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.	课程名称 Course Title	信号分析 Signal Analysis
2.	授课院系 **Originating Department**	机械与能源工程系 Department of Mechanical and Energy Engineering
3.	课程编号 **Course Code**	ME401
4.	课程学分 Credit Value	3
5.	课程类别 **Course Type**	专业核心课 Major Core Course
6.	授课学期 **Semester**	秋季学期 Fall
7.	授课语言 **Teaching Language**	中英双语 English & Chinese
8.	授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） **Instructor(s), Affiliation& Contact** （**For team teaching, please list all instructors**）	柯文德 机械与能源工程系 13809883997 Wende Ke Department of Mechanical and Energy Engineering 13809883997
9.	实验员/助教、所属学系、联系方式 **Tutor/TA(s), Contact**	需助教1人，待公布 To be announced
10.	选课人数限额(可不填) **Maximum Enrolment** （**Optional**）	

11.	授课方式 **Delivery Method**	讲授 **Lectures**	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**	32		32		64

12.	先修课程、其它学习要求 **Pre-requisites or Other Academic Requirements**	ME307 控制工程基础 Fundamentals of Control Engineering
13.	后续课程、其它学习规划 **Courses for which this course is a pre-requisite**	
14.	其它要求修读本课程的学系 **Cross-listing Dept.**	

<h2 align="center">教学大纲及教学日历 SYLLABUS</h2>

15. 教学目标 Course Objectives

信号分析是机械制造领域内的专业课程，选用教材为《信号与系统》（第 3 版），郑君里（编著），参考教材为美国麻省理工学院 奥本海姆教授编著《信号与系统》（第 2 版），用于本科生及研究生教学用书，该课程为中英双语授课，系统性讲授信号分析与处理的基本原理、方法和应用等知识，如信号的定义及分类、连续时间信号分析、离散时间信号分析、离散傅里叶变换和快速傅里叶变换、数字滤波器的设计、随机信号分析等。

通过本课程的讲授，使学生掌握信号分析的理论知识、提高对实际问题的分析能力和解决能力、培养学生国际化思维以及团队协作管理复合能力。

The course 'Signal Analysis' is one of the professional courses in mechanical manufacturing field. Signal and System (3rd edition) by Junli Zheng and Signals and Systems (2nd edition), by Alan V. Oppenheim are chosen as the reference books for undergraduate students and graduate students. We teach this course in both English and Chinese. The basic theories, methods and applications are concerned, in which the definition of signal and its categories, continuous time signal analysis, discrete time signal analysis, discrete Fourier transform and fast Fourier transform, design of digital filter, random signal analysis, etc.

Students will master the fundamental theories of signal analysis through this course and improve the abilities of analysing and solving problems as well as international thinking and teamwork management.

16. 预达学习成果 Learning Outcomes

本课程系统地阐述信号分析与处理的基本概念、原理、技术和方法，与后续的系统类课程结合，构成关于信号、系统的分析以及综合设计的完备知识结构。本课程以信号分析、处理为主线，使学生掌握在不同讨论域的连续信号分析、离散信号分析方法，以及信号与线性系统的关系，并掌握模拟和数字滤波器的基本理论和设计方法，为后续的理论课程和专业课程的学习打下坚实的理论基础。

The basic concept, principle, technique and method of signal analysis and processing are systematically introduced. The complete knowledge structure of analysis on the signal system based on this course and the subsequent courses will be constructed for students. Taking the signal analysis and processing as the main line will help students to master the continuous signal domain analysis, the discrete signal analysis, and the relationship between the signal and linear system as well as the basic theories and design methods of analog and digital filter. All these will definitely help students to build a solid theoretical foundation for the subsequent theoretical courses and professional courses learning.

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.)

Week	内容 Contents
1（2 课时）	信号的描述、分类、运算，阶跃信号、冲激信号、信号分解、系统模型、线性时不变系统

1 (2 hours)	Signal description, classification, operation, step signal, impulse signal, signal decomposition, system model, linear time-invariant system
2（2 课时） 2 (2 hours)	连续时间系统的时域分析，用时域经典法求解微分方程 Time Domain Analysis of Continuous Time Systems and Solving Differential Equations by Classical Time Domain Method
3（2 课时） 3 (2 hours)	零输入响应与零状态响应，冲激响应与阶跃响应，卷积性质及其计算 Zero Input Response and Zero State Response, Impulse Response and Step Response, Convolution Properties and Their Computation
4（2 课时） 4 (2 hours)	周期信号的傅里叶分析，典型周期信号的傅里叶级数，傅里叶变换 Fourier analysis of periodic signals, Fourier series of typical periodic signals, Fourier transform
5（2 课时） 5 (2 hours)	典型非周期信号的傅里叶变换，傅里叶变换的基本性质，卷积定理 Fourier transform of typical aperiodic signals, basic properties of Fourier transform, convolution theorem
6（2 课时） 6 (2 hours)	周期信号的傅里叶变换，抽样信号的傅里叶变换，抽样定理 Fourier Transform of Periodic Signal, Fourier Transform of Sampled Signal, Sampling Theorem
7（2 课时） 7 (2 hours)	拉普拉斯变换的定义、收敛域、基本性质，拉普拉斯逆变换 Definition, Convergence Region, Basic Properties of Laplace Transform, Inverse Laplace Transform
8（2 课时） 8 (2 hours)	拉普拉斯变换法的模型分析，系统函数（网络函数），零点、极点分布的时域、频响特性 Model analysis of Laplace transform method, system function (network function), time domain and frequency response characteristics of zero and pole distribution
9（2 课时） 9 (2 hours)	二阶谐振系统的 s 平面分析，全通函数与最小相移函数的零点、极点分布，线性系统的稳定性 S-plane analysis of second-order resonant system, distribution of zeros and poles of all-pass function and minimum phase-shift function, stability of linear system
10（2 课时） 10 (2 hours)	利用系统函数求响应，无失真传输，理想低通滤波器，系统的物理可实现性、佩利-维纳准则 Using system functions to obtain response, undistorted transmission, ideal low-pass filter, physical realizability of the system, Perry-Wiener criterion
11（2 课时） 11 (2 hours)	希尔伯特变换及系统函数的约束特性，调制与解调，带通滤波系统，从抽样信号恢复连续信号 Hilbert transform and constraints of system functions, modulation and demodulation, bandpass filtering system, recovery of continuous signals from sampled signals
12（2 课时） 12 (2 hours)	z 变换定义、典型序列的 z 变换，z 变换的收敛域，逆 z 变换，z 变换的基本性质 Definition of Z-transform, Z-transform of typical sequence, convergence domain of z-transform, inverse Z-transform and basic properties of Z-transform
13（2 课时） 13 (2 hours)	z 变换与拉普拉斯变换的关系，利用 z 变换解差分方程，离散系统的系统函数，序列的傅里叶变换（DTFT） The relation between Z transform and Laplace transform, the difference equation is solved by Z transform, the system function of discrete system and the Fourier transform of sequence (DTFT)
14（2 课时） 14 (2 hours)	数字滤波器的原理及设计，随机信号、平稳随机过程、各态遍历随机过程、非平稳随机过程、随机信号的自相关函数及互相关函数

	The principle and design of digital filter, random signal, stationary random process, ergodic random process, non-stationary random process, autocorrelation function and cross-correlation function of random signal	
15（2 课时） 15 (2 hours)	随机信号的功率谱估计、功率谱密度、功率谱估计的方法 A Method for Estimating Power Spectrum, Power Spectrum Density and Power Spectrum of Random Signals	
16（2 课时） 16 (2 hours)	复习与项目答辩 Review and dissertation of project	

实验 Experiments
Matlab 基础知识实验（第 1、2、3 周，6 课时） 1. 系统和程序控制指令；2. 数据类型和数学运算；3. 数值计算和符号计算；4. 绘图；5. Simulink Experiments of Matlab (week 1, 2, 3. 6 hours) 1. System and program control instructions; 2. Data type and mathematics calculation; 3. Numerical calculation and symbol calculation; 4. Drawing; 5. Simulink
信号的表示和运算实验（第 4、5、6、7 周，8 课时） 1. 信号的表示；2. 卷积与相关运算；3. LTI 系统分析方法；4. 冲击响应和阶跃响应 Experiments on signal representation and calculation (week 4,5, 6, 7. 8 hours) 1. Representation of signal; 2. Convolution; 3. Analysis of LTI; 4. Impulse and step
傅里叶分析实验（第 8、9、10、11 周，8 课时） 1. 傅里叶级数；2. 傅里叶变换的数值分析；3. 抽样定理；4. 拉普拉斯变换与频谱分析；5. 功率与能量 Experiments on Fourier transform (week 8, 9, 10, 11. 8 hours) 1. Fourier series; 2. Numerical analysis of Fourier transform; 3. Sampling theorem; 4. Laplace transform and spectrum analysis; 5. Power and energy
S 域、Z 域分析与系统特性实验（第 12、13、14、15 周，8 课时） 1. S、Z 变换的符号计算；2. 零极点、稳定性与系统的频率特性；3. 系统的互连；4. 状态变量分析 Experiments on S domain and Z domain (week 15, 16. 8 hours) 1. Symbol calculation of S and Z transformation; 2. Frequency characteristics of zero pole, stability and system; 3. Interconnection of system; 4. Analysis of state variables
项目展示与答辩（第 16 周，2 课时） Project presentation and dissertation(week 16. 2 hours)

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

1. 信号与系统（第三版）（上册、下册），郑君里，高等教育出版社，ISBN：9787040315196 Signal and System(3rd edition) by Junli Zheng, Higher Education Press, ISBN: 9787040315196 2. 信号与系统（第 2 版）. 美国麻省理工学院奥本海姆教授 编著，电子工业出版社；ISBN: 9787121257278 Signals and Systems by Alan V. Oppenheim in MIT. Electronic Industry Press; ISBN: 9787121257278 3. 信号分析与处理（第 2 版）. 赵光宙 编著，机械工业出版社；ISBN: 9787111084921, 7111084926 Signal Analysis and Processing by Guangzhou Zhao, China Machine PRESS, 2nd edition, ISBN: 9787111084921, 7111084926

课程评估 ASSESSMENT

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**
19.				

出勤 Attendance			
课堂表现 Class Performance			
小测验 Quiz			
课程项目 Projects	30		
平时作业 Assignments	10		
期中考试 Mid-Term Test			
期末考试 Final Exam	40		
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（实验部分）		

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

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课程审批 REVIEW AND APPROVAL
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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