东北大学秦皇岛分校本科课程教学大纲

一、课程基本信息

<table>
<tr><td>开课单位</td><td colspan="3">悉尼智能科技学院</td><td>课程代码</td><td colspan="5">3100113010</td></tr>
<tr><td>中文名称</td><td colspan="8">通信原理</td></tr>
<tr><td>英文名称</td><td colspan="8">Principles of Communications</td></tr>
<tr><td>总学时</td><td>56</td><td>理论学时</td><td>56</td><td>实验学时</td><td>0</td><td>上机学时</td><td>0</td><td>设计学时</td><td>0</td><td>课外学时</td><td>0</td></tr>
<tr><td>学　分</td><td>3.5</td><td colspan="10"></td></tr>
<tr><td>课程类型</td><td colspan="8">☑理论课程　☐理论（含实验）课程　☐实践类课程</td></tr>
<tr><td>课程类别</td><td colspan="8">☐通识类　☐学科基础类　☑专业方向类　☐实践类</td></tr>
<tr><td>适用专业</td><td colspan="8">通信工程</td></tr>
<tr><td>先修课程</td><td colspan="8">复变函数与积分变换、模拟电子技术基础、数字电子技术基础、信号与系统分析</td></tr>
<tr><td>建议开课学期</td><td colspan="8">☐1-1 ☐1-2 ☐2-1 ☐2-2 ☑3-1 ☐3-2
☐4-1 ☐4-2 ☐5-1 ☐5-2 ☐*（代表每学期都开设）</td></tr>
<tr><td>考核方式</td><td colspan="3">☑考试 ☐考查</td><td>成绩分制</td><td colspan="4">☑百分制 ☐五级制 ☐二级制</td></tr>
<tr><td>使用教材</td><td colspan="8">1、 Principles of Communications Author(s): Fan, Changxin, Publishing House of Electronics Industry, 2020</td></tr>
<tr><td>参考书及教学资源</td><td colspan="8">1、Principles of Communications systems, Modulation, and Noise (7th Edition) Author: Rodger E. Ziemer William H. Tranter, 2014
2、樊昌信，曹丽娜，《通信原理》，国防工业出版社，2012，第 7 版</td></tr>
<tr><td>其他说明</td><td colspan="8">无</td></tr>
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二、课程简介

中文描述

通信原理是通信工程本科专业的专业方向课程，主要讲授通信的基本原理和关键技术。本课程既有很强的理论性和系统性，又有很强的工程性和实践性。

课程主要内容包括绪论、随机过程基础、模拟调制系统、数字基带传输、数字带通传输（数字调制）、信源编码（A/D 转换、PCM 等）、同步原理和信道编码。

课程的教学目标使学生掌握通信与通信系统的基本概念、基本理论、基本技术和分析方法；熟悉通信系统的组成和工作原理以及各主要组成部分的功能和实现方法；建立对通信系统的分析、设计、建模、仿真和工程实现的能力。

课程的培养目标是培养学生发现问题、分析问题和解决问题的能力；培养工程意识、系统观念和国际视野；了解通信对人类生活方式、商务活动、国民经济、文化教育、医疗、安防、军事和政治等事务带来的变革、影响和意义；了解现代通信技术发展的现状、趋势、有待于解决的难题、竞争高地及改进思路；培养学生自主学习和终身学习的意识、勇于担当和报效祖国的责任感。

通过本课程的学习，要求学生掌握信息传输的基本原理和通信系统的性能分析方法，具备一定的分析和解决通信系统设计中的工程实践问题的能力，为后续相关专业课程的学习打下坚实的基础。

English Description

Communication Principles is a core course for undergraduate students in communication engineering. The course introduces the basic principles and key technologies of communication. It is not only theoretical and systematic, but also emphasizes engineering applications and practical skills.

The main contents of the course include introduction, fundamentals of stochastic processes, analog modulation systems, digital baseband transmission, digital bandpass transmission (digital modulation), source coding (A/D conversion, PCM, etc.), synchronization principles and channel coding.

The goal of the course is to enable students to master the basic concepts, theories, techniques, and analytical methods related to communication systems. Students will become familiar with the composition and working principles of communication systems, as well as the functions and implementation methods of their main components. By the end of the course, students will have the ability to analyze, design, model, and simulate communication systems.

The training goal of the course is to equip students with the skills to identify, analyze, and solve problems. It aims to cultivate an engineering mindset, a systemic perspective, and an international vision. Students will gain an understanding of the changes, impacts, and significance of communication in various aspects of life, including daily activities, business operations, the national economy, culture and education, healthcare, security, military affairs, and politics. Additionally, they will learn about the trends, challenges, competitive landscape, and improvement strategies within modern communication technology. The course also seeks to foster a sense of independent learning and lifelong learning, encouraging students to embrace the responsibility of serving their homeland.

By learning this course, students are expected to master the basic principles of information transmission and the performance analysis methods of communication systems. They will develop the ability to analyze and solve engineering problems related to communication system design, laying a solid foundation for the subsequent study of relevant professional courses.

三、课程目标

1、知识目标：

1-1：了解通信的重要性及发展历史，掌握通信基本概念和通信系统的性能指标。

1-2：掌握模拟调制、数字调制、数字信号传输和编码的原理，掌握系统有效性和可靠性分析方法，掌握信道的基本特性及对信号传输的影响，掌握通信系统同步原理和信道编码原理，为后续课程学习和从事信息传输等工作奠定基础。

2、能力目标：

2-1：通过仿真实验强化学生对数字通信系统和信源编码的工作原理和系统有效性的认识和理解，培养学生分析问题和解决问题的能力。

2-2：培养学生系统分析和设计能力，具备分析通信系统有效性和可靠性能力，初步掌握通信系统设计能力。

3、德育/素养目标：

3-1：理解通信技术对于国家战略安全与国防的重要意义。

3-2：认知当前全球下一代通信技术发展前沿、关键技术及相关中国企业的核心竞争力。

表 1 课程目标与毕业要求的对应关系

毕业要求	指标点	课程目标	关联 (H/M/L)
1. 工程知识：能够将数学、自然科学、工程基础和专业知识用于解决复杂工程问题。	1-2 掌握通信原理、信号与信息处理、电子电路技术等专业知识，具备通信系统功能模块设计开发能力和通信与信息系统设计开发与维护能力。	1-1、1-2、2-1、3-1、3-2	H
2. 问题分析：能够应用数学、自然科学和工程科学的基本原理、方法和手段，识别、表达、并通过文献研究分析复杂工程问题，以获得有效结论。	2-1 能够应用数学、自然科学和工程科学的基本原理、方法和手段，分析、识别、表达本专业相关的复杂工程问题；	1-2、2-1	H
	2-2 能够应用数学、自然科学和工程科学的基本原理、方法和手段，针对实际复杂工程问题设计针对性的技术方案，并综合运用文献、科学理论和技术手段予以解决。	2-1、2-2	M
3. 设计/开发解决方案：能够设计针对复杂工程问题的解决方案，设计满足特定需求的系统、单元或流程，并能够在设计环节中体现创新意识，考虑社会、健康、安全、法律、文化以及环境等因素。	3-1 能够设计针对本专业相关复杂工程问题的解决方案，能够设计和开发实现特定功能、满足特定需求的信息传输、信号处理或网络通信系统；	1-2、2-1、2-2、3-1	M
	3-2 能够对不同设计方案进行比较和优化，在工作各环节中具有创新意识。	1-2、2-1、2-2	M

四、主要教学内容（中英文内容）

（一）理论教学

第 1 章：Introduction to communication systems（支撑课程目标 1-1、2-2、3-1、3-2）

【1】知识点：

(1) The basic conception of communication.

(2) Functions of blocks in communication systems.

(3) Entropy and information theory.

(4) Channel.

【2】学习目标：

了解：The history and the basic classification of communication systems.

理解：The concept of communication systems, the classification and channel capacity.

掌握：The basic structure of a communication system, calculation of information entropy and the measurement of its performance parameters such as .

【3】重点内容：

The basic structure of communication systems and functions of blocks in communication systems.

【4】难点内容：

The calculation of information entropy.

【5】思政案例：

This discussion spans from the development history of communication to the current state of mobile communication technology. The patents for 2G to 4G mobile communication are primarily held by foreign companies, which restricts the development of China's mobile communication technology. However, in the formulation of 5G and 6G standards, Chinese enterprises have begun to participate actively, with some of their contributions being adopted as international standards.

第 2 章：Signal and random processes（支撑课程目标 1-2、2-2）

【1】知识点：

(1) Signal classifications.

(2) Fourier transform.

(3) Random process and random signal.

【2】学习目标：

了解：Characterization of deterministic signals.

理解：Random processes and linear systems.

掌握：Analysis of random signals.

【3】重点内容：

Power spectral density and energy spectral density.

【4】难点内容：

Analysis of input-output relationships for linear systems.

【5】思政案例：

Carl Friedrich Gauss is a renowned German mathematician and physicist. Gauss made extraordinary achievements in multiple fields. He discovered the prime number distribution theorem and the method of least squares at the age of 17. The standard normal distribution in probability, also known as the Gaussian distribution, is widely used in random signal analysis. By introducing Gauss's contributions, students are encouraged to be proactive and daring in their exploration and innovation.

第 3 章：Analog Modulation（支撑课程目标 1-2、2-1、2-2）

【1】知识点：

(1) Amplitude modulation.

(2) Angle modulation.

(3) Interference in modulation analog modulation.

(4) Performance comparison of analog modulation methods.

【2】学习目标：

了解：Vestigial-sideband (VSB) modulation.

理解：The basic method of anti-noise analysis of linear modulation envelope detection and frequency modulation system.

掌握：The transmitted signal, spectral characteristic, and bandwidth requirement of different modulation methods.

【3】重点内容：

The basic principles and anti-noise performance of AM, DSB, SSB, and FM.

【4】难点内容：

Modeling and anti-noise analysis of amplitude / angle modulation.

【5】思政案例：

This section introduces the history of broadcast development in China. On December 30, 1940, the first radio station established by the Communist Party of China, the Yan'an Xinhua Broadcasting Station began broadcasting. This day is recognized as the anniversary of the founding of the People's Broadcasting Service in China. On March 21, 1947, it was renamed the Shanbei Xinhua Broadcasting Station. On January 31, 1949, with the peaceful liberation of Beiping (now Beijing), the Shanbei Xinhua Broadcasting Station officially took over the Kuomintang's Beiping Broadcasting Station. On March 25, 1949, the Shanbei Station moved to Beiping and was renamed the Beiping Xinhua Broadcasting Station. On December 5, 1949, the Beijing Xinhua Broadcasting Station was officially designated as the Central People's Broadcasting Station. The broadcasting station played a significant role in promoting the Communist Party's policies, helping the world understand the new China. The early equipment utilized shortwave and medium-wave broadcasting.

第 4 章：Digitization of Analog Signal（支撑课程目标 1-2、2-1、2-2）

【1】知识点：

(1) Sampling of analog signal.

(2) Quantization of sampled signal.

(3) Pulse code modulation.

(4) Differential PCM and Delta modulation.

【2】学习目标：

了解：Principles of time division multiplexing.

理解：Principles of differential pulse code modulation and Delta modulation.

掌握：Principles of sampling theorem and methods of quantization, PCM modulation principle and coding method.

【3】重点内容：

Sampling theorem, methods of uniform quantization and non-uniform quantization of signal; Principle and coding method of pulse code modulation.

【4】难点内容：

The proof of the sampling theorem and the principle of pulse code modulation.

【5】思政案例：

Voice communication is an important means of information transmission, and the development of telephones has evolved from analog to digital technology. In 1900, the first indoor telephone in China was introduced in Nanjing. In 1982, China’s first 10,000-line program-controlled telephone exchange, the Japanese F-150, was put into operation in Fuzhou. By 1986, the first local digital program-controlled telephone exchange, the DS-2000, was successfully developed. During the late 1980s and early 1990s, China's telephone system experienced rapid development, importing program-controlled switching products from companies such as SIEMENS, Alcatel, and Ericsson. Domestic companies like Huawei and ZTE also developed homegrown program-controlled exchanges, breaking the foreign monopoly in this field and playing a significant role in the rapid proliferation of telephone services.

第 5 章：Principles of baseband digital data transmission（支撑课程目标 1-2、2-1、2-2）

【1】知识点：

(1) Digital data transmission and symbol code types of baseband digital signals.

(2) Transmission with / without ISI of baseband digital signal.

(3) Eye diagrams.

(4) Channel equalization.

【2】学习目标：

了解：Eye diagrams and channel equalization.

理解：The spectral characteristic of baseband digital signal and the basic structure of baseband communication systems.

掌握：Symbol code types for baseband digital signal; modeling for transmission of baseband digital signal and Zero ISI system.

【3】重点内容：

Pulse shaping: Nyquist's criterion for zero ISI.

【4】难点内容：

Partial-response signals and time-domian equalization.

【5】思政案例：

Network switches use digital baseband transmission and it is a crucial infrastructure of the Internet. In the early days, network switches were primarily dominated by foreign companies such as 3Com and Cisco. In recent years, the network switch products of Huawei, H3C and other domestic companies have developed rapidly, and their market share has gradually increased, which plays an important role in ensuring the security of China's communication infrastructure.

第 6 章：Digital transmission through bandlimited bandpass channels（支撑课程目标 1-2、2-1、2-2）

【1】知识点：

(1) Binary digital modulation.

(2) Performance comparison of different binary digital modulation methods.

(3) M-ary digital modulation.

(4) Performance comparison of different M-ary digital modulation methods.

【2】学习目标：

了解：The basic of MASK/MFSK.

理解：Performance analysis of binary/M-ary modulation.

掌握：The transmitted signal, spectral characteristic, and bandwidth requirement of binary digital modulation systems; the basic of 4PSK and 4DPSK.

【3】重点内容：

The basic and the robustness of binary digital modulation methods (2ASK, 2FSK, 2PSK, 2DPSK).

【4】难点内容：

The basic of binary digital modulation methods (4PSK, 4DPSK).

【5】思政案例：

In the 5G digital communication standard, the Polar code scheme led by Huawei has become the coding standard for the control channel. This has given China a certain level of influence in the field of 5G mobile communication standards.

第 7 章：Channel Coding and Error Control（支撑课程目标 1-2、2-1、2-2）

【1】知识点：

(1) Principles of error control coding.

(2) Common methods of error control coding.

(3) Linear block code and cyclic code.

【2】学习目标：

了解：The sufficient importance of channel coding.

理解：Simple and practical coding methods and their applications.

掌握：Coding algorithm of linear block code and cyclic code.

【3】重点内容：

The basic of error correction code.

【4】难点内容：

Linear block code and cyclic code.

【5】思政案例：

The Hamming Code is named by its inventor, Richard W. Hamming, and it is a type of linear error-correcting code used in information transmission. The Hamming Code still has widespread applications today since it published by Hamming in 1950. It inspires students' enthusiasm for innovation through examples.

第 8 章：Synchronization（支撑课程目标 1-2、2-1、2-2）

【1】知识点：

(1) Carrier synchronization.

(2) Bit/frame synchronization.

【2】学习目标：

了解：Types of synchronization and their applications.

理解：The basic of bit synchronization.

掌握：The methods of carrier synchronization.

【3】重点内容：

The typical methods of synchronization.

【4】难点内容：

Bit synchronization.

【5】思政案例：

By spanning from the synchronization in communication systems to the collaborative cultivation of individuals and ethics in education, this approach emphasizes imparting knowledge of natural sciences while simultaneously integrating moral education.

五、教学安排与学时分配

This course primarily adopts classroom teaching as its instructional form. The classroom instruction focuses on the fundamental concepts, theories, and principles of communication. Centered around the fundamental task of moral education, the course enables students to systematically grasp the working principles of communication systems and methods for performance analysis through their studies. It combines theory with practical applications to cultivate students' abilities to analyze and solve problems while developing their initial capacity to design basic communication systems. The course fully utilizes offline classrooms, software simulations, online resources, and ideological and political case studies to conduct teaching activities, emphasizing both the transmission of theoretical knowledge and value guidance, solidifying foundational knowledge, and enhancing practical skills. The distribution of in-person teaching hours is shown in Table 3

表 3 学时分配表

讲　　课　　内　　容		学时				
		讲课	实验	上机	设计	课外
第 1 章	Introduction to communication systems	4	0	0	0	0
第 2 章	Signal and random processes	8	0	0	0	0
第 3 章	Analog modulation	8	0	0	0	0
第 4 章	Digitization of Analog Signal	8	0	0	0	0

第 5 章	Principles of baseband digital data transmission	8	0	0	0	0
第 6 章	Digital transmission through bandlimited bandpass channels	8	0	0	0	0
第 7 章	Channel Coding and Error Control	8	0	0	0	0
第 8 章	Synchronization	4	0	0	0	0
小计		56	0	0	0	0
总计	56					

六、教学方法

1. The basic principles, analysis methods of communication system are taught to cultivate students' ability of system analysis and design.

2. A teaching method that combines multimedia presentations with traditional blackboard instruction.

3. Combining theoretical teaching with simulations increases students' intuitive understanding and interest in communication systems, while also cultivating their practical skills and problem-solving abilities.

七、成绩评定

The examination of the course is closed-book examination, and the full score is 100. A comprehensive assessment of class attendance, homework, simulation reports, quizzes and final exams.

（1）Points of students' attendance (15% of the total score)

（2）Points of homework (15% of the total score). Students should complete homework on time.

（3）Points of simulation reports (10% of the total score)

（4）Points of quizzes (10% of the total score)

（5）Points of final exams (50% of the total score)

八、评价及持续改进

1. syllabus

Assessment period: 4 years. Revise period: 4 years

Improvement measures: After the course leader organizes discussions with all teachers in the course team to propose improvement suggestions, these suggestions will be reviewed by the head of the teaching and research office and approved by the deputy dean.

2. Achievement assessment

Assessment period: 1 year. Evaluation basis: distribution of students' final points

Improvement measures: The course leader will improve the teaching methods and grading procedures based on the course content, classroom teaching effectiveness, and grade distribution, while optimizing the evaluation methods.

撰写： 闫磊、景春国

审核： 辛凤鸣

批准： 史闻博

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