# 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">3100112015</td></tr>
<tr><td>中文名称</td><td colspan="8">传感、驱动与控制（全英课程）</td></tr>
<tr><td>英文名称</td><td colspan="8">Sensing, Actuation & Control</td></tr>
<tr><td>总学时</td><td>52</td><td rowspan="2">理论学时</td><td rowspan="2">40</td><td rowspan="2">实验学时</td><td rowspan="2">12</td><td rowspan="2">上机学时</td><td rowspan="2">0</td><td rowspan="2">设计学时</td><td rowspan="2">0</td><td rowspan="2">课外学时</td><td rowspan="2">0</td></tr>
<tr><td>学　分</td><td>3</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">C 程序设计基础</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<br>□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">无</td></tr>
<tr><td>参考书及教学资源</td><td colspan="8">1、 Waltenegus Dargie and Christian Poellabauer, Fundamentals of wireless sensor networks: Theory and Practice, John Wiley, 2010</td></tr>
<tr><td>其他说明</td><td colspan="8">无</td></tr>
</table>

## 二、课程简介

中文描述

本课程为旨在帮助学生掌握基本的传感、驱动和控制概念及其实际应用。通过该课程，学生将深入学习和理解无线传感网络及其在现代工程中的应用。课程强调理论与实践相结合，学生将有机会在实验设计中运用所学知识，提升解决现实问题的能力。

在学习过程中，学生将接触到各种传感器和执行器的工作原理，了解如何通过控制算法来实现自动化系统的高效运行。课程内容涵盖传感技术、信号处理、驱动器原理、控制系统设计等核心模块，帮助学生构建一个完整的技术知识框架。

该课程不仅注重技术能力的培养，还鼓励学生在小组项目中发挥创新思维，提出并解决现实问题。通过实际案例分析和项目实践，学生将学会如何在团队中高效协作，掌握有效的沟通技巧和项目管理方法。这些技能将为学生未来在工程领域的职业发展奠定坚实基础。

总之，《传感、驱动与控制》课程不仅提供了深入的技术知识，还培养学生的创新能力和团队合作精神，帮助他们在迅速发展的科技领域中脱颖而出。课程结束时，学生将具备运用无线传感网络和控制技术解决复杂工程问题的能力，为未来的学习和职业发展做好准备。

English Description

The course is designed to equip students with fundamental concepts and practical applications in sensing, actuation, and control. Through this course, students will gain in-depth knowledge and understanding of wireless sensor networks and their applications in modern engineering. Emphasizing a blend of theory and practice, students will have opportunities to apply their knowledge in experimental design, enhancing their ability to solve real-world problems.

Throughout the course, students will explore the working principles of various sensors and actuators and learn how control algorithms can optimize the efficiency of automated systems. Key modules include sensing technology, signal processing, actuator principles, and control system design, enabling students to build a comprehensive technical knowledge framework.

This course not only focuses on technical skills but also encourages students to utilize innovative thinking to identify and solve real-world challenges in group projects. By analyzing real-world cases and engaging in project practices, students will learn how to collaborate effectively in teams, mastering communication skills and project management techniques essential for future careers in engineering.

In summary, the "Sensing, Actuation, and Control" course provides in-depth technical knowledge while fostering innovation and teamwork skills, preparing students to excel in the rapidly evolving field of technology. By the end of the course, students will be equipped to use wireless sensor networks and control technologies to address complex engineering challenges, laying a solid foundation for future learning and career development.

## 三、课程目标

**1、知识目标：**

1-1：掌握基本的传感、无线传感网络，物联网等的概念、分类和应用，了解无线传感网络在物联网中的地位和作用。了解物联网在实际中的应用、云计算和大数据。

1-2：掌握无线传感网络的路由的概念、认识它的分类和实例，并能够根据需求设计搭建。了解无线传感网络的局限，重点认识网络安全和能耗方面的挑战。

1-3：驱动和控制原理，分类，了解应用原型。

**2、能力目标：**

2-1：认识无线传感网络各软件、硬件设备，可以根据实际应用设计相关系统和进行故障排除。

2-2：拥有良好的跨文化和领域的沟通能力，培养能对专业领域的任务进行合理的规划，分解任务并按时、高效率和高质量完成的能力。

**3、德育/素养目标：**

3-1：具有正确的价值观和社会责任感，培养优秀的职业道德和行为规范。获得良好的口头和书面沟通能力，团队协作意识和人际交往能力。

3-2：提高学生的创新意识，不怕困难和有效解决实际问题的能力

**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) |
|---|---|---|---|
| 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。 | 指标点 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； | 1-1、1-2、1-3、2-1 | 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。 | 指标点 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； | 1-1、1-2、2-1 | H |
| 4、研究:能够基于科学原理并采用科学方法对复杂工程问题进行研究，包括设计实验、分析 与解释数据、并通过信息综合得到合理有效的结论。 | 指标点 4-1:能够基于科学原理并采用科学方法，在本专业相关理论指导下对复杂工程问题设计实验进行研究； | 1-2、2-1、2-2、3-1 | M |
| | 指标点 4-2：能够结合本专业知识对实验数据进行分析与解释，设计并优化实验方案，并通过信息综合得到合理有效的结论； | 1-1、1-2、1-3、2-1、2-2 | H |
| | 指标点 4-3：能够追踪国际前沿技术动态，掌握本专业涉及的重要技术指标以及达到指标所需的技术途径。 | 2-1、2-2、3-2 | H |

# 四、主要教学内容

## （一）理论教学

**第 1 章：Introduction**（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】知识点：**

(1) Subject journey and introduction to the course

**(2)** Introduction to IOT (Internet of Things) and its applications

**(3)** Introduction to wireless sensor network (WSN)

**(4)** Sensor, actuator and their characteristics

**【2】学习目标：**

理解：Subject overview and requirements; IOT structure and applications; concept of sensing and actuation

掌握：The concept of IOT and WSN

**【3】重点内容：**

(1) The concept and structure of IOT
(2) The concept of WSN

**【4】难点内容：**

(1) IOT applications
(2) WSN structure

**【5】思政案例：**

(1) Smart City Initiatives: Demonstrates the role of IoT and wireless sensor networks in promoting sustainable urban development.
(2) Quality of Life: Highlights how technology can be leveraged to improve the quality of life for citizens.
(3) Societal Challenges: Illustrates the use of technology to address societal challenges, such as environmental sustainability and public safety.
(4) Social Responsibility: Emphasizes the importance of aligning technological advancements with social responsibility and ethical considerations.

**第 2 章：**Introduction to Sensing Actuation（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】 知识点：**

**(1)** Introduction to lab assignment and requirements Introduction to IOT (Internet of Things) and its applications
**(2)** Introduction to sensing and actuation
**(3)** Introduction to the software used in WSN applications
**(4)** Introduction to the hardware used in WSN applications

**【2】 学习目标：**

理解：Lab assignment and requirements; software and hardware used in WSN applications

掌握：The concept of sensing and actuation; the specific software and hardware used in the assignment of the subject

**【3】 重点内容：**

(1) The specific software and hardware used in the assignment of the subject The concept of IOT

**【4】 难点内容：**

(1) The specific software and hardware used in the assignment of the subject
(2) Actuation

**第 3 章：**Motes and sink Programming（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】 知识点：**

**(1)** Mote programming
**(2)** 6LoWPAN setup

**【2】学习目标：**

理解：Mote programming concept and languages; 6LoWPAN setup

掌握：Contiki VM setup; Motes and sink Programming

**【3】重点内容：**

(1) Contiki VM setup and Motes/Sink Programming

**【4】难点内容：**

(1) Operation methods of related software and hardware

**第 4 章：**Routing in WSN（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【2】 知识点：**

**(1)** Concept of routing, classification and prototypes

**(2)** Routing discovery mechanism

**(3)** hierarchical-based routing

**【2】学习目标：**

(4) 理解：Flat-based routing prototype; Concepts of various routing types and their applications

(5) 掌握：Concept and classification of routing

**【3】重点内容：**

(1) Concept of routing

(2) Routing discovery mechanism

**【4】难点内容：**

(1) Routing classification

(2) flat-based routing

(3) hierarchical-based routing

(4) Location-based routing

**第 5 章：**Introduction to Raspberry Pi（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】知识点：**

**(1)** Raspberry Pi Setup

**(2)** Using Raspberry Pi

**【2】学习目标：**

理解：Introduction to Raspberry Pi and its development history；The function of Raspberry Pi;

掌握：Setup and using of Raspberry Pi

**【3】重点内容：**

(1) The concept of Raspberry Pi

(2) The features of Raspberry Pi

(3) Using of Raspberry Pi

**【4】难点内容：**

**(1)** Configuration of Raspberry Pi

**第 6 章：**Introduction to Data Funneling（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】知识点：**

**(1)** MQTT configuration

**(2)** 6LoWPAN network setup

**(3)** 6LoWPAN network running

**【2】学习目标：**

理解：Concept of MQTT ; 6LoWPAN network concept and application；

掌握：6LoWPAN network setup and running

**【3】重点内容：**

(1) 6LoWPAN network setup and running

**【4】难点内容：**

(1) 6LoWPAN network setup and running

**第 7 章：**Security in WSN（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】知识点：**

**(1)** The concept and importance of wireless sensor network security

**(2)** CIA model, Challenges of Security in WSN, classification of attacks, attacks on routing

**(3)** WSN attacks on different layers, countermeasures

**【2】学习目标：**

理解：The concept and importance of wireless sensor network security；WSN attacks on different layers, classification, and countermeasures

掌握：CIA model, Challenges of Security in WSN and attacks on routing

**【3】重点内容：**

(1) CIA model

**【4】难点内容：**

(1) Countermeasures in routing attacks

**第 8 章：**NodeRed Setup & Database Implementation（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】知识点：**

**(1)** NodeRed Setup

**(2)** Database Implementation

**【2】学习目标：**

理解：Concept of NodeRed，Application cases of NodeRed

掌握：NodeRed Setup & Database Implementation

**【3】重点内容：**

(1) NodeRed Setup & Database Implementation

**【4】难点内容：**

(1) NodeRed Setup & Database Implementation

**第 9 章：**UI Configuration and Extension Activities NodeRed（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】知识点：**

**(1)** UI Configuration

**(2)** Extension Activities

**【2】学习目标：**

理解：The importance of UI setup ；UI Configuration approaches

掌握：UI Configuration and Extension Activities

**【3】重点内容：**

(1) UI Configuration and Extension Activities

**【4】难点内容：**

(1) UI Configuration and Extension Activities

**第 10 章：**Actuators（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】知识点：**

**(1)** Introduction to control and actuators

**(2)** Concept of Actuation

**(3)** Actuator classification and applications

**【2】学习目标：**

理解：Application examples of actuators ; Classification of actuators

掌握：Concepts control and actuation

**【3】重点内容：**

(1) Concepts control and actuation

**【4】难点内容：**

(1) Actuators operation and systems

**第 11 章：**Energy Efficiency and Harvesting（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】知识点：**

**(1)** Resource Management in WSN (Energy efficiency)

**(2)** Energy efficiency challenges and constrains

**(3)** IoT network architecture, IOT hardware structure, importance of energy efficiency and issues

**【2】学习目标：**

理解：Powering IOT Devices (Energy Harvesting and wireless power transfer); IoT network architecture, IOT hardware structure, importance of energy efficiency and issues

掌握：Resource Management in WSN (Energy efficiency)

**【3】重点内容：**

(1) Resource Management in WSN (Energy efficiency)

**【4】难点内容：**

(1) Energy efficiency challenges and constrains

**第 12 章：**Intelligent IOT in industries and smart cities & case study（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】知识点：**

(1) Basics of IoT: What it is and how it works.

(2) Smart Cities: Key IoT applications (e.g., traffic, energy).

(3) Industrial IoT: Examples in automation and monitoring.

**【2】学习目标：**

理解：What IoT is and its importance, IoT's role in smart cities and industries, Examples of IoT systems in daily life.

掌握：Identifying IoT applications in smart cities, Recognizing industrial IoT use cases, Benefits of IoT for real-time monitoring and efficiency.

**【3】重点内容：**

(1) IoT enables real-time data collection and automation.

(2) Smart cities use IoT for traffic, energy, and public services.

(3) Industrial IoT improves efficiency and safety in manufacturing.

**【4】难点内容：**

(1) Ensuring data security and privacy in IoT systems.

(2) Managing large-scale IoT device networks.

(3) High costs and complexity of IoT implementation.

**第 13 章：**Cloud computing and big data（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】知识点：**

(1) Basics of Cloud Computing: What and why.

(2) Introduction to Big Data: Characteristics and examples.

(3) Cloud Storage Basics: How data is stored online.

**【2】学习目标：**

理解：What cloud computing and big data mean, Basic uses of cloud services, Simple examples of big data in everyday life.

掌握：Identifying cloud storage and sharing benefits, Recognizing common big data applications, Basic data security practices.

**【3】重点内容：**

(1) Cloud as Online Storage.

(2) Big Data in Everyday Life (e.g., social media).

(3) Benefits of Cloud for easy access and sharing.

**【4】难点内容：**

(1) Data security basics (keeping data safe).

(2) Cost considerations for cloud services.

(3) Managing large data files efficiently.

**第 14 章：**Technical writing, project report and tutorial project Q&A（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】知识点：**

(1) Technical Writing Basics: Clear, concise, and objective writing style.

(2) Project Report Structure: Key sections (introduction, methodology, results, conclusion).

(3) Effective Q&A Skills: Strategies for answering questions concisely and confidently.

**【2】学习目标：**

理解： The purpose and components of technical writing, The organization of a well-structured project report, Effective communication strategies for Q&A sessions.

掌握：Writing clear and organized technical documents, Structuring and formatting a project report effectively, Answering questions with clarity and precision in Q&A sessions.

**【3】重点内容：**

(1) Writing concisely and avoiding jargon in technical documents.

(2) Including key sections and data in a project report.

(3) Preparing for common questions and answers in project Q&A.

**【4】难点内容：**

(1) Ensuring technical writing is accessible to all readers.

(2) Structuring a report to present information logically and clearly.

(3) Handling unexpected questions confidently in Q&A sessions.

**第 15 章：**Students presentation and feedbacks（支撑教学目标 1-1、1-2、1-3、2-2、3-1）

**【1】知识点：**

(1) Presentation Skills: Structuring content and engaging the audience.

(2) Understanding Teacher Feedback: Interpreting constructive criticism.

(3) Improvement Through Feedback: Using feedback to enhance skills.

**【2】学习目标：**

理解：Essential elements of a strong presentation, How to interpret teacher feedback effectively, The role of feedback in skill improvement.

掌握：Delivering organized, engaging presentations, Applying teacher feedback to improve future presentations, Developing a positive attitude towards constructive criticism.

【3】重点内容：

(1) Presenting with clarity and confidence.
(2) Recognizing actionable points in teacher feedback.
(3) Using feedback as a growth tool.

【4】难点内容：

(1) Managing presentation anxiety.
(2) Understanding and accepting constructive feedback.
(3) Implementing feedback to make noticeable improvements.

（二）实验教学

表 2　实验教学信息表

| 序号 | 实验项目名称 | 实验学时 | 每组人数 | 实验类型 | 实验性质 |
|---|---|---|---|---|---|
| 1 | Introduction to lab assignment and software/hardwares of WSN project | 2 | 4-5 | Comp | Elec |
| 2 | Contiki VM setup and Motes / Sink Programming | 2 | 4-5 | Verify | Elec |
| 3 | Raspberry Pi Setup | 2 | 4-5 | Verify | Elec |
| 4 | MQTT configuration | 2 | 4-5 | Verify | Elec |
| 5 | NodeRed Setup & Database Implementation | 2 | 4-5 | Design | Elec |
| 6 | UI Configuration and Extension Activities | 2 | 4-5 | Design | Elec |

实验项目一：**Introduction to WSN software and hardware and tutorial/lab overview**（支撑教学目标 1-2、2-1、2-2、3-1、3-2）

【1】实验内容：

(1) Tutorial/lab overview and group forming
(2) The assignment goal and requirements of experimental design
(3) Introduction to the software and hardware knowledge that may be used

【2】实验目的：

(1) Group the experimental projects,
(2) Understand the purpose and requirements of experimental design
**(3)** Learn the knowledge of software and hardware that may be used

【3】教学要求：

(1) Complete grouping F
(2) Fully understand the requirements of experimental design
(3) Download and install Softwares
(4) Get familiar with the hardwares

【4】实验方式：　Programming.

【5】实验场地与设备：　Laboratory, Computer.

实验项目二：**Motes and sink Programming**（支撑教学目标 1-2、2-1、2-2、3-1、3-2）

【1】实验内容：

(1) Contiki VM setup.
(2) Motes Programming
(3) Sink Programming

**【2】实验目的：**

(1) Familiar with Contiki VM setup
(2) Mote and Sink Programming

**【3】教学要求：**

(1) The method of programming
(2) Independent team completion

**【4】实验方式：** Programming.

**【5】实验场地与设备：** Laboratory, Computer.

**实验项目三：Raspberry Pi Setup**（支撑教学目标 1-2、2-1、2-2、3-1、3-2）

**【1】实验内容：**

(1) Raspberry Pi Setup

**【2】实验目的：**

(1) Raspberry Pi Setup and debugger

**【3】教学要求：**

(1) The method of programming
(2) Independent team completion

**【4】实验方式：** Programming.

**【5】实验场地与设备：** Laboratory, Computer.

**实验项目四：MQTT configuration**（支撑教学目标 1-2、2-1、2-2、3-1、3-2）

**【1】实验内容：**

(1) Setup and running of 6LoWPAN network

**【2】实验目的：**

(2) Performing MQTT configuration

**【3】教学要求：**

(1) MQTT/IBM Cloud Config
(2) Independent team completion

**【4】实验方式：** Programming.

**【5】实验场地与设备：** Laboratory, Computer.

**实验项目五：NodeRed Setup & Database Implementation**（支撑教学目标 1-2、2-1、2-2、3-1、3-2）

**【1】实验内容：**

(1) NodeRed Setup
(2) Database Implementation

**【2】实验目的：**

(1) Mastery of NodeRed Setup & Database Implementation

**【3】教学要求：**

(1) NodeRed Setup
(2) Independent team completion

**【4】实验方式：** Programming.

**【5】实验场地与设备：** Laboratory, Computer.

**实验项目六：UI Configuration and Extension Activities**（支撑教学目标 1-2、2-1、2-2、3-1、3-2）

**【1】实验内容：**

(1) UI Configuration

(2) Extension Activities

**【2】实验目的：**

(2) Complete UI Configuration

**【3】教学要求：**

(1) UI configuration

(2) Independent team completion

**【4】实验方式：** Programming.

**【5】实验场地与设备：** Laboratory, Computer.

## 五、教学安排与学时分配

**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 | 2 | 0 | 0 | 0 | 0 |
| 第 2 章 | Introduction to sensing actuation | 2 | 2 | 0 | 0 | 0 |
| 第 3 章 | Mote and Sink programming | 2 | 2 | 0 | 0 | 0 |
| 第 4 章 | Routing in WSN | 6 | 0 | 0 | 0 | 0 |
| 第 5 章 | Introduction to Raspberry Pi | 2 | 2 | 0 | 0 | 0 |
| 第 6 章 | Introduction to Data Funneling | 2 | 2 | 0 | 0 | 0 |
| 第 7 章 | Security in WSN | 2 | 0 | 0 | 0 | 0 |
| 第 8 章 | NodeRed Setup & Database Implementation | 2 | 2 | 0 | 0 | 0 |
| 第 9 章 | UI Configuration and Extension Activities | 2 | 2 | 0 | 0 | 0 |
| 第 10 | Actuator | 2 | 0 | 0 | 0 | 0 |
| 第 11 章 | Energy Efficiency and Harvesting | 4 | 0 | 0 | 0 | 0 |
| 第 12 章 | Intelligent IOT in industries and smart cities & case study | 2 | 0 | 0 | 0 | 0 |
| 第 13 章 | Cloud computing and big data | 2 | 0 | 0 | 0 | 0 |
| 第 14 章 | Technical writing, project report and tutorial project Q&A | 2 | 0 | 0 | 0 | 0 |
| 第 15 章 | Students presentation and feedbacks | 3 | 0 | 0 | 0 | 0 |

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|---|---|---|---|---|---|---|
| 小计 | | 40 | 12 | 0 | 0 | 0 |
| 总计 | 52 | | | | | |

## 六、教学方法

1、Multi-media-based lecturing
2、Combining theory with industrial practical problems
3、Knowledge delivery with ethic education
4、Problem-based learning

## 七、成绩评定

1. This course is an assessment-based course and is graded on a percentage scale. The final grade is a comprehensive evaluation based on regular performance, mid-term test scores, and final paper & oral presentation scores.

(1) Regular performance accounts for 30%, which mainly includes classroom performance, attendance, and overall evaluation.

(2) Mid-term test scores account for 20%, mainly including three online quizzes.

(3) Final scores account for 50%, mainly based on the group-based final paper & oral presentation scores.

2. Students who miss more than 1/3 of the required experiments or assignments, or have absences exceeding 1/3 of the scheduled class hours, or fail the laboratory assessment, will be disqualified from the course assessment.

## 八、评价及持续改进

1. Teaching Syllabus

- Assessment Cycle: 4 years
- Revision Cycle: 4 years
- Improvement Measures: The course leader organizes a discussion with all teachers in the course team to propose improvement suggestions. These suggestions are then reviewed by the department head and approved by the Dean of the School.

2. Grading and Assessment

- Assessment Cycle: 1 academic year
- Evaluation Basis: Comprehensive analysis of students' final grades
- Improvement Measures: Based on the distribution of students' final grades, make appropriate content adjustments and optimizations, and improve teaching methods.

撰写：　于瑶

审核：　辛凤鸣

批准：　史闻博

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