考书：

[1] 严蔚敏 李冬梅 吴伟民. 数据结构（C 语言版）. 人民邮电出版社，2015 年 2 月

[2] 严蔚敏. 数据结构（C 语言版）. 清华大学出版社，2007 年 3 月

[3] 汪友生等. 计算机软件基础. 清华大学出版社，2016 年 12 月

[4] 邓玉洁. 算法与数据结构（C 语言版）. 北京邮电大学出版社，2017 年 8 月

[5] 马克·艾伦·维斯（Mark Allen Weiss）. 数据结构与算法分析：C 语言描述(英文版 原书第 2 版). 机械工业出版社，2019 年 11 月

0010149 Data Structure and Algorithms

Course Number: 0010149

Course Title: Data Structure and Algorithms

Course Type: Basic compulsory course、Basic Elective Course

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

Students: Undergraduate students majoring in Automation, Robotic Engineering

Prerequisites: High level language programming, High level language programming practice training

Evaluation Method: course participation + experiment + written exams

Writer： Wang Liang

Course Description:

Data structure and algorithm is one of the basic compulsory courses for undergraduates major in Automation, and one of the basic elective courses for undergraduates major in robotic engineering. The main target of this course is to clarify the storage, transfer and conversion of various data in the computer, enable students to master the basic theory and method of data structure and algorithm, improve students' programming ability of various data structure and algorithm, and improve students' practical application ability of data structure and algorithm. The teaching content are mainly covered by the following aspects: the concepts, methods, theories, basic operations and common algorithms of linear table, stack and queue, binary tree, tree, graph, sorting and searching. The difficulty of teaching content are described as following: letting students realize the algorithm with C language on the basis of understanding the concept and theory, and applying relevant knowledge to solve specific complex engineering problems.

Recommended Textbooks/References:

1.Weimin Yan, et al., Data structure (C Language Edition). *Posts & Telecom Press*, 2-2015

2.Weimin Yan, Data structure (C Language Edition). *Tsinghua University Press*, 3-2007

3.Yousheng Wang, et al., Fundamentals of computer software. *Tsinghua University Press*, 12-2016

4.Yujie Deng, Algorithm and data structure (C Language Edition). *Beijing University of Posts and Telecommunications Press*, 8-2017

5.Mark Allen Weiss, Data structure and algorithm analysis: C language description (English version, 2nd Edition), *Mechanical Industry Press*, 11-2019

0007753 数字信号处理

课程编码：0007753

课程名称：数字信号处理

英文名称：Digital Signal Processing

课程类型：专业选修课

学分： 2.5 **总学时：** 40

面向对象：自动化、机器人工程专业本科生

先修课程：信号与系统，微机原理与接口技术，复变函数与积分变换

考核形式：平时成绩+考试

撰写人：李明爱

课程简介：

数字信号处理是信息学部为自动化和机器人工程专业本科生开设的一门人工智能选修课。本课程的任务是让学生掌握数字信号处理的基本理论、方法和技术。教学内容重点：包括离散时间信号、离散傅里叶变换及其快速计算算法、离散时间系统分析、数字滤波器(含IIR、FIR 滤波器)的设计与实现四个方面，并能够建立基本的数字信号处理模型，运用快速傅立叶变换（FFT）与数字滤波器两个主要工具进行信号的频谱分析、信号滤波和数字信号系统的分析。教学内容的难点：包括离散信号的频谱分析与频谱混叠，离散傅里叶级数与离散傅里叶变换的概念及相关关系，周期卷积、圆周卷积和线性卷积的区别与联系，IIR 数字滤波器的频率变换设计法，及 FIR 数字滤波器的窗函数设计法。

推荐教材或主要参考书：

[1] 胡广书. 数字信号处理导论（第 2 版）. 清华大学出版社，2013.5

[2] 陈后金，薛健，胡健, 李艳凤. 数字信号处理（第 3 版）. 高等教育出版社，2018.7

[3] 吴镇扬. 数字信号处理（第 3 版）. 高等教育出版社，2016.7

0007753 Digital Signal Processing

Course Number: 0007753

Course Title: Digital Signal Processing

Course Type: Professional elective course

Credit: 2.5 **Total Credit Hours:** 40

Students: Undergraduate students majoring in Automation and Robotic Engineering

Prerequisites: Signal and System, Microcomputer Principle and Application, Complex Variable Functions and Integral Transformation

Evaluation Method: Course participation + written exams

Writer： Li Mingai

Course Description:

Digital Signal Processing is one of the professional elective courses for undergraduate students majoring in automation and robotic engineering. The main target of this course is to clarify the fundamental theory, method and technology of Digital Signal Processing. This course is focus on the analysis of discrete time signals and discrete time systems. The teaching contents are mainly covered by the following aspects: discrete time signal, Discrete Fourier Transform (DFT) and its fast computation algorithm, analysis of discrete system, design and implementation of Infinite Impulse Response (IIR) and Finite Impulse Response (FIR) digital filers. The difficulties of teaching contents are described as followings: spectral analysis and spectral aliasing, the relation between Discrete Fourier Series (DFS) and DFT, the differences among periodic convolution, circular convolution and linear convolution, the frequency transformation method for designing IIR filters and the window function method for designing FIR filters.

Recommended Textbooks/References:

1.Guanshu Hu. Intruduction of Digital Signal Processing (the second edition). *Tsinghua University* Press, 05-2013

2.Houjin Chen, Jian Xue, Jian Xue and Yanfeng Li. Digital Signal Processing (the third edition), *Higher Education* Press, 07-2018

3.Zhenyang Wu. Digital Signal Processing (the third edition), *Higher Education* Press, 07-2016

0010101 机器人机构设计

课程编码：0010101

课程名称：机器人机构设计

英文名称：Mechanical Design of Robot

课程类型：专业选修课

学分： 2.5 **总学时：** 40

面向对象：机器人工程专业本科生

先修课程：工程图学基础与 AutoCAD

考核形式：平时成绩+大报告/考试

撰写人：苏丽颖

课程简介：（250-300 字）

机器人机构设计是人工智能与自动化学院为机器人专业本科生开设的专业基础课。本课程的任务是研究机器人所涉及机构的结构原理、运动特性、机械动力学，研究通用零件的工作原理、特点、选用和设计计算，培养学生初步具有分析和设计基本机构的能力和初步具有设计简单的机械和普通机械传动装置能力的学科基础课。教学内容重点为：机械设计的一般原则和过程；平面机构的结构分析；凸轮机构；齿轮机构；轮系；机械零件的工作能力和计算准则；联结件设计；轴系件设计和其它零、部件设计等。教学内容难点：机构的结构分析；机械零件的工作能力和计算准则；轴系设计。

推荐教材或主要参考书：

[1] 王大康. 机械设计基础. 机械工业出版社，2015 年 6 月第三次出版

[2] 杨可桢，程光蕴，李仲生，钱瑞明. 机械设计基础. 高等教育出版社，2013 年

0010101 Mechanical Design of Robot

Course Number: 0010101

Course Title: Mechanical Design of Robot

Course Type: Professional elective course

Credit: 2.5 **Total Credit Hours:** 40

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Fundamentals of engineering graphics and AutoCAD

Evaluation Method: Course participation + written reports/exams

Writer： Su Liying

Course Description:

Mechanical Design of Robot is one of the professional elective courses for undergraduate students major in robotic engineering. The main target of this course is to study the structure theory, kinematic characteristic and dynamics of mechanism. This course is focus on studying the principle, specialties, design calculation and application of universal part. The teaching contents are mainly covered by the following aspects:： principles and procedures of mechanical design; structural analysis of plane mechanism; cam mechanism; gear mechanism; gear train; calculation rule and capability of machine parts; design of connecting member; design of shafting parts and design of other parts and components, etc. The difficulties of teaching contents are described as followings: structural analysis of the mechanism; calculation rule and capability of machine parts; design of shafting parts. By studying this course students should have the ability of basic analysis and design of general mechanism, together with the ability of design simple machine and general mechanically-driven device.

Recommended Textbooks/References:

1.Dakang Wang, Foundamentals of Mechanical Design, *Mechanical Engineering Press*, June-2015

2.Kezhen Yang, Guangyun Cheng, Zhongsheng Li, Ruiming Qian, Foundamentals of Mechanical Design, *Advanced Education Press*, July-2013

0010099 机器人操作系统基础

课程编码：0010099

课程名称：机器人操作系统基础

英文名称：Fundamentals of Robot Operating System

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：机器人工程专业本科生

先修课程：机器人基础原理、高级语言程序设计、Python 编程基础

考核形式：平时成绩+考试

撰写人：辛乐

课程简介：（250-300 字）

机器人操作系统基础是信息学部为机器人专业本科生开设的专业选修课。本课程的任务是掌握使用机器人操作系统（ROS）进行机器人系统集成及功能开发的编程方法，实现快速搭建机器人原型应用系统的目的。本课程的教学内容重点是机器人操作系统（ROS）的核心通信框架、编程开发技术、实用功能库以及调试仿真工具等。本课程教学内容的难点主要包括在深刻理解ROS基本分布式架构设计思想的基础上，建立关于ROS基本概念的认知体系，同时强化 ROS 编程操作流程。本课程注重理论基础与工程实践相结合，内容丰富、针对性强、注重实用性，为进一步学习后续机器人方向课程打好坚实的基础。

推荐教材或主要参考书：

[1] 胡春旭编著. ROS 机器人开发实践. 机械工业出版社. 2018

[2] 陈金宝，韩冬，聂宏，陈萌编著. ROS 开源机器人控制基础. 上海交通大学出版社. 2016 年 1 月.

[3] Lentin Joseph. Robot Operating System for Absolute Beginners: Robotics Programming Made Easy. Apress Press. 2018.

[4] YoonSeok Pyo, HanCheol Cho, RyuWoon Jung, TaeHoon Lim. ROS Robot Programming：From the basic concept to practical programming and robot application. ROBOTIS Press. 2017.

[5] Morgan Quigley, Brian Gerkey, and William D. Smart. Programming Robots with ROS: A Practical Introduction to the Robot Operating System. O'Reilly Media. November, 2015.

0010099 Fundamentals of Robot Operating System

Course Number: 0010099

Course Title: Fundamentals of Robot Operating System

Course Type: Professional elective course

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

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Basic principles of robot, High level language programming, Fundamentals of Python Programming

Evaluation Method: Course participation + written exams

Writer： Xin Le

Course Description:

Fundamentals of Robot Operating System is one of the professional elective courses for undergraduate students major in robotic engineering. The main target of this course is to master the programming method of robot system integration and function development by using Robot Operating System (ROS), so as to realize the purpose of rapid construction of robot prototype application system. The teaching contents are mainly covered by the following aspects: the core communication framework, programming and development technology, practical function library and debugging simulation tools of Robot Operating System (ROS). The difficulties of teaching contents are described as followings: establishing a cognitive system about the basic concept of ROS, and strengthening the operation process of ROS programming, on the basis of a deep understanding of the basic distributed architecture design idea of ROS. This course focuses on the combination of theoretical basis and engineering practice, with rich content, strong pertinence and practicality, so as to lay a solid foundation for further learning of the follow-up courses.

Recommended Textbooks/References:

1.Hu Chunxu. Robot Development and Practice base on ROS. China Machine Press, 2018

2.Chen Jinbao, Han Dong, Nie Hong and Chen Meng. Fundamentals of Open Source Robot Control using ROS. Shanghai Jiaotong University Press, January, 2016

3.Lentin Joseph. Robot Operating System for Absolute Beginners: Robotics Programming Made Easy. Apress Press. 2018

4.YoonSeok Pyo, HanCheol Cho, RyuWoon Jung, TaeHoon Lim. ROS Robot Programming：From the basic concept to practical programming and robot application. ROBOTIS Press. 2017.

5.Morgan Quigley, Brian Gerkey, and William D. Smart. Programming Robots with ROS: A Practical Introduction to the Robot Operating System. O'Reilly Media. November, 2015.

0010675 图像处理与机器视觉（双语）

课程编码：0010675

课程名称：图像处理与机器视觉（双语）

英文名称：Image Processing and Machine Vision

课程类型：专业选修课

学分： 2.5 **总学时：** 40

面向对象：机器人工程专业本科生

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

考核形式：平时成绩+考试

撰写人：王亮

课程简介：

图像处理与机器视觉是信息学部为机器人工程专业本科生开设的专业选修课程。本课程的任务是使学生掌握数字图像处理和机器视觉涉及的基本概念，掌握数字图像的空间域和频率域增强、图像恢复、图像分割和识别等基本操作的原理和实现方法，掌握机器视觉的基本原理特别是摄像机成像模型，并理解相机标定、立体视觉和三维重建等视觉算法，从而为针对特定需求完成机器人视觉感知打下基础。教学内容重点：数字图像的增强、恢复、分割和识别、摄像机成像模型等方面的知识和方法。教学内容的难点：图像的频率域增强、图像恢复与立体视觉和三维重建， 以及如何让学生将所学内容应用于特定的复杂的工程问题等。

推荐教材或主要参考书：

[1] C. Gonzales(美). 阮秋琦等译. 数字图像处理（第四版）.北京：电子工业出版社，2020.

[2] C. Gonzales(美). 阮秋琦等译. 数字图像处理（第三版）.北京：电子工业出版社，2017.

[3] Milan Sonka(美)等著，兴军亮 艾海舟等译. 图像处理、分析与机器视觉（第 4 版）. 北京：清华大学出版社. 2016.

[4] David A. Forsyth.(美)等著，高永强等译. 计算机视觉—一种现代的方法（第二版）. 电子工业出版社，2017.

[5] J. Parker(加)等著，景丽等译. 图像处理与计算机视觉算法及应用（第 2 版）. 北京：清华大学出版社. 2016.

0010675 Image Processing and Machine Vision（Bilingual）

Course Number: 0010675

Course Title: Image Processing and Machine Vision(Bilingual)

Course Type: Professional elective course

Credit: 2.5 **Total Credit Hours:** 40

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Advanced mathematics, probability and mathematical statistics, linear algebra, advanced language programming, data structure and algorithms

Evaluation Method: Course participation + written exams

Writer： Wang Liang

Course Description:

Image Processing and Machine Vision is one of the major optional courses for undergraduates major in robotic engineering. The main target of this course is to clarify the basic concepts involved in digital image processing and machine vision, enable students to master the basic operations of image processing such as image enhancement in spatial and frequency domain, image restoration, image segmentation and image recognition, and the basic principles of machine vision such as camera imaging model, and understand camera calibration, stereo vision and 3D reconstruction. The teaching content are mainly covered by the following aspects: principle and methods of image enhancement, image restoration, image segmentation, image recognition and camera imaging model, etc. The difficulty of teaching content is described as follows: image frequency domain enhancement, image restoration, stereo vision and 3D reconstruction, and applying relevant knowledge to solve specific complex engineering problems.

Recommended Textbooks/References:

1.C. Gonzales, Digital Image processing (the Fourth Edition). *Publishing house of Electronics Industry*, 2020

2.C. Gonzales, Digital Image processing (the Third Edition). *Publishing house of Electronics Industry*, 2017

3.Milan Sonka, Image processing, analysis and machine vision (the Fourth Edition), *Tsinghua University Press*, 2016

4.David A. Forsyth and et. al., Computer vision – a modern approach. *Publishing house of Electronics Industry*, 2017

5.J. Parker and et. al., Algorithms for image processing and computer vision, *Tsinghua University Press*, 2016

0008696 机器学习与智能优化（双语）

课程编码：0008696

课程名称：机器学习与智能优化（双语）

英文名称：Machine Learning and Intelligent Optimization

课程类型：专业选修课

学分：2.5　　**总学时：**40

面向对象：机器人工程专业本科生

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

考核形式：平时成绩+课程报告

撰写人：黄静

课程简介：

机器学习与智能优化是信息学部为机器人工程专业本科生开设的专业选修课。本课程的任务是使学生初步掌握机器学习与智能优化的一般性原理和主要技术，为进一步设计和实现智能机器人提供必要的知识基础。教学内容重点包括：决策树模型、贝叶斯分类器、人工神经网络，K 均值算法、自组织映射图，以及强化学习、模拟退火算法等。教学内容难点为各类算法的数学推导及实际应用解析。

推荐教材或主要参考书：

[1] Miroslav Kubat. An Introduction to Machine Learning(2nd).Springer International Publishing, 2017

[2] Gopinath Rebala et al. An Introduction to Machine Learning.Springer International Publishing, 2019

[3] Rishal Hurbans. Artificial Intelligence Algorithms. Manning Publications Co.,2020

[4] 李航.统计学习方法(第 2 版).清华大学出版社,2019 年 5 月

[5] 周志华著.机器学习.清华大学出版社.2016 年 1 月

[6] 罗伯托•巴蒂蒂 毛罗•布鲁纳托 著,王彧戈译.机器学习与优化.人民邮电出版社.2018 年 5 月

[7] Tom Mitchell. Machine Learning.McGraw Hill, 1997

0008696 Machine Learning and Intelligent Optimization(Bilingual)

Course Number: 0008696

Course Title: Machine Learning and Intelligent Optimization(Bilingual)

Course Type: Professional elective course

Credit: 2.5 **Total Credit Hours:** 40

Students: Undergraduate students majoring in robotic engineering

Prerequisites: Advanced Mathematics, Probability Theory and Mathematical Statistics, Linear Algebra, Advanced Language Programming

Evaluation Method: Regular Grades + Final Course-report

Writer： Huang Jing

Course Description:

Machine Learning and Intelligent Optimization is one of the professional elective courses for undergraduate students majored in robotic engineering, which is offered by the faculty of information technology. The main target of this course is to clarify general principles and important techniques of machine learning and intelligent optimization, providing basis for designing and implementing intelligent robots. The course involves the classic algorithms and methods in related area and emphasizes the following ones: decision tree model, Bayesian classifier, artificial neural network, K-means algorithm, Self-organizing map (SOM), reinforcement learning and particle swarm optimization algorithm (SAA) . The difficulties in teaching are the mathematical derivations and application cases study for the involved algorithms.

Recommended Textbooks/References:

1.Miroslav Kubat. An Introduction to Machine Learning(2nd).Springer International Publishing, 2017

2.Gopinath Rebala et al. An Introduction to Machine Learning.Springer International Publishing, 2019

3.Rishal Hurbans. Artificial Intelligence Algorithms. Manning Publications Co.,2020

4.Li Hang, Statistical Learning Methods (Second Edition), *Tsinghua University Press*, 2019.5.

5.Zhou Zhihua, Machine Learning, *Tsinghua University Press*, 2016.1.

6.Roberto Battiti etal. translated by Wang yuge, *People's Post and Telecommunications Press*, 2018.05.

7.Tom Mitchell. Machine Learning.McGraw Hill, 1997

0008699 机器人动力学与控制

课程编码：0008699

课程名称：机器人动力学与控制

英文名称：Robot Dynamics and Control

课程类型：专业选修课

学分： 2.5 **总学时：** 40

面向对象：机器人工程专业本科生

先修课程：大学物理 I-1、大学物理 I-2、高等数学（工）-1、高等数学（工）-2、自动控制原理、机器人基础原理

考核形式： 平时成绩+考试

撰写人：张祥银

课程简介：（250-300 字）

机器人动力学与控制是人工智能与自动化学院为机器人工程专业本科生开设的专业选修课。课程主要讲述机器人动力学的基本理论、分析方法、建模技术，以及基本的控制方法、常用的控制器构成。通过本课程的教学，使学生掌握机器人动力学与控制方面的基本概念、基本理论、基本方法，了解该领域的新技术、新发展、新方法；使学生具有运用数学、力学知识建立机器人动力学模型并对机器人动力学特性进行分析的基本能力，掌握用机器人系统的控制技术，能够利用自动控制原理的知识设计出满足要求的机器人控制系统；使学生具有一定的工程实践能力，能够使用常见仿真软件，调试并验证机器人动力学模型及控制系统，初步具备实验研究的能力，为学习后续攻读研究生或从事相关专业工作奠定基础。

推荐教材或主要参考书：

[1] 霍伟. 机器人动力学与控制. 高等教育出版社. 2005 年 1 月

[2] 马克 W. 斯庞 等著, 贾振中 等译. 机器人建模和控制. 机械工业出版社, 2019 年 9 月

[3] 雷扎 N. 贾扎尔 著, 周高峰 等译. 应用机器人学：运动学、动力学与控制技术. 机械工业出版社, 2019 年 3 月

0008699 Robot Dynamics and Control

Course Number: 0008699

Course Title: Robot Dynamics and Control

Course Type: Professional elective course

Credit: 2.5 **Total Credit Hours:** 40

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Automatic control principle, Modern control theory, Motion control system/Process control system I, High level language programming, Intelligent detection and networking technology, Microcomputer principle and interface technology, Computer network and application, Freshman seminar

Evaluation Method: Course participation + report paper

Writer： Zhang Xiangyin

Course Description:

Robot Dynamics and Control is a professional elective course offered by the College of artificial intelligence and automation for undergraduates majoring in robotic engineering. The course mainly introduces the basic theory, analysis method, modeling technology, basic control method and common controller composition of robot dynamics. Through the teaching of this course, students can master the basic concepts, basic theories and basic methods of robot dynamics and control, and understand the new technologies, new developments and new methods in this field; To enable students to have the basic ability to use mathematics and mechanics knowledge to establish robot dynamics model and analyze robot dynamics characteristics, master the control technology of robot system, and be able to use the knowledge of automatic control principle to design a robot control system that meets the requirements; So that students have certain engineering practice ability, can use common simulation software to debug and verify robot dynamic model and control system, and preliminarily have the ability of experimental research, so as to lay a foundation for subsequent postgraduate study or related professional work.

Recommended Textbooks/References:

1. Huo Wei, Robot dynamics and control. *Higher education press*. January 2005
2. Mark W. span et al., translated by Jia Zhenzhong et al. Robot modeling and control. *Mechanical Industry Press*, September 2019
3. Reza n. jazar, translated by Zhou Gaofeng et al., Applied robotics: kinematics, dynamics and control technology. *Mechanical Industry Press*, March 2019

0008706 人工智能技术基础

课程编码：0008706

课程名称：人工智能技术基础

英文名称：Foundation of Artificial Intelligence Technology

课程类型：专业选修课

学分：2.0　　**总学时：**32

面向对象：机器人工程专业本科生

先修课程：高等数学（工）、概率论与数理统计（工）、离散数学、高级语言程序设计

考核形式：平时成绩+考试

撰写人：王立春

课程简介：（250-300 字）

人工智能技术基础是信息学部为机器人工程专业本科生开设的专业选修课。本课程的任务是使学生初步掌握人工智能的一般性原理和主要技术，为进一步设计和实现智能机器人提供必要的知识基础。教学内容重点包括：人工智能的定义与主要技术流派；图灵测试；状态空间表示；问题归约表示；谓词逻辑表示；A*算法；AO*算法；α-β剪枝搜索算法；局部优先搜索算法；归结原理的基本概念和方法；一阶谓词逻辑公式化成子句集；置换与合一；归结原理；积木世界的机器人规划；基于模拟退火算法的局部路径规划。教学内容难点有：图灵测试；谓词逻辑表示；A*算法；α-β剪枝搜索算法；局部优先搜索算法；置换概念和合一算法；积木世界的机器人规划。

推荐教材或主要参考书：

[1] 蔡自兴，刘丽钰，蔡京峰，陈白帆著，《人工智能及其应用》（第 5 版），清华大学出版社，2016.7.

[2] 马少平、朱小燕著，《人工智能》， 清华大学出版社，2004.8.

[3] Stephen Lucci，Danny Kopec 著,《人工智能》(第 2 版)， 林赐译，中国工信出版集团，人民邮电出版社，2018.10.

0008706 Foundation of Artificial Intelligence Technology

Course Number: 0008706

Course Title: Foundation of Artificial Intelligence Technology

Course Type: Professional elective course

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

Students: Undergraduate students majoring in robotic engineering

Prerequisites: Advanced Mathematics, Probability Theory and Mathematical Statistics, Discrete Mathematics, High Level Language Programming

Evaluation Method: Course participation + written exams

Writer： Wang Lichun

Course Description:

Foundation of Artificial Intelligence Technology is a professional elective courses for the undergraduate students majored in robotic engineering, which is offered by the faculty of information technology. The main target of this course is to clarify general principles and important techniques of artificial intelligence, provide basis for designing and implementing intelligent robot. This course focuses on knowledge representation, searching, inference and automatic planning. The teaching contents are mainly covered by the following aspects: definition and major technical schools of artificial intelligence, Turing test, state space representation, problem reduction representation, predicate logical representation, A* algorithm, AO* algorithm, α-β pruning searching, local first search algorithm, concept and method of resolution principle, translating first order predicate logical formulas into a set of clauses, substitution and union, robot`s planning in the model of block world, local routing based on Simulated Annealing Algorithm. The difficulties of teaching contents are described as followings: Turing test, predicate logical representation, A* algorithm, α-β pruning searching, local first search algorithm, substitution and union, robot`s planning in the model of block world.

Recommended Textbooks/References:

1.Cai Zixing, Liu Liyu, Cai jingfeng, Chen Baifan, Artificial Intelligence: Principles & Applications (Fifth Edition), *Tsinghua University Press*, 2016.7.

2.Ma Shaoping, Zhu Xiaoyan, Artificial Intelligence: Principles & Applications (Fifth Edition), *Tsinghua University Press*, 2004.8.

3.Stephen Lucci，Danny Kopec, Artificial Intelligence (Second Edition), translated by Lin Ci, *China Industry and Information Publishing Group, People's Post and Telecommunications Press*, 2018.10.

0010085 多机器人系统建模与分析（英文）

课程编码：0010085

课程名称：多机器人系统建模与分析（英文）

英文名称：Modeling and analysis of multi-robot systems

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：机器人工程专业本科生

先修课程：线性代数（工）、高等数学（工）、自动控制原理、现代控制理论

考核形式： 平时成绩+考查

撰写人：傅安琪

课程简介：

多机器人系统建模与控制是信息学部为机器人工程专业本科生开设的专业选修课程。本课程为全英文授课，课程包含讲授环节和研讨环节。本课程的任务是使学生能够了解完整的多机器人系统的建模、设计和分析方法，能够面向多机器人系统及其相关的研究领域，使用英语进行学术交流，同时学生能够显著提高多机器人系统领域的国际视野记忆自主学习的意识和能力。本课程着重介绍多机器人系统建模与分析的方法，以及经典控制理论和现代控制理论在多机器人控制中的运用。课程包括机器人系统建模，基于通信网络的多机器人系统构建与分析，以及多种多机器人系统协同和编队的控制方法。

推荐教材或主要参考书：

[1] Z. Qu, Cooperative Control of Dynamical Systems: Applications to Autonomous Vehicles, Springer, 2009

[2] F. Bullo, Lectures on Network Systems, Kindle Direct Publishing, 2019

[3] F. Bullo, J. Cortes, and S. Martinez, Distributed Control of Robotic Networks: A Mathematical Approach to Motion Coordination Algorithms, Princeton University Press, Princeton, NJ, USA, 2009

[4] F. Lewis, H. Zhang, K. Hengster-Movric, A. Das, Cooperative Control of Multi-Agent Systems: Optimal and Adaptive Design Approaches, Springer, 2014

0010085 Modeling and Analysis of Multi-Robot Systems

Course Number: 0010085

Course Title: Modeling and analysis of multi-robot systems

Course Type: Professional elective course

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

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Linear Algebra, Calculus, Automatic Control, Modern Control Systems

Evaluation Method: Course discussion + written report

Writer： Fu Anqi

Course Description:

Modeling and Analysis of Multi-Robot Systems is one of the professional elective courses for undergraduate students majoring in robotic engineering. This course is organized by Faculty of Information Technology. This course is given in English. It includes lectures and discussion. The main target is to clarify the modeling, design, and analysis methods of multi-robot systems. After this course, the students are supposed to be able to communicate in English in robotic academic. Also, the students will have a clue of the up-to-date multi-robot system technologies and researches of the world. Besides, the ability of self-study of the students will be improved. The main content of this course is the modeling of multi-robot systems and how to control these systems with theories from Automatic Control and Modern Control Systems. This course will cover the following topics: multi-robot systems modeling, multi-robot systems consensus and analysis, various control approaches for multi-robot systems.

Recommended Textbooks/References:

1.Z. Qu, Cooperative Control of Dynamical Systems: Applications to Autonomous Vehicles, *Springer*, 2009

2.F. Bullo, Lectures on Network Systems, *Kindle Direct Publishing*, 2019

3.F. Bullo, J. Cortes, and S. Martinez, Distributed Control of Robotic Networks: A Mathematical Approach to Motion Coordination Algorithms, *Princeton University Press, Princeton, NJ, USA*, 2009

4.F. Lewis, H. Zhang, K. Hengster-Movric, A. Das, Cooperative Control of Multi-Agent Systems: Optimal and Adaptive Design Approaches, *Springer*, 2014

0010104 机器人系统仿真

课程编码：0010104

课程名称：机器人系统仿真

英文名称：Simulation of Robot System

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：机器人专业本科生

先修课程：大学物理Ⅰ，机器人机构设计，高级语言程序设计

考核形式：平时成绩+综合设计

撰写人：朱晓庆

课程简介：（250-300 字）

机器人系统仿真是信息学部为机器人专业本科生开设的学科专业选修课程。本课程的任务是使得学生掌握机器人系统仿真基本原理、常用仿真软件工具 (Solid works 和 Vrep) 使用并仿真复现北工大典型机器人系统，为学习后续进入研究生学习或从事相关专业工作奠定基础。教学内容重点：机器人系统仿真软件使用方法。教学内容的难点：理论联系实践，复现北工大代表机器人综合设计，包括：两轮自平衡机器人、独轮自平衡机器人、六足机器人等。

推荐教材或主要参考书：

[1] 臧海波，仿生机器人制作入门，人民邮电出版社, 2014

[2] 罗庆生，罗霄，我的机器人:仿生机器人的设计与制作，北京理工大学出版社, 2016；

[3] 北京兆迪科技公司，solid works2018 快速入门、进阶与精通，电子工业出版社，2006 年 5 月

[4] vrep 官方帮助文档 https://www.coppeliarobotics.com/helpFiles/index.html

[5] 刘金琨.机器人控制系统的设计与 Matlab 仿真,Michael Hassen. Fundamentals of Digital Logic Design with VHDL. Innovate LLC, 2013 年 1 月.

0010104 Simulation of Robot System

Course Number: 0010104

Course Title: Simulation of Robot System

Course Type: Professional elective course

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

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: University Physics, Robot Mechanism Design, C Programming

Evaluation Method: Course participation +Comprehensive design

Writer： Zhu Xiaoqing

Course Description:

Robot system simulation is one of the professional elective courses for undergraduate students Major in robotic engineering. The main target of this course is to enable students to master the basic theoretical methods in the field of robotics, understand the new development in this field, and enable students to use computers to analyze and design typical robots, so as to lay the foundation for learning follow-up professional courses and engaging in professional work. This course is focus on robot silmulation. The teaching contents are mainly focus on the use of simulation software. The difficulties of teaching contents are described as followings: comprehensive design of representative robot of Industrial University, including: two wheel self balancing robot, one wheel self balancing robot, six legged robot, etc.

Recommended Textbooks/References:

1. Zang Haibo, introduction to bionic robot production, people's post and Telecommunications Press, 2014

2. Luo Qingsheng, Luo Xiao, my robot: design and production of bionic robot, Beijing University of Technology Press, 2016;

3. Beijing Zhaodi Technology Co., Ltd., solid works 2018 quick start, advanced and proficient, electronic industry press, May 2006

4. Official help document of vrep https://www.coppeliarobonics.com/helpfiles/index.html

5. Liu Jinkun. Design and MATLAB simulation of robot control system, Michael Hassen. Fundamentals of digital logic design with VHDL. Innovation LLC, January 2013

0000815 智能控制技术

课程编码：0000815

课程名称：智能控制技术

英文名称：Intelligent Control Technology

课程类型：专业选修课

学分：2.0　**总学时：**32

面向对象：自动化、机器人工程专业本科生

先修课程：高等数学（工）、线性代数（工）、自动控制理论

考核形式：平时成绩+考试

撰写人：李晓理

课程简介：（250-300 字）

智能控制技术是信息学部为自动化和机器人工程专业本科生开设的专业限选课程。本课程的任务是学习智能控制的理论基础及相关技术。教学内容重点：模糊控制系统设计及神经网络结构及相应的控制器设计。在模糊控制系统设计中，首先学习由模糊集、模糊运算、模糊规则、模糊化、解模糊、模糊推理方法等知识点构成的模糊数学，接着学习模糊控制器及模糊控制系统设计；神经网络控制方面，首先学习感知器、反向传播网络的结构设计及神经网络训练方法，并通过具体生产过程控制问题学习神经网络控制系统的设计、仿真及开发。教学内容的难点：模糊控制器的设计，神经网络的权值学习与控制器设计。

推荐教材或主要参考书：

[1] 张乃尧, 阎平凡编著. 神经网络与模糊控制. 北京: 清华大学出版社, 1998 年 10 月

[2] 孙增圻,邓志东,张再兴编著.智能控制理论与技术.北京：清华大学出版社,2011 年 9 月

[3] 刘金琨编著.智能控制.北京：电子工业出版社,2009 年 7 月

[4] 罗兵,甘俊英,张建民编著.智能控制技术.北京：清华大学出版社,2011 年 3 月.

[5] 刘杰 等编著，智能控制与 MATLAB 实用技术. 北京：科学出版社， 2019 年 7 月

0000815 Intelligent Control Technology

Course Number: 0000815

Course Title: Intelligent Control Technology

Course Type: Professional elective course

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

Students: Undergraduate students majoring in Automation and Robotic Engineering

Prerequisites: Advanced Mathematic, Linear Algebra, Principle of Automatic Control

Evaluation Method: Course participation + written exams

Writer： Li Xiaoli

Course Description:

Intelligent Control Technology is one of the Specialized Elective courses for undergraduate students major in automation and robotic engineering. The main target of this course is to clarify the theoretical basis and related technologies of intelligent control. This course is focus on fuzzy control system design, neural network structure and corresponding controller design. The teaching contents are mainly covered by the following aspects: first for the design of fuzzy control system(fuzzy mathematics of fuzzy sets, fuzzy operations, fuzzy rules, fuzziness, defuzzification, fuzzy reasoning methods and other knowledge points, and the design of fuzzy controller and fuzzy control system), then for the aspect of neural network control (the structure design of perceptron, back-propagation network and neural network training method, and design, simulation and development of neural network control system for specific production process control problems). The difficulties of teaching contents are described as followings: the design of fuzzy controller, the weight learning of neural network and the design of controller.

Recommended Textbooks/References:

1. Zhang Naiyao, Yan Pingfan. Neural Network and Fuzzy Control. Beijing: Tsinghua University Press, 1998,10.
2. Sun Zengqi, Deng Zhidong, Zhang Zaixing. Intelligent Control Theory and Technology. Beijing: Tsinghua University Press, 2011,9.
3. Liu Jinkun. Intelligent Control . Beijing: Publishing House of Electronics Industry, 2009,7.
4. Luo Bing, Gan Junying,Zhang Jianmin. Intelligent Control Technology. Beijing: Tsinghua University Press, 2011,3.
5. Liu Jie et al, Intelligent control and MATLAB practical technology. Beijing: Science Press, 2019，7

0008708 机器人导航技术

课程编码：0008708

课程名称：机器人导航技术

英文名称：Mobile Robots Navigation

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：机器人工程专业本科生

先修课程：机器人基础原理、自动控制原理、机器人感知技术、机器人智能交互技术

考核形式： 平时成绩+报告

撰写人：孔德慧

课程简介：（250-300 字）

机器人导航技术是人工智能与自动化学院为机器人工程专业本科生开设的专业选修课。本课程介绍移动机器人自主导航技术，是一门多学科领域高度交叉的前沿技术学科，也是开发各不同应用领域机器人控制系统的基础性通用技术，有着广泛的应用前景。该课程的开设对于研究型及应用型人才的培养都具有重要作用。通过本课程的学习应使学生对移动机器人控制系统的导航算法实现的相关理论、原理及数值计算相关技术有较为全面的了解，从而具备设计、开发移动机器人导航功能的能力及对各种移动机器人控制系统的快速掌握能力。

推荐教材或主要参考书：

[1] Gerald Cook著，赵春晖等译. 移动机器人导航、控制与遥感. 国防工业出版社，2015年10月

[2] Amitava Chatterjee等编著， 连晓峰等译. 基于视觉的自主机器人导航. 机械工业出版社，2017年7月

[3] 郑慧娆，等编著. 数值计算方法（第2版）. 武汉大学出版社，2012年1月

[4] 张强，张雯. 水下机器人导航技术. 科学出版社，2019年6月

0008708 Mobile Robots Navigation

Course Number: 0008708

Course Title: Mobile Robots Navigation

Course Type: Professional elective course

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

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Automatic control principle, Modern control theory, Motion control system/Process control system I, High level language programming, Intelligent detection and networking technology, Microcomputer principle and interface technology, Computer network and application, Freshman seminar

Evaluation Method: Course participation + report paper

Writer： Kong Dehui

Course Description:

Mobile Robots Navigation is a professional elective course offered by the College of artificial intelligence and automation for undergraduates majoring in robotic engineering. This course introduces the autonomous navigation technology of mobile robot. It is a cutting-edge technology subject with high intersection in multi-disciplinary fields. It is also a basic general technology for developing robot control systems in different application fields. It has a wide application prospect. The course plays an important role in the cultivation of research and application-oriented talents. Through the study of this course, students should have a more comprehensive understanding of the relevant theories, principles and numerical calculation technologies of the navigation algorithm implementation of mobile robot control system, so as to have the ability to design and develop mobile robot navigation functions and quickly master various mobile robot control systems.

Recommended Textbooks/References:

1.Gerald cook, translated by Zhao Chunhui, et al. Navigation, control and remote sensing of mobile robots. *National Defense Industry Press*, October 2015

2.Amitava Chatterjee et al., translated by Lian Xiaofeng et al. Vision based autonomous robot navigation. *China Machine Press*, July 2017

3.Zheng huirao, et al. Numerical calculation method (2nd Edition). Wuhan University Press, January 2012

4.Zhang Qiang, Zhang Wen. Navigation technology of underwater vehicle. *Science Press*, June 2019

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：机器人工程专业本科生

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信息学部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 Robotic Engineering

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 robotic engineering. 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.

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：机器人工程专业本科生

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。本课程是自动化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 Robotic Engineering

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 automation. 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

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、机器人工程专业本科生

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）

先进控制理论是信息学部为自动化专业本科生和机器人工程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 Robotic Engineering

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 professional elective courses offered by the Faculty of Information Technology for undergraduate students major in automation and robotic engineering. 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

0010689 物联网机器人

课程编码：0010689

课程名称：物联网机器人

英文名称：Internet of things robot

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：机器人工程专业本科生

先修课程：python 语言程序设计、人工智能技术基础

考核形式：平时成绩+考试

撰写人：常鹏

课程简介：（250-300 字）

本课程是机器人工程专业的一门重要的专业选修课程，也是人工智能、机器学习领域重要技术基础课。本课程着重于培养学生对物联网基础、面向对象的编程思想、掌握从事本专业工作所需的数学（特别是离散数学）、自然科学知识、学科基础和专业知识，能够用于解决复杂人工智能系统设计、开发和应用中的问题。主要任务是学习物联网是物与物、人与物之间的信息传递与控制，并能应用这些基本方法设计实现简单的物联网应用案例，掌握包括计算思维在内的适应解决人工智能工程问题的基本思维方法和研究方法，具有良好的学科素养和工程意识，能够识别和表达复杂人工智能系统设计、开发和应用中的问题。

推荐教材或主要参考书：

[1] 李联宁 (著)，物联网基础教程， 清华大学出版社，2019-11-01

[2] 马飒飒，王伟明，张磊，张勇 (著) 袁国忠(译)，物联网基础技术及应用， 西安电子科技大学出版社，2018-01-01

[3] 张冀，王晓霞，宋亚奇，庞春江，李天 (著) 物联网技术与应用,， 清华大学出版社，2017-08-01

0010689 Internet of things robot

Course Number: 0010689

Course Title: Internet of things robot

Course Type: Professional elective course

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

Students: Undergraduates majoring in Robotic Engineering

Prerequisites: Python language programming, introduction to artificial intelligence

Evaluation Method: Usual results + exams

Writer： Chang Peng

Course Description:

This course is an important professional elective course for students major in robotic engineering, and also an important technical basic course in the field of artificial intelligence and machine learning. This course focuses on cultivating students' basic knowledge of the Internet of things, object-oriented programming ideas, and mastering the mathematics (especially Discrete Mathematics), natural science knowledge, discipline basis and professional knowledge required for their professional work, which can be used to solve the problems in the design, development and application of complex artificial intelligence system. The main task is to learn that the Internet of things is the information transmission and control between things, people and things, and to be able to apply these basic methods to design and implement simple application cases of the Internet of things, master the basic thinking methods and research methods including computational thinking to solve artificial intelligence engineering problems, and have good discipline literacy and engineering consciousness, It can identify and express the problems in the design, development and application of complex artificial intelligence system.

Recommended Textbooks/References:

1. Li lianning, basic course of Internet of things, Tsinghua University Press, November 1, 2019

2. Ma Sasa, Wang Weiming, Zhang Lei, Zhang Yong, Yuan Guozhong, basic technology and application of Internet of things, Xi'an University of Electronic Science and Technology Press, January 1, 2018

3. Zhang Ji, Wang Xiaoxia, song Yaqi, Pang Chunjiang, Li Tian, Internet of things technology and application, Tsinghua University Press, August 1, 2017

0010698 协作操控机器人

课程编码：0010698

课程名称：协作操控机器人

英文名称：Collaborative Control Robot

课程类型：专业选修课

学分： 2.0 **总学时：** 32

面向对象：机器人工程类本科生

先修课程：概率论与数理统计，大学物理Ⅰ，机器人基础原理，高级语言程序设计，机器人系统仿真

考核形式：平时成绩+课程设计报告+考试

撰写人：刘春芳

课程简介：（250-300 字）

协作操控机器人是信息学部为机器人工程专业本科生开设的专业选修课。本课程的任务是引导学生认识协作机器人的特点与重要应用，理解协作机器人的外力感知技术，掌握机器人阻抗控制方法、协作控制策略与机器人动态行为控制技术，掌握协作机器人认知控制技术（意图理解、知识记忆、自然交互学习的基本方法），掌握典型协作机器人的基本操作，以及了解协作机器人特殊应用案例中多种控制技术的综合应用。教学内容的重点：协作机器人柔顺控制与认知控制的原理和方法。教学内容的难点：应用所学的柔顺控制模型和认知控制模型到机器人与人的协作任务中。

推荐教材或主要参考书：

[1] 讲义.

[2] 王璐欢，张笑天，智能协作机器人技术应用初级教程，哈尔滨工业大学出版社，2020.

[3] 杨辰光，程龙，李杰，机器人控制，清华大学出版社，2020.

0010698 Collaborative Control Robot

Course Number: 0010698

Course Title: Collaborative Control Robot

Course Type: Professional elective course

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

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Probability and Statistics， Generral Physics， language programming，

Evaluation Method: Course participation + Course design + Written exams

Writer： Liu Chunfang

Course Description:

Collaborative Control Robot is one of the professional elective courses for undergraduate students major in robotic engineering. The main target of this course is to clarify the characteristic and important applications of collaborative control robot. This course is focus on control technologies in cooperative robots. The teaching contents are mainly covered by the following aspects: the external force sensing technology, the impedance control method, cooperative control strategy, dynamic behavior control technology of robots, and the cognitive control technology. The difficulties of teaching contents are described as followings: the applications of the compliance control model and cognitive control model.

Recommended Textbooks/References:

1.Lecture notes.

2.Wang Luhuan, Zhang Xiaotian, Application of Intelligent Collaborative Robot Technology, Harbin Institute of Technology Press, 2020.

3.Yang Chenguang, Cheng Long, Li Jie, Robot Control, Tsinghua University Press, 2020.

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 **总学时：** 16

面向对象：机器人工程专业本科生

先修课程：无

考核形式： 平时成绩+分析设计报告

撰写人：于乃功

课程简介：（250-300 字）

“新生研讨课”是由大学知名教授专门为机器人工程专业大一新生开设的小班专题讨论课程。主要教学方式是以小组方式与开课教授就某一专题共同开展研究，在教授指导下开展小组讨论，进行口头辩论和写作训练。与其他类型课程不同，新生研讨课没有固定的教材，开课专题可以涉及本专业内的任何领域，由任课教师依新生的特点自行确定，鼓励交叉学科选题。通过该课程的学习，使学生认知机器人工程专业，了解机器人的前沿发展现状和趋势，激发求知欲、好奇心和研究兴趣，对终身学习有正确认识，具有不断学习和适应发展的能力。

推荐教材或主要参考书：

[1] Robin R. Murphy 著. 人工智能机器人学导论(第二版)(英文版). 电子工业出版社, 2019 年 10 月

[2] 孙富春 等 译. 机器人学导论——分析、控制及应用（第二版）. 电子工业出版社, 2018 年 3 月

[3] 樊炳辉 等 编著. 机器人工程导论. 北京航空航天大学出版社, 2018 年 6 月

[4] 蒋再男, 王珂 编著. 机器人交互技术. 清华大学出版社, 2020 年 3 月

[5] 赵耀 编. 自动化概论（第 2 版）. 机械工业出版社, 2014 年 10 月

0009394 Freshman Seminar

Course Number: 0009394

Course Title: Robotics Engineering Freshman Seminar

Course Type: Independent course

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

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: N/A

Evaluation Method: Course participation + Analysis and Design Report

Writer： Yu Naigong

Course Description:

The "Robotics Engineering Freshman Seminar" is a small workshop course offered by distinguished professors for freshmen majoring in robotics engineering. The main teaching method is to conduct group research, essay writing, in-class debate and group discussion on a particular topic under the guidance of the professor. Different from other types of courses, there is no fixed textbook for freshman seminar, and the topics can be related to any field of the major, which is determined by the teacher according to the characteristics of freshmen, and interdisciplinary topics are encouraged. Through the study of this course, students will understand the major of robot engineering, the frontier development status and trend of robots. The course will stimulate the desire for knowledge, curiosity and research interest. Student will grow a correct understanding of lifelong learning, and gain the ability to keep learning and adapt to development.

Recommended Textbooks/References:

1.Robin R.Murphy. Introduction to Robotics with Artificial Intelligence (2nd edition), *Electronic Industry Press*, 10-2019

2.Sun Fuchun etc Translation. Introduction to Robotics -- Analysis, Control, and Applications (2nd edition). *Electronic Industry Press,* 3-2018

3.Fan Binghui etc. Introduction to Robotic engineering. Beihang University Press, 6-2018

4.Jiang Zainan, Wang Ke. Robot interaction technology. Tsinghua University Press, 3-2020

5.Zhao Yao. Introduction to Automation (2nd edition). China Machine Press, 10-2014

0010105 机器人智能交互技术

课程编码：0010105

课程名称：机器人智能交互技术

英文名称：Technologies on Human-Robot Intelligent Interaction

课程类型：自主课程

学分： 2.0 **总学时：** 32

面向对象：机器人工程专业本科生

先修课程：机器人感知技术, 图像处理与机器视觉

考核形式：通过综合设计类实验进行考查

撰写人：李秀智

课程简介：（250-300 字）

机器人智能交互技术是信息学部为机器人工程专业本科生开设的一门自主课程。本课程重点介绍人与智能机器人之间前沿交互的概念、理论与技术，以视觉、语音、触觉等方式为重点。通过学习和训练环节，使学生培养创新思维和实践能力，达到能够根据具体的应用场景，设计技术方案并付诸实现的目的。该课程为学生从事机器人领域的专业技术工作打下坚实的理论的实践基础。

教学内容重点：基于人体动作、手势的视觉交互。教学内容的难点：人机交互中特征提取和识别的深度学习方法，以及多模态的交互策略。

推荐教材或主要参考书：

[1] 蒋再男, 王珂. 机器人交互技术. 清华大学出版社, 2020 年 3 月.

[2] 杜广龙, 张平. 机器人自然交互理论与方法. 华南理工大学出版社, 2017 年 3 月.

[3] 吴亚东等. 自然人机交互技术及应用. 科学出版社, 2020 年 4 月.

0010105 Technologies on Human-Robot Intelligent Interaction

Course Number: 0010105

Course Title: Technology on Human-Robot Intelligent Interaction

Course Type: Independent course

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

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Robot Sensing Technologies, Image Processing and Machine Vision

Evaluation Method: Project training scheme

Writer： Li Xiuzhi

Course Description:

Technology on Human-Robot Intelligent Interaction is one of the independent courses for undergraduate students majoring in robotic engineering. The main target of this course is to clarify basic concept, theories and techniques in advancing interaction approaches between human and intelligent robotics. This course is mainly focus on visual, verbal and tactile methods. With the learning and training in this course, students are expected to develop creative thinking and practical ability, which enable them to deal with project design and implementation for engineering applications. This course can lay theoretical and practical foundations for students engaged in developing engineering applications in intelligent robot related fields.

The teaching contents are mainly covered by visual interaction routines, which are based on detection and recognition of human actions, postures, and so on. The difficulties of teaching contents are twofold. The first is the deep learning techniques used for feature extraction and recognition in human-robot interaction, and the second focuses on multi-modal interaction technologies.

Recommended Textbooks/References:

1.Jiang Zainan, Wang Ke, Human Robot Interaction Technology, *Tsinghua University Press*, March-2020

2.Du Guanglong, Zhang Ping, Theory and Technologies on Robot Natural Interaction, *South China University of Technology Press*, March-2017

3.Wu Yadong, et al, Natural Human-Interface Technologies and Applications, *Science Press*, April-2020

0010704 信息通信网络及应用

课程编码：0010704

课程名称：信息通信网络及应用

英文名称：Information Communication Network and its Application

课程类型：自主课程

学分：2　　**总学时：**32

面向对象：机器人工程专业本科生

先修课程：高级语言程序设计，微机原理与接口技术

考核形式：平时成绩+实验+考试

撰写人：高学金

课程简介：

信息通信网络及应用是信息学部为机器人工程专业本科生开设的专业任选课程。本课程的任务是讲述信息通信网络的基本原理、技术和方法。主要内容包括信息通信网络的发展、应用，数据通信基础，计算机网络体系结构，局域网，TCP/IP 协议，无线网络技术，网络互连设备，广域网技术等。通过本课程的学习和相关实验训练，学生可以掌握信息通信网络的基本原理和相关技术，为从事机器人工程研究和应用打下基础。教学重点内容包括数据通信基础、计算机网络体系结构、局域网、TCP/IP 协议、无线网络技术。教学难点内容包括数据通信基础、计算机网络体系结构、TCP/IP 协议。

推荐教材或主要参考书：

[1] 陈熙源, 祝雪芬, 汤新华. 信息通信网络概论（第一版）. 北京: 清华大学出版社, 2018.10

[2] 谢希仁. 计算机网络（第五版）. 北京:电子工业出版社, 2008.01

[3] （美）詹姆斯·F. 库罗斯, （美）基思·W. 罗斯著; 陈鸣译. 计算机网络: 自顶向下（原书第 7 版）. 北京: 机械工业出版社, 2018.05

[4] 何莉, 许林英, 等. 计算机网络概论（第二版）. 北京: 高等教育出版社, 1999.04

0010704 Information Communication Network and its Application

Course Number: 0010704

Course Title: Information Communication Network and its Application

Course type: Independent course

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

Students: Undergraduate students major in Robotic Engineering

Prerequisites: High Level Language Programming, Microcomputer Principle and Interface Technology

Evaluation Method: Usual performance+Experiment+Written Exam

Writer： Gao Xuejin

Course Description:

Information communication network and its application is an independent course for undergraduates majoring in robotic engineering. The task of this course is to describe the basic principles, technologies and methods of information communication network. The main contents include the development and application of information communication network, data communication foundation, computer network architecture, local area network, TCP/IP protocol, wireless network technology, network interconnection equipment, wide area network technology, etc. Through the study and related experimental training of this course, students can master the basic principles and related technologies of information communication network, laying a foundation for the research and application of robotics engineering. Key contents of the course include data communication foundation, computer network architecture, local area network, TCP/IP protocol, wireless network technology. Teaching difficulties include data communication foundation, computer network architecture, TCP/IP protocol.

Recommended Textbooks/References:

1. Chen Xiyuan, Zhu Xuefen, Tang Xinhua. Introduction of Information Communication Network (First Edition). Beijing: Tsinghua University Press, 2018.10

2. Xie Xiren. Computer Network (Fifth Edition). Electronic Industry Press, 2008.01

3. James F. Kurose, Keith W. Ross; translated by Chen MingYi. Computer Networking: A Top-Down Approach, Seventh Edition. Beijing: Mechanical Industry Press, 2018.05

4. He Li, Xu Linying, et al. Overview of Computer Networks (Second Edition). Higher Education Press, 1999.04

0010662 学术论文写作

课程编码：0010662

课程名称：学术论文写作

英文名称：Academic Paper Writing

课程类型：自主课程

学分： 1.0 **总学时：** 16

面向对象：机器人工程专业本科生

先修课程：

考核形式：平时成绩+报告

撰写人：奥顿

课程简介：（250-300 字）

学术论文写作是人工智能与自动化学院为机器人工程专业本科生开设的自主课程。本课程的任务是通过学习学术论文写作，为学生最后撰写毕业论文和发表科技论文打下良好基础，并掌握撰写毕业论文方法、技巧和能力。论文是展现研究成果的一种重要方式，也是科研工作者与同行交流的一个重要途经，学术论文写作方法和规范是学生应该掌握的基本知识和基本技能，为将来从事科学研究打下基础。并且掌握口头、书面与同行和相关人员进行有效沟通和交流的能力。教学内容重点：期刊评价标准，论文管理工具的使用, 如何写综述，撰写开题报告，毕业论文的写作。教学内容的难点：论文管理工具的使用, 摘要的主要内容，如何提取关键词。

推荐教材或主要参考书：

[1] 张孙玮，吕伯昇，张 迅. 科技论文写作入门(第五版). 化学工业出版社，2017 年 2 月

[2] Barbara Gastel，Robert A. Day 著，任志刚译. 科技论文写作与发表教程(第八版). 电子工业出版社，2018 年 1 月

[3] 闫茂德，左磊，杨盼盼等. 科技论文写作. 机械工业出版社，2021 年 3 月

0010662 Academic Paper Writing

Course Number: 0010662

Course Title: Academic Paper Writing

Course Type: Independent course

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

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites:

Evaluation Method: Course participation + Report paper

Writer： Ao Dun

Course Description:

Academic paper writing is an independent course offered by the College of artificial intelligence and automation for undergraduate students majoring in robotic engineering. The task of this course is to lay a good foundation for students to write graduation thesis and publish scientific papers, and master the methods, skills and ability of writing graduation thesis. Thesis is an important way to show research results, and it is also an important way for scientific researchers to communicate with their peers. The writing methods and norms of academic papers are the basic knowledge and skills that students should master, so as to lay a foundation for future scientific research. And master oral, written and peer and related personnel for effective communication and exchange ability. Teaching contents: journal evaluation standards, the use of paper management tools, how to write a review, write the opening report, graduation thesis writing. The difficulties of teaching content: the use of paper management tools, the main content of the abstract, how to extract keywords.

Recommended Textbooks/References:

1.Zhang Sunwei, Lv Bosheng, Zhang Xun. Introduction to the writing of scientific and Technological Papers (Fifth Edition). Chemical Industry Press, February 2017

2.Barbara Gastel, Robert A. day, translated by Ren Zhigang. A course on writing and publishing scientific papers (Eighth Edition). Electronic Industry Press, January2018

3.Yan Maode, Zuo Lei, Yang Panpan, etc. Scientific and technological paper writing. Mechanical Industry Press, March 2021

0010103 机器人前沿论坛

课程编码：0010103

课程名称：机器人前沿论坛

英文名称：Robotics Frontier Forum

课程类型：自主课程

学分： 1.0 **总学时：**16

面向对象：机器人工程专业本科生

先修课程：机器人基础原理、电机驱动与运动控制、机器人感知技术、高级语言程序设计、机器人智能交互技术、微机原理与接口技术、自动控制原理、信息通信网络及应用等课程

考核形式：平时成绩+机器人工程领域理论研究及技术发展掌握情况汇报交流

撰写人：于乃功

课程简介：（250-300 字）

本课程是为机器人工程专业毕业班（大学四年级）学生开设的综合性专业提高课程。主要内容是介绍机器人工程领域科学研究和技术的最新发展与前沿知识，包括机器人环境感知技术研究情况、机器人导航技术进展、机器人智能操控技术进展、人机交互技术进展、机器人仿生技术进展、机器人智能决策技术进展，及人工智能、自动化等其他相关领域的研究进展和技术进步等。通过本课程的学习，使学生能更多地了解机器人工程领域面临的挑战和所要解决的主要问题，掌握机器人前沿理论研究和技术发展的动态，以开阔学生视野，增强学生的创新意识，提高学生的交流能力和分析问题、解决问题的能力。

推荐教材或主要参考书：

自主查阅和论坛内容相关的学术文献。

0010103 Robotics Frontier Forum

Course Number: 0010103

Course Title: Robotics Frontier Forum

Course Type: Independent course

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

Students: Undergraduate students majoring in Robotic Engineering

Prerequisites: Basic principles of robots, Motor drive and motion control, Course3, Robot sensing technology, High level language programming, Robot intelligent interaction technology, Microcomputer principle and interface technology , Principle of automatic control, Information communication networks and applications

Evaluation Method: Course participation + Report and exchange of theoretical research and technological development in the field of robot engineering

Writer： Yu Naigong

Course Description:

Robotics Frontier Forum is one of the independent courses for undergraduate students majoring in robotic engineering. The main objective of this course is to clarify the latest development and frontier knowledge of scientific research and technology in robot engineering. This course is focused on mastering the dynamics of cutting-edge theoretical research and technological development of robotics.The course will broaden students' vision, enhance students' awareness of innovation, improve students' ability of communication, problem analysis and problem solving abilities.

Recommended Textbooks/References:

Independent review and forum content related academic literature.

0010739 信息物理系统建模与仿真

课程编码：0010739

课程名称：信息物理系统建模与仿真

英文名称：Cyber-Physical Systems: Modeling and Simulation

课程性质：专业选修课

学分： 2.0 **总学时：** 32

面向对象：机器人工程专业本科生

先修课程：智能检测与网联技术、现代控制理论、计算机网络与应用

考核形式： 平时成绩+大作业

课程简介：（250-300 字）

《信息物理系统建模与仿真》是信息学部为机器人工程专业本科生开设的专业选修课。信息物理系统是信息资源和物理世界有机融合和深度协作的新一代网络化智能系统，具有广泛的应用前景。本课程系统讲授信息物理系统的建模与仿真的基本原理、方法与应用，使学生掌握系统基础理论知识，培养学生综合运用理论与方法对信息物理应用系统进行建模、分析与控制设计的能力，为复杂机器人工程项目的设计、开发与实施奠定基础。教学内容重点包括物理过程模型、有限状态机、计算、物理与信息变量之间的转换、数字网络、反馈控制设计等基础知识。教学内容的难点是将系统建模的基本原理与工程应用紧密结合，使学生能够设计集计算、通信与控制一体的实际信息物理系统。

推荐教材或主要参考书：

[1] Danda B. Rawat, Joel J.P.C. Rodrigues, Ivan Stojmenovic. Cyber-Physical Systems: From Theory to Practice. CRC Press, 2016.

[2] Houbing Song, Danda B. Rawat, Sabina Jeschke, Christian Brecher. Cyber-Physical Systems: Foundations, Principles and Applications. Academic Press, 2017.

[3] Rajeev Alur. Principles of Cyber-Physical Systems. MIT Press, 2015.

0010739 Cyber-Physical Systems: Modeling and Analysis

Course Number: 0010739

Course Title: Cyber-Physical Systems: Modeling and Simulation

Course Type: Professional elective course

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

Students: Undergraduate students majoring in Robotics Engineering

Prerequisites: Intelligent Detection and Networking Technology, Modern Control Theory, Computer Network and Application

Evaluation Method: Course participation + Project

Course Description:

Cyber-Physical Systems: Modeling and Simulation is one of the professional elective courses for undergraduate students majoring in Robotics Engineering. Cyber-physical system (CPS for short) is a new generation of networked intelligent system based on the integration and deep cooperation between information resources and the physical world, which has wide application prospects. This course systematically introduces the basic principles, methods, and applications of CPSs, and thus to make students master the relevant theoretical knowledge of CPSs, and to train students to be capable of modelling, analyzing, and control design of CPSs, so as to lay a foundation for the design, development and implementation of complex robotics engineering projects. The teaching contents are mainly covered by the following aspects: models of physical process, finite state machines, computation, converters between physical and cyber variables, digital networks, and feedback control design. The difficulties of teaching contents are to combine the basic principles of CPSs with engineering applications, so as to make students be capable of designing practical CPSs that integrate computing, communication and control.

Recommended Textbooks/References:

1.Danda B. Rawat, Joel J.P.C. Rodrigues, Ivan Stojmenovic. Cyber-Physical Systems: From Theory to Practice. CRC Press, 2016.

2.Houbing Song, Danda B. Rawat, Sabina Jeschke, Christian Brecher. Cyber-Physical Systems: Foundations, Principles and Applications. Academic Press, 2017.

3.Rajeev Alur. Principles of Cyber-Physical Systems. MIT Press, 2015.