

## 课程详述

### COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	<b>课程名称 Course Title</b>	自动控制原理 Automatic Control Theory
2.	<b>授课院系 Originating Department</b>	电子与电气工程系 Department of Electronic and Electrical Engineering
3.	<b>课程编号 Course Code</b>	EE371
4.	<b>课程学分 Credit Value</b>	3
5.	<b>课程类别 Course Type</b>	专业核心课 Major Core Courses
6.	<b>授课学期 Semester</b>	秋季 Fall
7.	<b>授课语言 Teaching Language</b>	英文 English
8.	<b>授课教师、所属学系、联系方式 Instructor(s), Affiliation &amp; Contact</b> (For team teaching, please list all instructors)	刘国平, 电子与电气工程系, liugp@sustech.edu.cn Guoping Liu, Department of Electronic and Electrical Engineering
9.	<b>实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact</b>	无 NA
10.	<b>选课人数限额(可不填) Maximum Enrolment (Optional)</b>	

11. 授课方式 Delivery Method	讲授 Lecture	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
学时数 Credit Hours	48				48
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	电路基础 Fundamentals of Electric Circuits				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	现代控制与最优估计 Modern Control and Estimation 机器人运动与控制方法 Robotic Motion and Control 移动机器人导航与控制 Mobile Robot Navigation and Control 计算机控制系统设计与实践 Design and Practice of Computer Control System 系统辨识与自适应控制 System Identification and Adaptive Control 先进控制理论 Advanced Control Theory 高级机器人控制方法 Advanced Robotic Control				
14. 其它要求修读本课程的学系 Cross-listing Dept.	机械与能源工程系 Department of Mechanical and Energy Engineering 力学与航空航天系 Department of Mechanics and Aerospace Engineering 计算机科学与工程系 Department of Computer Science and Engineering				

### 教学大纲及教学日历 SYLLABUS

#### 15. 教学目标 Course Objectives

本课程将介绍自动控制系统的基本概念和方法。其主题包括控制系统建模，时域分析法，根轨迹法，频率特性分析法，控制系统设计，非线性分析法，离散系统分析。该课程还将这些自动控制方法与电气、机械、航空航天系统中的应用相连接。

This course introduces the fundamental concepts and methods of automatic control systems. The topics include control system modeling, time-domain analysis methods, root locus methods, frequency-domain analysis methods, control system design, nonlinear analysis methods, and discrete system analysis. Those methods are also connected with the control applications of electrical, mechanical and aerospace systems.

#### 16. 预达学习成果 Learning Outcomes

能够推导线性动力学系统传递函数模型  
The ability to derive transfer function models for linear dynamical systems

能够使用时域法、频域法和根轨迹法分析线性动力学系统性能  
The ability to analyse the performance of a linear dynamical system using time-domain analysis methods, frequency-domain analysis methods, and root-locus methods

能够使用各种常规控制方法设计线性动力学系统控制器  
The ability to design the controller of a linear dynamical system using various conventional control methods

很好地理解离散线性系统分析与设计  
The good understanding on the analysis and design of discrete linear systems

很好地理解非线性系统分析  
The good understanding on the analysis of nonlinear systems

能够系统地理解控制系统分析和设计的原理，并对一系列控制系统问题的解决方案做出合理评价

The ability to demonstrate a systematic understanding of the principles of control system analysis and design, and show critical judgement in developing solutions to a range of control system problems

17. 课程内容及教学日历（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）

**Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)**

1. Introduction to Automatic Control (2h) 自动控制简介 (2 小时)
2. Math Basics (2h) 数学基础 (2 小时)
  - 1) Differential equations 微分方程
  - 2) Laplace transform 拉普拉斯变换
3. Control System Modeling (6h) 控制系统建模 (6 小时)
  - 1) Impulse responses 脉冲响应
  - 2) Transfer functions 传递函数
  - 3) Modeling of physical systems 物理系统建模
  - 4) Block diagram of control systems 控制系统方框图
  - 5) Signal flow diagrams 信号流图
4. Time-Domain Analysis Methods (8h) 时域分析法 (8 小时)
  - 1) Stability of control systems 控制系统稳定性
  - 2) Typical input signals and responses 典型输入信号和响应
  - 3) Time-domain specifications 时域性能指标
  - 4) Steady state error analysis 稳态误差分析
  - 5) Effects of poles and zeros 零点和极点的作用
5. Root Locus Methods (6h) 根轨迹法 (6 小时)
  - 1) Basic concept of root locus 根轨迹的基本概念
  - 2) Properties of root locus 根轨迹特性
  - 3) Root locus drawing of control systems 控制系统根轨迹绘制
  - 4) Design using the root locus method 用根轨迹方法设计
  - 5) Root locus analysis of control systems 控制系统的根轨迹分析
6. Frequency-Domain Analysis Methods (8h) 频率特性分析法 (8 小时)
  - 1) Frequency responses 频率响应
  - 2) Frequency-domain specifications 频域指标
  - 3) Analysis of system specifications 系统指标分析
  - 4) Nyquist stability criterion 奈奎斯特稳定判据
  - 5) Bode plot 波特图
  - 6) Stability margin 稳定性裕度
  - 7) Frequency analysis of control systems 控制系统的频域分析

7. Control System Design (8h) 控制系统设计 (8 小时)
  - 1) Design specifications 设计指标
  - 2) Controller configurations 控制器结构
  - 3) PID control 比例-积分-微分控制
  - 4) Pole-zeros cancellation 零极点对消
  - 5) Pole assignment 极点配置
  - 6) Model reference control 模型参考控制
8. Nonlinear Analysis Methods (2h) 非线性分析法 (2 小时)
  - 1) Nonlinear control systems 非线性控制系统
  - 2) Phase plane analysis 相平面分析
9. Discrete System Analysis (6h) 离散系统分析 (6 小时)
  - 1) Digital control systems 数字控制系统
  - 2) Sampled-data systems 数字采样系统
  - 3) z-transform z 变换
  - 4) Model of discrete control system 离散控制系统模型
  - 5) Stability analysis of discrete control systems 离散控制系统稳定性分析
  - 6) Performance analysis of discrete control systems 离散控制系统性能分析
  - 7) Design of discrete control systems 离散控制系统设计

18. 教材及其它参考资料 Textbook and Supplementary Readings

- 1) 胡寿松, 自动控制原理 (第七版), 科技出版社, 2019  
Hu Shousong, Automatic Control Theory (Seventh Edition), Science and Technology Press, 2019
- 2) F Golnaraghi and B. C. Kuo, Automatic Control Systems, McGraw-Hill Education, 2017

**课程评估 ASSESSMENT**

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		5		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects		15		
平时作业 Assignments		10		
期中考试 Mid-Term Test		20		
期末考试 Final Exam	2h	50		
期末报告 Final Presentation				
其它（可根据需要 改写以上评估方式） Others (The above may be modified as necessary)				

20. 记分方式 GRADING SYSTEM

- A. 十三级等级制 Letter Grading  
 B. 二级记分制（通过/不通过） Pass/Fail Grading

**课程审批 REVIEW AND APPROVAL**

21. 本课程设置已经过以下责任人/委员会审议通过  
 This Course has been approved by the following person or committee of authority

电子与电气工程系  
 Department of Electronic and Electrical Engineering