Aviation and Aerospace Engineering

Course type	Course Code	Course Title	Hours	Credits	Semester	College	Remark
Compulsory Course	6A120007L	Chinese Culture	45	3	Spring	Col. of Foreign Languages	
	8A080002L	Linear Algebra in System and Control Theory	60	4	Spring	Col. of Science	Compulsory for master Students
Optional Course	6B015003L	Environment Control System for Aircraft and Refrigerant Technology	48	3	Spring	Col. of Aerospace Engineering	
	8B015001L	Advanced Two-phase Flow and Heat Transfer	48	3	Spring	Col. of Aerospace Engineering	
	7D013009L	Mechanical Vibration Theory	48	3	Spring	Col. of Aerospace Engineering	
	7D022011L	Contemporary Technology of Turbulence Measurement	40	2.5	Spring	Col. of Energy & Power Engineering	
	6B072003L	Air Transportation System Analysis and Modelling	48	3	Spring	Col. of Aviation	
	7D071003L	Human Factors in ATC	32	2	Spring	Col. of Aviation	
	6B151002L	Space Robotics	40	2.5	Spring	Col. of Astronautics	

Course Code：6A120007L

Course Title(Chinese)：中国文化

Course Title(English)：Chinese Culture

College and Department：Col. of Foreign Languages
Semester：Spring
Class Hours：45
Teaching Methods：Lecture
Suitable Majors: International postgraduates
Assessment Instruments：Report
Pre-requisites：Elementary Chinese

1.Course Objective and Requirements

In the time of globalization, cross-cultural communication appears to be more and more important for nowadays students. With the rapid growth of Chinese economy, China now once again stands up on the world stage. The world is looking at China, and eager to know about this old and young, traditional but fashionable country, especially for the international students. Therefore it's necessary for overseas students to know something about Chinese culture and tradition, which will greatly help them to adapt themselves to the life in China.

After the 12 weeks of lectures and presentations, students of this class are expected to be familiar with some aspects of Chinese culture mentioned in the textbook. Furthermore, the students are recommended to make some comparative studies between Chinese culture and western culture.

2.Course Content and Schedule

Unit 1 The Origin of Chinese Culture 中国文化溯源（4 小时）
1.1Chinese Culture 祠 ast and Present 中国文化—传统与现代
1.2The Appellation of China 国名由来
1.3Chinese Mythology 神话传说
1.4Cultural Mosaic 文化常识
Heavenly Stems and Earthly Branches 天干地支
The Twenty-four Solar Terms 二十四节气
Chinese Zodiac 十二生肖
Unit 2 Chinese Language 中国的语言（4 小时）
2.1Han Chinese Language 汉语
2.2The Chinese Written Language 中国的文字
2.3The Origins of Chinese Writing 汉字的源流
2.4Chinese Calligraphy 书法
2.5Chinese Seals 印章
2.6Traditional System & Simplified System 繁体与简体
2.7 Cultural Mosaic 文化常识
The Chinese Character Classification 六书
The Components of Characters 偏旁部首
Four Treasures of the Study 文房四宝
Lanting Xu by Wang Xizhi 王羲之的《兰亭序》
Unit 3 Ancient Capitals and Heritages 古都与文化遗产（4 小时）
3.1The Seven Great Ancient Capitals 七大古都
3.2Tourist Resources in China 旅游资源
3.3Cultural Mosaic 文化常识
The Great Wall of China 长城
The Forbidden City 紫禁城
Terracotta Army 兵马俑
China's Top Ten 中国的"十大之最"
Unit 4 Crafts and Skills 传统工艺（4 小时）

4.1Traditional Chinese Crafts 传统工艺品
4.2Jade Culture 玉文化
4.3Ancient Chinese Bronze 青铜器
4.4Chinese Silk 丝绸
4.5Chinese Embroidery 刺绣
4.6Chinese Porcelain 瓷器
4.7Chinese Knots 中国结
4.8Paper Cuttings 剪纸
4.9 Cultural Mosaic 文化常识
Si Mu Wu Ding 司母戊鼎
Galloping Horse Overtaking a Flying Swallow 马踏飞燕
Unit 5 Traditional Sports and Athletics 传统运动与竞技（4 小时）
5.1Traditional Sports 传统运动
5.2Chinese Martial Arts 中国武术
5.3Taijiquan 太极拳
5.4Cuju 蹴鞠
5.5Qigong 气功
5.6Chinese Chess 象棋
5.7Traditional Acrobatic Acts 传统杂技
5.8Cultural Mosaic 文化常识
Five-Animal Play 五禽戏
The Mongolian Horsemanship 蒙古马术
Martial Arts in Popular Culture 流行文化中的武术
Unit 6 Ancient Science and Technology 中国古代科技（4 小时）
6.1History of Science and Technology 科技简史
6.2Early Technological Achievements 早期科技成就
6.3The Four Great Inventions 四大发明
6.4Scientific Achievements in the Middle Ages 中古科学发明
6.5Mongol Transmission & Jesuit Activity 科技传播与交流
6.6Joseph Needham 李约瑟
6.7Science and Technology in the PRC 现代科技发展
6.8 Cultural Mosaic 文化常识
Science and Civilization in China Series 李约瑟的《中国科学技术史》
Unit 7 Operas and Music 戏曲与音乐（4 小时）
7.1Chinese Opera 中国戏曲
7.2Kunqu Opera 昆曲
7.3Introduction of Beijing Opera 京剧简介
7.4Quyi 曲艺
7.5Chinese Music 中国音乐
7.6Butterfly Lovers 梁祝
7.7Legend of the White Snake 白蛇传
7.8 Cultural Mosaic 文化常识
The Story of High Mount Flowing Water 高山流水
Changing Faces 变脸
The Meaning of Colors in Chinese Opera Masks 脸谱的含义
Bronze Chime-Bells of Marquis Yi of the Zeng State 曾侯乙编钟
Unit 8 Education and Aesthetics 古代教育与审美（4 小时）
8.1Education in Ancient China 中国古代教育
8.2Imperial Examination 科举考试
8.3Institutions of Higher Education 古代高等教育衍变
8.4Chinese Aesthetics 中国人的审美观
8.5Chinese Painting 国画
8.6Ancient Chinese Architecture 古代建筑
8.7Cultural Spirit in Classical Gardens 古典园林的文化内涵

8.8 Cultural Mosaic 文化常识
Some Details of the Imperial Examination 科举考试细则
Academies of Classical Learning 四大书院
Wu Daozi, Sage in Chinese Painting 画圣吴道子
Unit 9 Thoughts and Philosophy 思想与哲理（4 小时）
9.1Traditional Philosophy 传统哲学
9.2Confucius 孔子
9.3Confucianism, Taoism and Buddhism 儒、道、释
9.4Neo-Confucian Zhu Xi 理学家朱熹
9.5Harmony between Man and Nature 天人合一
9.6 Cultural Mosaic 文化常识
Laozi and Zhuangzi 老子与庄子
Mencius 孟子
Four Books and Five Classics 四书五经
Unit 10 Religions and Beliefs 宗教与信仰（4 小时）
10.1What Do Chinese People Believe in? 中国人的信仰
10.2Heaven Worship 祭天
10.3Ancestor Worship 拜祖
10.4Taoism in China 道教
10.5Buddhism in China 佛教
10.6Feng Shui 风水
10.7 Cultural Mosaic 文化常识
The God of Wealth 财神
King Yam 阎王
The God of Kitchen 灶神
The Matchmaker 月老
Unit 11 Exchanges with Foreign Countries 中外往来述要（4 小时）
11.1The Silk Road 丝绸之路
11.2The Influences of Silk Road 丝绸之路的影响
11.3The Tea Horse Road 茶马古道
11.4Zheng He’s Voyages 郑和下西洋
11.5Did Zheng He Discover the World? 郑和发现了世界？
11.6 Cultural Mosaic 文化常识
Great Ming Amalgamated Map 《大明混一图》
Jian Zhen 鉴真东渡
Matteo Ricci 利玛窦
Unit 12 Review 复习（1 小时）

2.Textbooks

《中国文化概览》 *A Panoramic View of Chinese Culture* 编著 吴鼎民，译林出版社，2010 年

Written by：WANG Zheng（王征）
Instructor：LIANG Hongfei（梁红飞）,WANG Zheng（王征）, et al.

Course Code：8A080002L

Course Title(Chinese)：系统与控制理论中的线性代数

Course Title(English)：Linear Algebra in System and Control Theory

College and Department：Col. of Science
Semester：Spring
Class Hours：60
Teaching Methods：Lecture, Homework
Suitable Majors: All Specialities in Engineering
Assessment Instruments：Examination, Project
Pre-requisites：Linear Algebra, Matrix Theory

1. Course Objective and Requirements

The theories and methods of linear algebra are indispensable to science and technology, are especially fundamental to studying modern system and control theory. In this course, the theories, methods of linear algebra with applications to system and control are introduced. The main contents may be divided into three parts. The first part is the basic concepts of modern mathematics including mapping, algebraic operation, group, ring，field and so on. The second part is contains the theories and methods of linear algebra including linear space, subspace, linear mapping and transformation, inner product space, orthogonal projection, normed space, best approximation and so on. The third part contains some topics of numerical linear algebra including matrix factorizations, generalized inverse of a matrix, matrix equation, least squares problem, total least squares problem, matrix perturbation analysis and so on. Course objectives: enhance the mathematical quality of graduates, provide the mathematical foundations for studying follow-up courses and carrying out scientific research.

2. Course Content and Schedule

Chapter 1 Basic Concepts（8h）
- 1.1 Sets
- 1.2 Mapping
- 1.3 Algebraic Operations
- 1.4 Homomorphism and Isomorphism
- 1.5 Equivalence and Classification of Set
- 1.6 Ordered Spaces
- 1.7 Metric Spaces

Chapter 2 Groups （8h）
- 2.1 Basic Concepts of Groups
- 2.2 Subgroups
- 2.3 Homomorphism and Isomorphism of Groups
- 2.4 Normal Subgroups and Quotient Groups
- 2.5 Groups of Transformations

Chapter 3 Rings and Fields （4h）
- 3.1 Basic Concepts of Rings
- 3.2 Subrings and Homomorphism of Rings
- 3.3 Ideals and Quotient Rings
- 3.4 Fields

Chapter 4 Linear Spaces （10h）
- 4.1 Linear Spaces
- 4.2 Subspaces
- 4.3 Homomorphism and Isomorphism of Linear Spaces
- 4.4 Linear Manifold and Quotient Spaces
- 4.5 Modules and Linear Algebra
- 4.6 Invariant Subspaces

Chapter 5 Inner Product Spaces （6h）
- 5.1 Inner Product Spaces
- 5.2 Gram-Schmidt Orthogonalization and QR factorization
- 5.3 Orthogonal Projection and Best Approximation
- 5.4 Linear Transformations of Inner Product Spaces

Chapter 6 Normed Linear Spaces（6h）
- 6.1 Normed Linear Spaces
- 6.2 Best Approximation
- 6.3 Banach Spaces
- 6.4 Norms of Linear Operators and Matrices

Chapter 7 Generalized Inverse and Least Squares Problems（10h）
- 7.1 Matrix Factorizations
- 7.2 Singular Value Decomposition and Its Generalization
- 7.3 Generalized Inverse of a Matrix
- 7.4 Linear Least Squares Problem
- 7.5 Total Least Squares Problem
- 7.6 Robust Least Squares Problem
- 7.7 Matrix Approximation with Constraints
- 7.8 Matrix Perturbation Analysis

Chapter 8 Matrix Functions and Matrix-Valued Functions（4h）
- 8.1 Matrix Functions
- 8.2 Matrix-Valued Functions with Applications
- 8.3 Eigenvalue Sensitivity Analysis with Applications

Chapter 9 Matrix Equations and Matrix Inequalities （4h）
- 9.1 Kronecker Product of Matrices
- 9.2 Linear Matrix Equations
- 9.3 Algebraic Riccati Equations
- 9.4 Matrix Inequalities
- 9.5 Pole Assignment Problems

2. Textbooks

(1) Lancaster P, Tismenetsky M. The Theory of Matrices with Applications. Academic Press, 1985.
(2) Greub W. Linear Algebra. Springer-Verlag，1981.

Main Reference Books

(1) Horn R A, Johnson C R. Matrix Analysis. Cambridge University Press, 1985.
(2) Golub G H, Van Loan C F. Matrix Computation. Third Edition, The John Hopkins University Press, 1996.

Written by：DAI Hua（戴华） **Instructor**：DAI Hua（戴华）

Course Code：6B015003L

Course Title(Chinese)：飞行器环境控制与制冷技术

Course Title(English)：Environment Control System for Aircraft and Refrigerant Technology

College and Department：Col. of Aerospace Engineering

Semester：Spring

Course hours：48

Teaching methods：Lecture, Experiment, Project

Suitable majors: Aerospace Engineering, Cryogenics and Refrigeration, Heating, Ventilation and Air conditioning

Assessment instruments：Examination, Assignments, Class performances

Pre-requisites：Heat transfer, Thermodynamics, Fluid mechanics, Fundamentals of refrigeration and air-conditioning

1. Course objective and requirements

The aircraft environmental control (ECS) and refrigeration is vital to modern aircraft, building systems, and vehicle systems because of increasing comfort level for commercial airliners and vehicles, intensive avionics cooling for military aircraft, and energy saving requirements for buildings.

This course mainly focuses on fundamentals of the aircraft ECS and components, refrigeration principles and systems. Fundamentals of aircraft ECS mainly include atmosphere, phycrometrics, energy equation and air conditioning processes. Fundamentals of refrigeration mainly contain refrigeration principles, including air cycle, CO_2 transcritical cycle, and experiment-based modeling methods. An aircraft ECS consists of various subsystems such as refrigeration subsystem, heating subsystem, bleed air subsystem, ventilation subsystem, temperature control subsystem, and so on, among which the emphasis is placed on aircraft air cycle refrigeration subsystems because of the difficulty and importance of aircraft cooling requirements. Aircraft environmental control components mainly include heat exchangers, turbines, compressors and fans. Refrigeration mainly focuses on the refrigeration principles discussed in the Aircraft ECS. Students are required not only to firmly master in-course knowledge, but also to have practical engineering experience in experiments and system designs for them to be prepared for their future study and professional career.

2. Course contents and Schedules

0 Introduction to Aircraft ECS（2h）

0.1 Types of Aircraft ECS

0.2 Functions and constituents of Aircraft ECS

0.3 Relationships between Aircraft ECS and ground air-conditioning and refrigeration

Unit 1 Atmosphere and Climatic Design Conditions (5h)

1.1 Atmosphere

1.2 Atmospheric Pressure and Standard Atmosphere

1.3 Climatic Design Conditions for Aircraft Environmental Control

Unit 2 Psychrometrics and Steady Flow Energy Equation （8h）

2.1 Compositions of dry and moisture air

2.2 Thermodynamic parameters of moisture air

2.3 Psychrometric charts

2.4 Steady flow energy equation

2.5 Use of psychromatric charts and steady flow energy equation

Unit 3 CO_2 supercritical refrigeration and experiment-based modeling (6h)

3.1 Introduction

3.2 CO_2 transcritical cycle

3.3 Heat transfer and pressure drop in gas coolers

3.4 Heat transfer and pressure drops in evaporators

3.5 Suggestions

Unit 4 Refrigeration Components and Design (8h)

4.1 Heat exchanges

4.2 Cooling turbines

4.3 Fans

4.4 Compressors

Unit 5 Air Cycle Refrigeration Systems and ECS (11h)

5.1 Introduction

5.2 Simple air cycle systems

5.3 Bootstrap air cycle systems

5.4 Regenerative air cycle systems

5.5 Three wheel air cycle systems

4.6 Closed loop air cycle systems

5.7 Reverse bootstrap air-cycle refrigeration systems

5.8 High pressure water separation air cycle systems

5.9 Four wheel air cycle systems

5.10 All-electric air cycle systems

Unit 6 Air Cycle Refrigeration Systems Design (8h)

6.1 Basic equations

6.2 Design of three wheel high pressure water separation air cycle systems

3. **Experiments and Projects** (8 h)

(1) Experiment 1: Atmosphere (2h)

In this lab assignment, students are to measure the variation of atmospheric pressure with altitude and investigate the relationship of the temperature and pressure of the boiling point of water

(2) Experiment 2: High pressure water separation air cycle systems (2h)

In this lab assignment, students are to get familiar with experimental methods for aircraft ECS, to experience the temperature and pressure distributions in the tested system, and to validate the computational results of the aircraft ECS with the experimental data to strengthen the understanding of the ECS.

(3) Project 1：Design of three-wheel high pressure water separation air cycle systems (4h)

In this project, students design a three wheel high pressure water separation air cycle refrigeration systems at the given conditions

4. Textbook and references

Textbook

Xiande Fang. Aircraft environmental control systems. NUAA, 2010.

References

[1] SAE, Aerothermodynamic Systems Engineering and Design, 2004.

[2] ASHRAE, Handbook-Fundamentals. ASHRAE, 2001.

Written by: FANG Xiande（方贤德） **Lecturer:** FANG Xiande（方贤德）

Course Code：8B015001L

Course Title (Chinese)：高等两相流与传热

Course Title (English)：Advanced Two-phase Flow and Heat Transfer

College and Department：Col. of Aerospace Engineering

Semester：Spring

Course Hours：48

Teaching Methods：Lecture, Project

Suitable Majors: Aerospace Engineering, Engineering thermophysics, Thermal power engineering, Heating, Ventilation and Air conditioning

Assessment Instruments：Examination, Assignments, Class performances

Pre-requisites：Heat transfer, Thermodynamics, Fluid mechanics, Fundamentals of refrigeration and air-conditioning

1. Course Objective and Requirements

Two-phase flow and heat transfer is important in many industrial sectors, such as aeronautical and astronautical engineering, thermal engineering, power engineering, and building systems. This course mainly focuses on fundamentals of gas-liquid two-phase flow and heater transfer in channels. The main contents include concepts and basic parameters of two-phase flow, two-phase flow patterns and flow pattern maps, friction drops of two-phase flow, pool boiling heat transfer, subcooled flow boiling heat transfer, saturated flow boiling heat transfer, and two-phase flow and heat transfer under microgravity and hypergravity. Students are required not only to firmly master in-course knowledge, but also to have practical engineering experience in experiments and model development to be prepared for their professional career.

2. Course Contents and Schedules

0 Introduction (2h)
- 0.1 Concept of two-phase flow
- 0.2 Macro-scope physical parameters of two-phase flow
- 0.3 Dimensionless parameters of two-phase flow

1 Two-phase flow patterns (5h)
- 1.1 Two-phase flow patterns and flow pattern maps of upward vertical flow
- 1.2 Flow pattern maps of upward vertical flow
- 1.3 Two-phase flow patterns of horizontal pipe flow
- 1.4 Flow pattern maps of horizontal pipe flow

2 Friction pressure drops of two-phase flow (7h)
- 2.1 Introduction to friction pressure drops of two-phase flow
- 2.2 Friction pressure drops of single-phase flow
- 2.3 Approaches for calculation of friction pressure drops of two-phase flow
- 2.4 Correlations for friction pressure drops of two-phase flow
- 2.5 Evaluation of correlations for friction pressure drops of two-phase flow

3 Pool boiling heat transfer（6h）
- 3.1 Concept and mechanism of pool boiling
- 3.2 Models of heat transfer coefficient (HTC) of nucleate pool boiling
- 3.3 Critical heat flux (CHF) of pool boiling
- 3.4 Film pool boiling heat transfer

4 Flow boiling process and critical heat flux (6h)
- 4.1 Flow boiling process
- 4.2 Mechanisms and affecting factors of flow boiling CHF
- 4.3 Correlations of flow boiling CHF
- 4.4 Evaluation of correlations for flow boiling CHF

5 Subcooled flow boiling heat transfer (6h)

5.1 Characteristics of subcooled flow boiling heat transfer
5.2 Onset of nucleate boiling
5.3 Onset of significant void
5.4 HTC correlations of subcooled flow boiling
5.5 Evaluation of correlations for subcooled flow boiling HTC
6 Heat transfer coefficients of saturated flow boiling (8h)
6.1 Types of correlations of saturated flow boiling HTC
3.2 General correlations for saturated flow boiling heat transfer
3.3 Specific correlations for CO_2 saturated flow boiling heat transfer
3.4 Evaluation of correlations for saturated flow boiling HTC
7 Two-phase flow and heat transfer under various gravities (8h)
7.1 Introduction
7.2 Two-phase friction pressure drop under microgravity
7.3 Flow boiling heat transfer under microgravity
7.4 Two-phase friction pressure drop under hypergravity
7.5 Flow boiling heat transfer under hypergravity

3. Experiments and Projects

(1) Experiment 1: Two-phase flow and heat transfer under normal gravity (4h)

In this lab assignment, students are to measure pressure drops and heat transfer coefficients of gas-liquid two-phase flow boiling under normal gravity and to learn data reduction and experiment based modeling methods.

(2) Experiment 2: Two-phase flow and heat transfer under hypergravity (4h)

In this lab assignment, students are to measure pressure drops and heat transfer coefficients of gas-liquid two-phase flow boiling under normal gravity and to learn data reduction and experiment based modeling methods

(3) Project 1：Experiment based modeling of two-phase flow friction pressure drops or boiling HTC (12h)

In this project, students are to review a chosen subject, collect experimental data, and then develop a correlation.

4. Textbook and References

1. 方贤德. 高等两相流与传热.
1. S. Mostafa Ghiaasiaan. Two-phase flow, boiling and condensation in conventional and miniature systems.
Cambridge University Press, Cambridge, UK, 2008.

Written by: FANG Xiande（方贤德） **Lecturer:** FANG Xiande（方贤德）

Course Code：7D013009L

Course Title(Chinese)：机械振动理论

Course Title(English)：Mechanical Vibration Theory

College and Department：Col. of Aerospace Engineering

Semester：Spring

Class Hours：48

Teaching Methods：Lecture, Homework

Suitable Majors: Mechanical Engineering, Engineering Mechanics, Aerospace Engineering

Assessment Instruments：Examinations

Pre-requisites：Matrix Algebra, Random Signal Processing, Material Mechanics, Theoretical Mechanics

1.Course Objective and Requirements

This "Mechanical Vibration Theory" is one of the core courses for the postgraduates in fields of mechanics, mechanical engineering, aerospace engineering and vehicle engineering. After studying of this course, the students are expected to have a good grasp of systematic knowledge of mechanical vibration theory, the analysis methods and application skills to engineering practice. It is required for the students to understand typical vibration system's dynamic behaviours, know how to establish a vibration model, carry out modal analysis. Based on that, students should be familiar with approximation methods for vibration problem solving, vibration isolation techniques, rotational system vibration, vibration suppression using viscoelastic damping materials, random vibration analysis and elements of nonlinear system vibration.

2.Course Content and Schedule

Chapter 1 Introduction and Basis（6h）
- 1.1 Vibration problems in engineering and their purposes
- 1.2 Classification of vibration problems
- 1.3 Basis of mechanical vibration theory
- 1.4 Single-DOF systems
- 1.5 Two-DOF systems

Chapter 2 Multi-DOF system vibrations （8h）
- 2.1 Equation of motion of M-DOF systems
- 2.2 Undamped system free vibrations
- 2.3 Undamped system forced vibrations
- 2.4 proportional damping system vibrations
- 2.5 General viscous damping system vibrations
- 2.6 Mode analysis and its approximate numerical methods
- 2.7 Numerical solutions of vibration reponses

Chapter 3 Continuous system vibrations （12h）
- 3.1 Vibrations of elastic rod, shaft and cord
- 3.2 Elastic beam vibrations
- 3.3 Approximate approaches
- 3.4 Rotational system vibrations

Chapter 4 Random vibrations （12h）
- 4.1 Steady state random processes
- 4.2 Preliminary of processing of random vibration signals
- 4.3 Spectrum analysis of random vibration
- 4.4 Random response analysis

Chapter 5 Dynamics problems of elastic-viscoelastic complex structures（4h）‡
- 5.1 Viscoelastic materials and their constitutive relations
- 5.2 Dynamic behaviours of viscoelastic materials
- 5.3 Viscoelastic damping materials and their engineering applications
- 5.4 Dynamics analysis of elastic-viscoelastic complex structures

Chapter 6 Elements of nonlinear vibrations（6h）‡
- 6.1 Introduction
- 6.2 Geometrical nonlinear systems
- 6.3 Physical nonlinear systems
- 6.4 Analysis methods of nonlinear vibration systems

Note: The contents marked with ‡ are optional.

3.Textbooks

Chen Qian, Mechanical Vibration Theory with Applications, NUAA lecture notes，2006 年

Main Reference Books

1. S.S. Rao -"Mechanical Vibrations", Addison Wesley Publishing Company, Reading, Massachusetts, 1995, third edition. ISBN 0-201-52686-7 (about 900 pages)
2. W.T. Thomson - "Theory of Vibration with Applications", Stanely Thornes (Publishers) Ltd., Cheltenham, UK, 1998, fourth edition. ISBN 0-7487-4380-4 (about 520 pages)
3. 胡海岩、孙久厚，陈怀海，《机械振动与冲击》，第二版，2002

Written by：CHEN Qian（陈前）　　**Instructor**：CHEN Qian（陈前）

Course Code：7D022011L

Course Title(Chinese)：现代紊流测量技术

Course Title(English)：Contemporary Technology of Turbulence Measurement

College and Department：Col. of Energy & Power Engineering
Semester：Spring
Class Hours：40
Teaching Methods：Lecture, Experiment, Homework
Suitable Majors: Propulsion Theory and Engineering of Aeronautics and Astronautics, Power Engineering and Engineering Thermophysics, Environment Engineering
Assessment Instruments：Project reports, Experimental report
Pre-requisites：Engineering fluid mechanics, Heat transfer, Probability and random procedure

1.Course Objective and Requirements

The course of Contemporary Technology of Turbulence Measurement is an optional course for postgraduate students whose major is related to fluid flow and turbulence measurement, such as the majors of Propulsion Theory and Engineering of Aeronautics and Astronautics, Power Engineering and Engineering Thermophysics, Environment Engineering and so on. The content of the course include random signal analysis and processing, the measurement principle and technology of hot wire anemometry, laser Doppler anemometry (LDA) and particle image velocimetry (PIV). The objective of the course is to make students to understand the contemporary technology of turbulence measurement, to lay a foundation for further research related to turbulence measurement. To take the course the student should have certain knowledge about turbulence, random procedure, heat transfer and laser optics.

2.Course Content and Schedule （32h）

Chapter 1 Introduction (2h)
- 1.1 Why Measure?
- 1.2 Brief review of mass flow measurement
- 1.3 Brief review of velocity measurement techniques

Chapter 2 Random Signal Processing (10h)
- 2.1 Basic concept and characteristics of random signal
- 2.2 Describing random signal in amplitude domain
- 2.3 Describing random signal in time domain
- 2.4 Describing random signal in frequency domain
- 2.5 Sampling process

Chapter 3 Hot Wire Anemometry (8h)
- 3.1 Fundamentals of Hot Wire Anemometry
- 3.2 Turbulence Measurement and HWA Calibration
- 3.3 HWA Problem Sources

Chapter 4 Laser Doppler Anemometry (8h)
- 4.1 Several optical problems related to LDA
- 4.2 Doppler effect and principle of LDA
- 4.3 LDA system

Chapter 5 Particle Image Velocimetry (4h)
- 5.1 Basic principle of PIV
- 5.2 PIV system
- 5.3 Comparison of hot wire anemometry, LDA and PIV

3. Experiments （8h）

Project1: Calibration of hot wire anemometry（2h，综合性）
The project involves a calibration of a normal wire.
Project2: Turbulent flow measurement with HWA（2h，设计性）

The project involves a measurement of turbulent flow of a fan, to get the mean velocity and double correlation of fluctuation velocity.

Project3: Visit LDA laboratory（2h，综合性）

Project4: Turbulent flow measurement with PIV（2h，综合性）

The project involves a measurement of turbulent flow in a disturbed water tank.

4.Textbooks

(1) Ji Honghu, lecture note of Contemporary Technology of Turbulence Measurement, 2012

Main Reference Books

(1) Dai Changhui, Fluid flow measurement, Aviation Industry Press, 1991.
(2) Bradshaw，P., An introduction to turbulence and its measurement, Pergamon Press, Oxford，1971
(3) Goldstein,R. T., Fluid mechanics measurement, Hemisphere Publishing Corporation,1983
(4) Perry, A. E., Hot wire anemometry, Clorenden Press, Oxford, 1982
(5) Durst, F., Melling, A. and Whitelaw, J. H., Principles and practice of Laser-Doppler Anemometry, Academic Press, London, 1979

Written by：JI Honghu（吉洪湖）　　**Instructor**：JI Honghu（吉洪湖）

Course Code：6B072003L

Course Title(Chinese)：航空运输系统分析与建模

Course Title(English)：Air Transport System Analysis and Modeling

College and Department：Col. of Aviation
Semester：Spring
Class Hours：48
Teaching Methods：Face-to-face Lecture, Discussion, Topic Study, Homework
Suitable Majors: Traffic and Transportation Engineering; Management Science & Engineering
Assessment Instruments：Examination, Course Paper
Pre-requisites：Calculus

1.Course Objective and Requirements

The model building for air transport system is very tough thing for students. The objective of the course aims at improving students' analysis and formulating ability via basic modeling skills training and a series of case studies and training so as to equip students' ability to solve real domain problems by using mathematical programming.

2.Course Content and Schedule

1: Introduction of Mathematical Modeling(MM)（2h）
2: Knowing MM through Case(1)-Assignment （2h）
3: Knowing MM through Case(2)-MCFP （4h）
4: Knowing MM through Case(3)-Scheduling （4h）
5: Solving Mathematical Programming Models（2h）
6: Building Linear Programming Models（2h）
7: Structured Linear Programming Models（2h）
8: Application and Special Types of Mathematical Programming Model（2h）
9: Interpreting and Using the Solution of a Linear Programming Model（2h）
10: Non-linear Models（2h）
11: Integer Programming（2h）
12: Building Integer Programming Models I（2h）
13: Special Topic -- Logical Conditions and Zero-One Variables（2h）
14: Special Topic -- Change Logical Conditions into Constraints（2h）
15: Building Integer Programming Models II（2h）
16: Special Topic -- Bender's Decomposition（2h）
17: The Implementation of a Mathematical Programming System of Planning（2h）
18: Topic Study
  18.1: Revenue Management（2h）
  18.2: Airline Operation Analysis and Modeling（4h）
  18.3: Air Traffic Management: Analysis and Modeling（2h）
19: Summary（2h）

3.Textbooks

H. P. Williams, Massoud Bazargan, Ahmed Abdelphany, Air Transport System Analysis and Modeling, Wiley & Ashgate, 2013.

Main Reference Books

（1）Wayne L. Winston, Operations Research, Application & Algorithm, 4th Edition, Thomson Brooks/Cole, 2003
（2）Hamdy A. Taha, Operations Research, An Introduction, 3rd Edition, Macmillan Publishing Co., Inc. 1982.
（3）M. Bazargan, Airline Operations and Scheduling, Ashgate Publishing Ltd.,2006.
（4）Milan Janic, Air Transportation System Analysis and Modeling, Ashgate Publishing Ltd.,2007.
（5）Milan Janic, The Sustainability of Air Transportation: A Quantitative Analysis and Assessment, Ashgate, 2007

Written by：LE Meilong（乐美龙）　　**Instructor**：LE Meilong（乐美龙）

Course Code：7D071003L

Course Title(Chinese)：空管中的人为因素

Course Title(English)：Human Factors in ATC

College and Department：Col. of Aviation
Semester：Spring
Class Hours：32
Teaching Methods：Lecture, Exercise
Suitable Majors: Civil Aviation
Assessment Instruments：Examination, Project
Pre-requisites：English, Basics in Aviation

1. Course Objective and Requirements

With the development of aviation industry, human factors have gained more and more attention. It has become a compulsory for air traffic controllers, dispatchers and pilots in many countries. This course, an applied science, which studies human performance in ATC, is a subject concerning knowledge of many areas. As graduate students of Aviation, especially ATC, they should be able to have a good mastery of the basics of human factors and apply it in practice in order to get ready for the future work. Candidates ready to take this course must have some basic knowledge in ATM, and they must also be proficient in English language.

2. Course Content and Schedule

Chapter 1 Necessity of the study of human factors (5h)
1.1 Possible consequences of human error in ATC
1.2 Necessity of the study of human factors
1.3 Characteristics of Human error in ATC
1.4 Theories in human factors
Chapter 2 Analysis of Human Error in ATC Operation (3h)
2.1 Overview
2.2 Mechanism of human errors in ATC
2.3 Human error analysis based on SHEL model
2.4 Solution to human errors in ATC operation
Chapter 3 Team resource management (4h)
3.1 Background
3.2 Purpose and significance of TRM
3.3 History and concept of TRM
3.4 Application of TRM in ATC
Chapter 4 Research on Error Defense System in ATC (3h)
4.1 Objectives and Meanings
4.2 Cause and category of human error in ATC
4.3 The establishment of R-S model
Chapter 5 Stress management (5h)
5.1 Getting to know fatigue
5.2 Fatigue and stress
5.3 Origin of controllers' stress
5.4 Stress management
Chapter 6 Safety management system in ATC (5h)
6.1 The Need for SMS
6.2 Evolution of Safety Oversight
6.3 The Concept of Safety
6.4 A Safety Culture
6.5 What is an SMS? (The SMS Table)
6.6 Construction of ATM SMS
Chapter 7 Safety risk management (4h)
7.1 Definition of risk management

7.2 The safety risk management process
7.3 Describe Hazard Identification
7.4 Perform Risk Analysis and Assessment
7.5 Understand Risk Mitigation Strategies
Chapter 8 Leadership and influencing (3h)
8.1 Leadership and influencing
8.2 Change management
8.3 Framework for empowerment
8.4 Coaching

3. Projects

3.1 Management of "Error, oblivion and oversight" in ATC
3.2 Construction of Error Defense System in ATC
3.3 Construction of controllers' selection system

4. Textbooks

Christopher D. Wickens, etc, An Introduction to Human Factors Engineering, Pearson Education, Inc., 2004

Main Reference Books

(1) Safety Management Manual, Doc 9859-ICAO
(2) Human Performance and Limitations, for private and commercial pilots, Bob Tait
(3)《飞行中人的因素》，2002 年 4 月，西南交大出版社
(4)《驾驶舱资源管理》，2002 年 9 月，西南交大出版社
(5) Human Factors in ATC

Written by：LIU Jixin（刘继新）　　**Instructor**：LIU Jixin（刘继新）

Course Code：6B151002L

Course Title (Chinese)：空间机器人学

Course Title (English)：Space Robotics

College and Department：Col. of Astronautics
Semester：Spring
Class Hours：40
Course Credit：2.5
Teaching Methods：Lecture
Suitable Majors: Mechanical or Control Engineering
Assessment Instruments：Examination
Pre-requisites：Matrix theory, Theoretical mechanics, Control theory

1 Course Objective

The objective of this course is to introduce students to the principles of robotics. The main topics of interest covered in the textbook include: Robot and multi-axle system (MAS), axle-variants based MAS forward and inverse kinematics, axle-variants based MAS Dynamics, force-position based MAS control, knowledge and heuristic based planning. Upon successful completion of the course, students must be able to:
(1) Understand chain-ordering based symbols and operators of MAS.
(2) Derive models for the forward and inverse kinematics of a tree-type robot.
(3) Describe the dynamics of a tree-type robot.
(4) Implement several robot control laws.
(5) Understand the principles of path planning, motion planning and task planning.

2 Course Content and Schedule

Chapter 1 Introduction（2h）
1.1 Robots
1.2 Mechatronics
1.3 Axiomatic isomorphism-systems approach
1.4 Robotics
1.5 Learn how to learn the course
Chapter 2 Robotic System （4h）
2.1 Robotic mechanical systems
2.2 Multi axle systems
2.3 Sensing systems
2.4 Actuator Systems
2.5 Robot Systems
Chapter 3 Axle-variants based MAS Kinematics （14h）
3.2 Notation Conventions
3.3 Chain-ordering based symbols and operators
3.4 Chain-ordering based Rodrigues quaternion
3.5 Chain-ordering based Euler quaternion
3.6 Chain-ordering based derivation
3.7 Axle- invariants based kinematics
3.7 Axle-invariants based partial velocity equations
3.8 Axle-invariant based canonical forms for inverse Kinematics
3.9 Axle-invariants based inverse kinematics of 6R decoupling manipulator
3.10 Axle-invariant based recursive kinematics of Chang'e 3 Rover
Chapter 4 Axle-variants based MAS Dynamics （10h）
4.1 Review of axle-chain based kinematics
4.2 Lagrange's and Hamilton's Equations
4.3 Kane's Equation
4.4 Axle-chain based Kane MAS
4.5 Ju-Kane dynamic equations without non-tree constraint pairs

4.6 Canonical form of Ju-Kane dynamic equations
4.7 Inertial Matrix of Tree Chain
4.8 Ju-Kane dynamic equations with non-tree constraint pairs
4.9 Ju-Kane dynamic equations with viscous friction
4.10 Dynamic Modelling of Mobile Platform based on Axle-invariants
Chapter 5 Force-Position based MAS Control （4h）
5.1 Force-position control of model-based inverse compensator
5.2 Resistance control of model-based inverse compensator
5.3 Fuzzy Sliding Mode Control
Chapter 6 Knowledge and Heuristic based Planning （5h）
6.1 Heuristic Programming
6.2 Linear Programming
6.3 Predicate Logic Rule based Programming
6.4 Fuzzy Logic Rule based Programming (self-learning)
6.5 Chang'e 3 Rover Task planning System
Project presentation（1h）

3 Homeworks

Homeworks will include primarily theory problems and a few short programming assignments. These will help audience understand the material and monitor their progress. Programming assignments should be implemented in VC++ or Matlab. There will be 4 homework assignments during the semester, depending on the material covered. Homeworks are due at the beginning of the lecture, usually one week after the hand out. Homeworks submitted two class sessions late will be penalized by a 20% grade reduction. No homeworks will be accepted after that point. Solutions to the homework problems will be distributed.

4 Project

Projects should take one of the following forms:

(1) Simulation. Examples will be given during the course of the class.

Suggestions are welcome. Please contact the instructor for discussing your topic idea.

(2) Theoretical work (problem description & formulation, mathematical derivation of the solution, comparison with similar work).

Students may decide to work in groups of 3-4 if the content of the proposed work is sufficient for the size of the group (consult with the instructor).

Students should write a 5-10 page description (technical report) of their project and give a short presentation towards the last two weeks of the semester. This report and presentation will count for 20% of the total grade. The project demonstration accounts for 20% of the total grade.

5 Text book

Hehua Ju，Axle-variants based MAS Modelling, Planning and Control，Handout

Other References

[1] R. A. Sharipov. Quick Introduction to Tensor Analysis, http://samizdat.mines.edu/tensors/, ISBN 0-306- 37509- 5

[2] Richard M. Murray, Zexiang Li, S. Shankar Sastry, A Mathematical Introduction to Robotic Manipulation. CRC Press, 1994.

[3] Jorge Angeles. Fundamentals of Robotic Mechanical Systems: Theory, Methods, and Algorithms, Second Edition. 2003 Springer-Verlag New York, Inc

Written by：JU Hehua（居鹤华）, QIAO Bing（乔兵）
Instructor：JU Hehua（居鹤华）, QIAO Bing（乔兵）

Electrical and Computer Engineering

Course type	Course Code	Course Title	Hours	Credits	Semester	College	Remark
Compulsory Course	6A120007L	Chinese Culture	45	3	Spring	Col. of Foreign Languages	
	8A080002L	Linear Algebra in System and Control Theory	60	4	Spring	Col. of Science	Compulsory for master Students
Optional Course	6B031004L	Theory and Application of Nonlinear Control System	32	2	Spring	Col. of Automation Engineering	
	6B031011L	Globe Navigation Satellite System	32	2	Spring	Col. of Automation Engineering	
	6B031015L	Fuzzy Modeling and Control	32	2	Spring	Col. of Automation Engineering	
	6B031017L	Fault Estimation and Accommodation for Dynamic Systems	32	2	Spring	Col. of Automation Engineering	
	7D031018L	Machine Vision	32	2	Spring	Col. of Automation Engineering	
	6B041002L	Antenna Theory and Technique	48	3	Spring	Col. of Electronic Information Engineering	
	6B042003L	Channel Coding:from Theory to Practice	32	2	Spring	Col. of Electronic Information Engineering	
	7D041007L	Signal Integrity for High-Speed Circuits	32	2	Spring	Col. of Electronic Information Engineering	
	7D042011L	Digital Image Processing	40	2.5	Spring	Col. of Electronic Information Engineering	
	7D153002L	Techniques of Radar Networking	32	2	Spring	Col. of Astronautics	
	6B162002L	Advanced Software Engineering	48	3	Spring	Col. of Computer Science&Technology	
	6B162003L	Software Metrics	40	2.5	Spring	Col. of Computer Science&Technology	
	6B169002L	Logic for Applications	48	3	Spring	Col. of Computer Science&Technology	
	7D161010L	Data Mining	48	3	Spring	Col. of Computer Science&Technology	

Course Code：6A120007L

Course Title(Chinese)：中国文化

Course Title(English)：Chinese Culture

College and Department：Col. of Foreign Languages
Semester：Spring
Class Hours：45
Teaching Methods：Lecture
Suitable Majors: International postgraduates
Assessment Instruments：Report
Pre-requisites：Elementary Chinese

1.Course Objective and Requirements

In the time of globalization, cross-cultural communication appears to be more and more important for nowadays students. With the rapid growth of Chinese economy, China now once again stands up on the world stage. The world is looking at China, and eager to know about this old and young, traditional but fashionable country, especially for the international students. Therefore it's necessary for overseas students to know something about Chinese culture and tradition, which will greatly help them to adapt themselves to the life in China.

After the 12 weeks of lectures and presentations, students of this class are expected to be familiar with some aspects of Chinese culture mentioned in the textbook. Furthermore, the students are recommended to make some comparative studies between Chinese culture and western culture.

2.Course Content and Schedule

Unit 1 The Origin of Chinese Culture 中国文化溯源（4 小时）
1.1Chinese Culture 祠 ast and Present 中国文化—传统与现代
1.2The Appellation of China 国名由来
1.3Chinese Mythology 神话传说
1.4Cultural Mosaic 文化常识
Heavenly Stems and Earthly Branches 天干地支
The Twenty-four Solar Terms 二十四节气
Chinese Zodiac 十二生肖
Unit 2 Chinese Language 中国的语言（4 小时）
2.1Han Chinese Language 汉语
2.2The Chinese Written Language 中国的文字
2.3The Origins of Chinese Writing 汉字的源流
2.4Chinese Calligraphy 书法
2.5Chinese Seals 印章
2.6Traditional System & Simplified System 繁体与简体
2.7 Cultural Mosaic 文化常识
The Chinese Character Classification 六书
The Components of Characters 偏旁部首
Four Treasures of the Study 文房四宝
Lanting Xu by Wang Xizhi 王羲之的《兰亭序》
Unit 3 Ancient Capitals and Heritages 古都与文化遗产（4 小时）
3.1The Seven Great Ancient Capitals 七大古都
3.2Tourist Resources in China 旅游资源
3.3Cultural Mosaic 文化常识
The Great Wall of China 长城
The Forbidden City 紫禁城
Terracotta Army 兵马俑
China's Top Ten 中国的"十大之最"
Unit 4 Crafts and Skills 传统工艺（4 小时）

4.1Traditional Chinese Crafts 传统工艺品
4.2Jade Culture 玉文化
4.3Ancient Chinese Bronze 青铜器
4.4Chinese Silk 丝绸
4.5Chinese Embroidery 刺绣
4.6Chinese Porcelain 瓷器
4.7Chinese Knots 中国结
4.8Paper Cuttings 剪纸
4.9 Cultural Mosaic 文化常识
Si Mu Wu Ding 司母戊鼎
Galloping Horse Overtaking a Flying Swallow 马踏飞燕
Unit 5 Traditional Sports and Athletics 传统运动与竞技（4 小时）
5.1Traditional Sports 传统运动
5.2Chinese Martial Arts 中国武术
5.3Taijiquan 太极拳
5.4Cuju 蹴鞠
5.5Qigong 气功
5.6Chinese Chess 象棋
5.7Traditional Acrobatic Acts 传统杂技
5.8Cultural Mosaic 文化常识
Five-Animal Play 五禽戏
The Mongolian Horsemanship 蒙古马术
Martial Arts in Popular Culture 流行文化中的武术
Unit 6 Ancient Science and Technology 中国古代科技（4 小时）
6.1History of Science and Technology 科技简史
6.2Early Technological Achievements 早期科技成就
6.3The Four Great Inventions 四大发明
6.4Scientific Achievements in the Middle Ages 中古科学发明
6.5Mongol Transmission & Jesuit Activity 科技传播与交流
6.6Joseph Needham 李约瑟
6.7Science and Technology in the PRC 现代科技发展
6.8 Cultural Mosaic 文化常识
Science and Civilization in China Series 李约瑟的《中国科学技术史》
Unit 7 Operas and Music 戏曲与音乐（4 小时）
7.1Chinese Opera 中国戏曲
7.2Kunqu Opera 昆曲
7.3Introduction of Beijing Opera 京剧简介
7.4Quyi 曲艺
7.5Chinese Music 中国音乐
7.6Butterfly Lovers 梁祝
7.7Legend of the White Snake 白蛇传
7.8 Cultural Mosaic 文化常识
The Story of High Mount Flowing Water 高山流水
Changing Faces 变脸
The Meaning of Colors in Chinese Opera Masks 脸谱的含义
Bronze Chime-Bells of Marquis Yi of the Zeng State 曾侯乙编钟
Unit 8 Education and Aesthetics 古代教育与审美（4 小时）
8.1Education in Ancient China 中国古代教育
8.2Imperial Examination 科举考试
8.3Institutions of Higher Education 古代高等教育衍变
8.4Chinese Aesthetics 中国人的审美观
8.5Chinese Painting 国画
8.6Ancient Chinese Architecture 古代建筑
8.7Cultural Spirit in Classical Gardens 古典园林的文化内涵

8.8 Cultural Mosaic 文化常识
Some Details of the Imperial Examination 科举考试细则
Academies of Classical Learning 四大书院
Wu Daozi, Sage in Chinese Painting 画圣吴道子
Unit 9 Thoughts and Philosophy 思想与哲理（4 小时）
9.1Traditional Philosophy 传统哲学
9.2Confucius 孔子
9.3Confucianism, Taoism and Buddhism 儒、道、释
9.4Neo-Confucian Zhu Xi 理学家朱熹
9.5Harmony between Man and Nature 天人合一
9.6 Cultural Mosaic 文化常识
Laozi and Zhuangzi 老子与庄子
Mencius 孟子
Four Books and Five Classics 四书五经
Unit 10 Religions and Beliefs 宗教与信仰（4 小时）
10.1What Do Chinese People Believe in? 中国人的信仰
10.2Heaven Worship 祭天
10.3Ancestor Worship 拜祖
10.4Taoism in China 道教
10.5Buddhism in China 佛教
10.6Feng Shui 风水
10.7 Cultural Mosaic 文化常识
The God of Wealth 财神
King Yam 阎王
The God of Kitchen 灶神
The Matchmaker 月老
Unit 11 Exchanges with Foreign Countries 中外往来述要（4 小时）
11.1The Silk Road 丝绸之路
11.2The Influences of Silk Road 丝绸之路的影响
11.3The Tea Horse Road 茶马古道
11.4Zheng He’s Voyages 郑和下西洋
11.5Did Zheng He Discover the World? 郑和发现了世界？
11.6 Cultural Mosaic 文化常识
Great Ming Amalgamated Map 《大明混一图》
Jian Zhen 鉴真东渡
Matteo Ricci 利玛窦
Unit 12 Review 复习（1 小时）

2.Textbooks

《中国文化概览》 *A Panoramic View of Chinese Culture* 编著 吴鼎民，译林出版社，2010 年

Written by：WANG Zheng（王征）
Instructor：LIANG Hongfei（梁红飞）,WANG Zheng（王征）, et al.

Course Code：8A080002L

Course Title(Chinese)：系统与控制理论中的线性代数

Course Title(English)：Linear Algebra in System and Control Theory

College and Department：Col. of Science
Semester：Spring
Class Hours：60
Teaching Methods：Lecture, Homework
Suitable Majors: All Specialities in Engineering
Assessment Instruments：Examination, Project
Pre-requisites：Linear Algebra, Matrix Theory

3. Course Objective and Requirements

The theories and methods of linear algebra are indispensable to science and technology, are especially fundamental to studying modern system and control theory. In this course, the theories, methods of linear algebra with applications to system and control are introduced. The main contents may be divided into three parts. The first part is the basic concepts of modern mathematics including mapping, algebraic operation, group, ring，field and so on. The second part is contains the theories and methods of linear algebra including linear space, subspace, linear mapping and transformation, inner product space, orthogonal projection, normed space, best approximation and so on. The third part contains some topics of numerical linear algebra including matrix factorizations, generalized inverse of a matrix, matrix equation, least squares problem, total least squares problem, matrix perturbation analysis and so on. Course objectives: enhance the mathematical quality of graduates, provide the mathematical foundations for studying follow-up courses and carrying out scientific research.

4. Course Content and Schedule

Chapter 1 Basic Concepts（8h）
- 1.8 Sets
- 1.9 Mapping
- 1.10 Algebraic Operations
- 1.11 Homomorphism and Isomorphism
- 1.12 Equivalence and Classification of Set
- 1.13 Ordered Spaces
- 1.14 Metric Spaces

Chapter 2 Groups （8h）
- 4.1 Basic Concepts of Groups
- 4.2 Subgroups
- 4.3 Homomorphism and Isomorphism of Groups
- 4.4 Normal Subgroups and Quotient Groups
- 4.5 Groups of Transformations

Chapter 3 Rings and Fields （4h）
- 3.5 Basic Concepts of Rings
- 3.6 Subrings and Homomorphism of Rings
- 3.7 Ideals and Quotient Rings
- 3.8 Fields

Chapter 4 Linear Spaces （10h）
- 4.7 Linear Spaces
- 4.8 Subspaces
- 4.9 Homomorphism and Isomorphism of Linear Spaces
- 4.10 Linear Manifold and Quotient Spaces
- 4.11 Modules and Linear Algebra
- 4.12 Invariant Subspaces

Chapter 5 Inner Product Spaces （6h）
- 5.5 Inner Product Spaces
- 5.6 Gram-Schmidt Orthogonalization and QR factorization
- 5.7 Orthogonal Projection and Best Approximation
- 5.8 Linear Transformations of Inner Product Spaces

Chapter 6 Normed Linear Spaces（6h）
- 6.5 Normed Linear Spaces
- 6.6 Best Approximation
- 6.7 Banach Spaces
- 6.8 Norms of Linear Operators and Matrices

Chapter 7 Generalized Inverse and Least Squares Problems（10h）
- 7.9 Matrix Factorizations
- 7.10 Singular Value Decomposition and Its Generalization
- 7.11 Generalized Inverse of a Matrix
- 7.12 Linear Least Squares Problem
- 7.13 Total Least Squares Problem
- 7.14 Robust Least Squares Problem
- 7.15 Matrix Approximation with Constraints
- 7.16 Matrix Perturbation Analysis

Chapter 8 Matrix Functions and Matrix-Valued Functions（4h）
- 8.4 Matrix Functions
- 8.5 Matrix-Valued Functions with Applications
- 8.6 Eigenvalue Sensitivity Analysis with Applications

Chapter 9 Matrix Equations and Matrix Inequalities （4h）
- 9.6 Kronecker Product of Matrices
- 9.7 Linear Matrix Equations
- 9.8 Algebraic Riccati Equations
- 9.9 Matrix Inequalities
- 9.10 Pole Assignment Problems

3. Textbooks

(3) Lancaster P, Tismenetsky M. The Theory of Matrices with Applications. Academic Press, 1985.
(4) Greub W. Linear Algebra. Springer-Verlag，1981.

Main Reference Books

(3) Horn R A, Johnson C R. Matrix Analysis. Cambridge University Press, 1985.
(4) Golub G H, Van Loan C F. Matrix Computation. Third Edition, The John Hopkins University Press, 1996.

Written by：DAI Hua（戴华）　　**Instructor**：DAI Hua（戴华）

Course Code：6B031004L

Course Title(Chinese)：非线性控制系统理论与应用

Course Title(English)：Theory and Application of Nonlinear Control System

College and Department：Col. of Automation Engineering
Semester：Spring
Class Hours：32
Teaching Methods：Lecture, Experiment, Homework
Suitable Majors: Control Science and Engineering
Assessment Instruments：Examination, Project
Pre-requisites：Linear Control Theorem, Robust Control Theorem, Intelligent Control Theorem

1.Course Objective and Requirements

The Nonlinear System Control (NSC) is a very important part of automatic engineering. In this course, the concept, the differential geometric method is introduced, including the concept, principle and application of this method. Topics contains the geometric theorem of the nonlinear control systems; its application in dynamic feedback linear, adaptive observer design and fault diagnosis. Finally, the course provides some applying examples in physical systems, such as, robot, flight, electric power, driving car, ect..

Course objectives: develop comprehensive knowledge in the fundamental mathematical and physical basis of NSC; have the ability of qualitative analysis and quantitative calculation to nonlinear systems; know how to adopt the NSC methods to the physical problems; have the skill of simulative research for controlled systems.

2.Course Content and Schedule

Chapter 1 Basic Concepts of Nonlinear Control Theory （4h）
- 1.1 Introduction
- 1.2 Coordinate transformation of nonlinear systems
- 1.3 Affine nonlinear control systems
- 1.4 Vector fields
- 1.5 Derived mapping of vector fields
- 1.6 Lie derivative and Lie bracket
- 1.7 Involutivity of vector field sets
- 1.8 Relative degree of a control system
- 1.9 Linearized normal form
- 1.10 Nonlinear feedback

Chapter 2 Nonlinear Control of Robot Arm and Power Systems (6h)
- 2.1 Third-order dynamic model of robot manipulators
- 2.2 Linearization of control equation
- 2.3 Simulations

Chapter 3 Tracking control via nonlinear feedback for articulated vehicles (6h)
- 3.1 Preliminaries
- 3.2 Dynamic control model
- 3.3 Nonlinear feedback control
- 3.4 Variable structure compensation
- 3.5 Nonlinear control of converter stations
- 3.6 Application of exact linearization theory to two examples

Chapter 4 Dynamic Feedback Linearization (4h)
- 4.1 Introduction
- 4.2 Preliminaries
- 4.3 Main result
- 4.4 Examples

Chapter 5 Adaptive Observer for Nonlinear Systems (4h)
- 5.1 Preliminaries and basic result
- 5.2 An adaptive design with asymptotic convergence
- 5.3 The filtered transformation
- 5.4 Adaptive observer with arbitrary exponential rate of convergence
- 5.5 Example

Chapter 6 Adaptive Control for Linearizable Systems (4h)
- 6.1 Review of exact linearization techniques
- 6.2 Adaptive control of linearizable systems

Chapter 7 Fault Diagnosis for Nonlinear Systems (4h)
- 7.1 Background

7.2 Definitions and concepts
7.3 Fault detection and diagnosis based on observer technique

3.Experiments

Project1: Fault diagnosis for a physical system（综合性）
The project involves design and simulation work on the fault diagnosis for a physical system.

4.Textbooks

(1) A. Isidori, Nonlinear Control Systems: An introduction (2nd edition), Springer Verlag 1989.
(2) Q. Lu, Nonlinear Control Systems and Power System Dynamics, Springer Verlag, 2001.
(3) R. Marino, P. Tomei, Nonlinear Control Design–Geometric, Adaptive and Robust, Pearson Education Limited, 1996.

Main Reference Books

(1) Hassan K. Khalil, Nonlinear Systems (3nd Edition), Prentice Hall, 2002.

Written by：JIANG Bin（姜斌）　　**Instructor**：JIANG Bin（姜斌）

Course Code：6B031011L

Course Title(Chinese)：全球导航卫星系统

Course Title(English)：Global Navigation Satellite System

College and Department：Col. of Automation Engineering

Semester：Spring

Class Hours：32

Teaching Methods：Lecture, Experiment, Homework

Suitable Majors: Navigation, Guidance& control

Assessment Instruments：Examination, Project

Pre-requisites： Advanced Mathematics, Linear Algebra, College Physics

1.Course Objective and Requirements

Global Satellite Navigation Systems or Global Navigation Satellite Systems （GNSS） is a very useful and important tools for all kinds of vehicles. The objective for this course is to master the theory and the typical application of GNSS, such as GPS time system, positioning and velocity algorithm of navigation satellite, different GPS application, and so on. Besides, there are others satellites navigation systems in the world, including Chinese Compass, Europe Galileo, and Russian GLONASS. To realize the difference of these system are very necessary to make full use the satellite navigation systems. With the help of the GPS experiment, students will have an overall understanding with GNSS, which will help their research greatly.

2.Course Content and Schedule

Chapter 1 Introduction (2h)
- 1.1 Condensed GPS Program History
- 1.2 GPS & GPS Modernization Program
- 1.3 GALILEO, GLONASS & BeiDou System

Chapter 2 Fundamentals of Satellite Navigation (4h)
- 2.1 Concept of Ranging Using TOA Measurements
- 2.2 Fundamentals of Satellite coordinate and Orbits
- 2.3 Position and Velocity Determination Using PRN Codes
- 2.4 Time and GPS

Chapter 3 GPS System Segments & Signal Characteristics (4h)
- 3.1 Overview of the GPS System
- 3.2 Space Segment Description
- 3.3 Control Segment & User Segment
- 3.4 Modulations for Satellite Navigation
- 3.5 Legacy GPS Signals & Navigation Message Format
- 3.6 Modernized GPS Signals

Chapter 4 Satellite Signal Acquisition, Tracking, and Data Demodulation (4h)
- 4.1 GPS Receiver Code and Carrier Tracking
- 4.2 Measurement Errors and Tracking Thresholds
- 4.3 Formation of Pseudorange, Delta Pseudorange, and Integrated Doppler
- 4.4 Signal Acquisition

Chapter 5 Interference, Multipath, and Scintillation (2h)
- 5.1 Overview
- 5.2 Radio Frequency Interference
- 5.3 Multipath
- 5.4 Ionospheric Scintillation

Chapter 6 Performance of Stand-Alone GPS (4h)
- 6.1 Measurement Errors
- 6.2 PVT Estimation Concepts
- 6.4 GPS Availability
- 6.5 Continuity & Measured Performance

Chapter 7 Differential GPS & Integration of GPS with Other Sensors (4h)
- 7.1 Spatial and Time Correlation Characteristics of GPS Errors
- 7.2 Code-Based Techniques
- 7.3 Carrier-Based Techniques
- 7.4 Message Formats
- 7.5 GPS/Inertial Integration
- 7.6 Sensor Integration in Land Vehicle Systems

Chapter 8 GALILEO & Other Satellite Navigation Systems (4h)

8.1 GALILEO Program Objectives, Services and Performance
8.2 Interoperability Between GPS and GALILEO
8.3 System Architecture & GALILEO Development Plan
8.4 The Russian GLONASS System
8.5 The Chinese BeiDou Satellite Navigation System
8.6 The Japanese QZSS Program

3.**Experiments**

Project1: Demonstrate & Simulation experiments (4h，演示性)
Demonstrate experiment with GPS receiver and antenna, which will show the positioning process and precision of GNSS.
Project2: Demonstrate & Simulation experiments (2h，综合性-课外)
Simulation experiment involves an analysis work on the GNSS structures and its working system.

4.Textbooks

(1)Mohinder S.Grewal, Global Positioning Systems, Inertial Navigation, and Integration, Wiley-Blackwell, 3nd Edition,2013

Main Reference Books

(1)Mohinder S.Grewal, Global Positioning Systems, Inertial Navigation, and Integration, Wiley-Blackwell, 3nd Edition,2013
(2)Guochang Xu, GPS theory, algorithms and applications, Springer,2nd Edition,2007
(3)Jaizki Mendizabal Samper, Juan Melendez Lagunilla, Roc Berenguer Perez. GPS and Galileo: Dual RF Front-end receiver and Design, Fabrication, & Test, by the McGraw-Hill Companies. 2009.
(4)Elliott D. Kaplan，Christopher J. Hegarty ,Understanding GPS： Principles and Applications, Second Edition, ARTECH HOUSE, INC, Second Edition, 2005

Written by： ZENG Qinghua（曾庆化）
Instructor：ZENG Qinghua（曾庆化）, ZHAO Wei (赵伟) , XU Rui (许睿) etc.

Course Code：6B031015L

Course Title(Chinese)：模糊建模与控制

Course Title(English)：Fuzzy Modeling and Control

College and Department：Col. of Automation Engineering

Semester：Spring

Class Hours：32

Teaching Methods：Lecture, Homework, Discussion, Simulation Experiment

Suitable Majors: Automation, Electrical Engineering, Mechanical Engineering

Assessment Instruments：Examination, Project

Pre-requisites：Principle of Automatic Control, Modern Control Theory, Matrix

1.Course Objective and Requirements

A fuzzy control system is a control system based on fuzzy logic, which is a mathematical system that makes decisions using human reasoning processes. This course presents in introductory-level exposure to two of the principle uses for fuzzy logic—modeling (identification) and control. Through this course, students will learn the basic concepts of fuzzy sets, fuzzy logic operations, fuzzy relations and approximate reasoning, structures and inference methods of Mamdani and Takagi-Sugeno fuzzy systems, how to design a decision-making system using fuzzy logic, how PID controllers can be made fuzzy and why this is useful, how nonlinear systems can be modeled as fuzzy systems in several forms, how fuzzy tracking control and model reference control can be realized for nonlinear systems using parallel distributed techniques, the estimation of fuzzy system parameters using least squares, recursive least squares and gradient method, the creation of direct and indirect adaptive fuzzy controllers.

This course is intended for first-year graduate students. It would be helpful if the students have some understanding of continuous- and discrete-time dynamic systems and an appreciation of the basic aims and methods of control (i.e. stabilization, tracking and model reference control).There is little in the way of advanced mathematics beyond differential and difference equations, transfer functions, and linear algebra required to read and understand this course.

2.Course Content and Schedule

Lecture01 Foundations of Fuzzy Logic (2h)

- Introduction on fuzzy sets, membership functions, logical operations, if-then rules and fuzzy inference system

Lecture02 Fuzzy Relations (2h)

- Classical relations; Fuzzy relations; Operations on fuzzy relations; Fuzzy Cartesian product; Fuzzy composition; Applications of fuzzy relations

Lecture03 Fuzzy Implication (2h)

- Material implication; Fuzzy implication method; Linguistic variable

Lecture04 Approximate Reasoning (2h)

- Translation rules; Generalized Modus Ponens; Compositional rule; Mamdani implication; T-S fuzzy implication

Lecture05 Defuzzification (2h)

- Lambda cuts for both fuzzy sets and fuzzy relations; defuzzification methods (Maxima, Centroid, Weighted average, Middle-of-maxima, First-of-maxima, Last-of-maxima)

Lecture06 Fuzzy Rule-based System (2h)

- Fuzzification interface; Fuzzy rulebase; Fuzzy inference engine; Defuzzification interface; Examples

Lecture 07 Fuzzy Logic Control with Case Studies (4h)

- Basic structure of FLC; FLC for Inverted Pendulum; FLC for Magnetic Suspension System; Introduction to Matlab Fuzzy Toolbox

Lecture08 Takagi-Sugeno Fuzzy System (4h)

- General form of T-S fuzzy system; Advantages of T-S fuzzy systems; T-S model based PDC control design; Stability of T-S fuzzy systems

Lecture09 Fuzzy Modeling (4h)

- Constructing fuzzy models from input-output data (Table lookup method; gradient decent method; clustering + gradient decent method; generalization); online identification of fuzzy model

Lecture10 Adaptive Fuzzy Control (4h)

- Indirect adaptive fuzzy control; direct adaptive fuzzy control

3.**Experiments**

Project1: Fuzzy control of an inverted pendulum system（2h，演示性）

The project demonstrates the control performance of a Mamdani fuzzy PD controller for stabilizing an inverted pendulum system.

Project2: Using Matlab/fuzzy toolbox to design a Mamdani type and a T-S type fuzzy controller for a magnetic suspension system （2h，综合性）

The project helps students to practice how to use fuzzy toolbox to design two types of fuzzy controllers for position control of a magnetic suspension system.

4.Textbooks

(1) John H. Lilly, Fuzzy Control and Identification, Wiley, 2010.

Main Reference Books

(1) Kevin M. Passino and Stephan Yurkovich, Fuzzy control, Addison Wesley, 1998.
(2) Jairo Espinosa, Joos Vandewalle and Vincent Wertz, Fuzzy logic, identification and predictive control, Springer-Verlag, London, 2005.
(3) Gang Feng, Analysis and Synthesis of Fuzzy Control Systems: A Model-Based Approach, CRC PRess, Taylor & Francis Group, 2010,

Written by：QI Ruiyun（齐瑞云） **Instructor**：QI Ruiyun（齐瑞云）

Course Code：6B031017L

Course Title(Chinese)：动态系统的故障估计与调节

Course Title(English)：Fault Estimation and Accommodation for Dynamic Systems

College and Department：Col. of Automation Engineering

Semester：Spring

Class Hours：32

Teaching Methods：Lecture, Homework

Suitable Majors: Control Science and Engineering

Assessment Instruments：Examination, Project

Pre-requisites：Principle of Automatic Control, Control System Engineering, Modern Control Theory

1. Course Objective and Requirements

Due to the increasing security and reliability demand of actual industrial process control systems, the study on fault diagnosis and fault tolerant control of dynamic systems has received considerable attention. Fault accommodation (FA) is one of effective methods that can be used to enhance system stability and reliability, so it has been widely and in-depth investigated and become a hot topic in recent years. Fault detection is used to monitor whether a fault occurs, which is the first step in FA. On the basis of fault detection, fault estimation (FE) is utilized to determine online the magnitude of the fault, which is a very important step because the additional controller is designed using the fault estimate. Compared with fault detection, the design difficulties of FE would increase a lot, so research on FE and accommodation is very challenging. Although there have been advancements reported on FE and accommodation for dynamic systems, the common methods at the present stage have design difficulties, which limit applications of respective design approaches. Therefore, the problems of FE and accommodation are needed to be further considered. This course considers the theory and technology of FE and accommodation for dynamic systems, and establishes a systemic and comprehensive framework of FE and accommodation for continuous/discrete-time systems.

This course provides an introduction to a framework of model-based FE and accommodation. We start by giving summaries of FE and accommodation for dynamic systems. Then FE design, including adaptive observer, sliding mode observer, full-order fault estimation observer (FFEO), reduced-order fault estimation observer (RFEO), and FA design, including dynamic output feedback based FA, static output feedback based FA are presented. The students are then guided through a set of techniques of FE and accommodation design methods. Many examples are taken from many different application areas.

2.Course Content and Schedule

Chapter 1 Introduction （4h）
- 1.1 Background
- 1.2 Summaries of FD and FTC
- 1.3 FE and FA Problems
- 1.4 Book Outline

Chapter 2 FE of Continuous-Time Systems （8h）
- 2.1 Introduction
- 2.2 FE of Linear Systems
- 2.3 FE of Lipschitz Nonlinear Systems
- 2.4 Concluding Remark

Chapter 3 FE of Continuous-Time Linear Systems with Time Delay（4h）
- 3.1 Introduction
- 3.2 FE Design of Retarded Time-Delay Systems
- 3.3 FE Design of Neutral Time-Delay Systems
- 3.4 Concluding Remarks

Chapter 4 FFEO Based FA for Linear Systems （8h）
- 4.1 Introduction
- 4.2 FFEO Based FA for Continuous-Time Systems
- 4.3 FFEO Based FA for Discrete-Time Systems
- 4.4 Concluding Remarks

Chapter 5 RFEO Based FA for Linear Systems （8h）
- 5.1 Introduction
- 5.2 RFEO Based FA for Continuous-Time Systems
- 5.3 RFEO Based FA for Discrete-Time Systems
- 5.4 Concluding Remarks

3.Textbooks

(1) Ke Zhang, Bin Jiang, and Peng Shi. Observer-Based Fault Estimation and Accommodation for Dynamic Systems. Springer. Heidelberg 2013.

Main Reference Books

(1) 姜斌等. 控制系统的故障诊断与故障调节. 北京: 国防工业出版社, 2009.

(2) S. X. Ding. Model-based Fault Diagnosis Techniques: Design Schemes, Algorithms, and Tools. Berlin Heidelberg: Springer Verlag, 2008.

Written by：ZHANG Ke (张柯)　　**Instructor**：ZHANG Ke (张柯)

Course Code：7D031018L

Course Title(Chinese)：机器视觉

Course Title(English)：Machine Vision

College and Department：Col. of Automation Engineering

Semester：Spring

Class Hours：32

Teaching Methods：Lecture, Homework

Suitable Majors: Control Science and Engineering, Armament Science, Computer Science

Assessment Instruments：Examination, Project

Pre-requisites：Matrix, Signal Processing

1.Course Objective and Requirements

Machine vision is a very important research topic in the field of computer science. In this course, the concept, principle and application of machine vision are introduced. Topics include human visual and color perception, image pre-processing, binary image analysis, image segmentation, depth map, camera calibration, motion estimation, 3D scene representation and object recognition. Course objectives: develop comprehensive knowledge in the basic theory and algorithm of machine vision; know how to analysis and deal with visual computing tasks, and apply appropriate algorithm to settle down practical problems.

2.Course Content and Schedule

Chapter 1 Introduction （2h）

1.1 Introduction to Machine Vision　1.2 Application of Machine Vision

1.3 Relationship to other disciplines　1.4 Principle of imaging geometry

Chapter 2 Binary image analysis （2h）

2.1 Introduction　2.2 Geometric properties

2.3 Binary image algorithms　2.4 Morphology operator

Chapter 3 Image pre-processing （4h）

3.1 Introduction　3.2 Histogram modification

3.3 Image linear operation　3.4 Linear filter & Non- Linear filter

3.5 Image sharpening　3.6 Color enhancement

3.7 Image correction

Chapter 4 Thinking in frequency （2h）

4.1 Introduction　4.2 Frequency view of filtering

4.3 Hybrid images　4.4 Sampling

Chapter 5 Image pyramids and applications （2h）

5.1 Introduction　5.2 Template matching

5.3 Image Pyramids　5.4 Filter banks and texture

5.5 Applications

Chapter 6 Edge detection （2h）

6.1 Introduction　6.2 Differential operator

6.3 Edge detection algorithm　6.4 Canny edge detector

6.5 Performance of edge detector

Chapter 7 Interest points and corners （2h）

7.1 Introduction　7.2 Key point detector

7.3 Models of Image Change　7.4 Rotation Invariant Detection

Chapter 8 Local Invariant Features （4h）

8.1 Introduction　8.2 Harris Corner Detector

8.3 Detectors　8.4 Descriptors

8.5 Stable region detectors & descriptors　8.6 Summary and comments

Chapter 9 Feature Matching and Robust Fitting （2h）

9.1 Introduction　9.2 Local feature matching

9.3 Fitting and alignment: overview　9.4 Hough transform

Chapter 10 Model fitting and RANSAC （2h）

10.1 Introduction　　10.2 RANSAC
10.3 Alignment models & algorithms　　10.4 Object instance matching (recognition)

Chapter 11 Stereo （2h）
11.1 Introduction　　11.2 Stereo imaging
11.3 Shape from X　　11.4 Range imaging

Chapter 12 Epipolar Geometry and Structure from Motion （2h）
12.1 Introduction　　12.2 Human stereopsis
12.3 Stereograms　　12.4 Epipolar geometry and the epipolar constraints
12.5 Structure from motion

Chapter 13 Feature Tracking and Optical Flow （4h）
13.1 Introduction　　13.2 Feature tracking
13.3 Optical flow　　13.4 Multi-resolution registration
13.5 Summary and comments

3.Textbooks

(1) Milan Sonka, Vaclav Hlavac, Roger Boyle. Image Processing, Analysis, and Machine Vision (4th Edition), Thomson Engineering, 2014.
(2) Richard Szeliski. Computer Vision: Algorithms and Applications, Springer, 2011.

Main Reference Books

(3) Ramerh Jian, et al., Machine Vision, MIT Press and McGraw-Hill, Inc, 2003
(4) Emanuele Trucco., Introductory Techniques for 3-D Computer Vision, Prentice-Hall Inc., 2008
(5) Svoboda T., Kybic J., and Hlavac V. Image Processing, Analysis, and Machine Vision: A MATLAB Companion. Thomson Engineering, 2008.
(6) 贾云得，机器视觉(第一版)，北京：科学出版社，2000

Written by：ZHOU Dake（周大可）　　**Instructor**：ZHOU Dake（周大可）

Course Code：6B041002L

Course Title(Chinese)：天线理论与技术

Course Title(English)：Antenna Theory and Technique

College and Department：Col. of Electronic and Information Engineering

Semester：Spring

Class Hours：48

Teaching Methods：Lecture, Homework

Suitable Majors: Electronic Science and Technology, Communications Engineering

Assessment Instruments：Examination, Project

Pre-requisites：Electromagnetics Theory, Field Theory

I. Course Objective and Requirements

In this course, theory of electromagnetic radiation, fundamentals of antennas, wire antennas and microstrip antennas, implementation EBG structures for microstrip antennas, antenna matching techniques, antenna arrays, analysis of antenna parameters, simulation of wire and microstrip antennas using 3D and planar electromagnetic simulators will be discussed.

II. Course Content and Schedule

1 Antennas (2h)
- 1.1 Introduction
- 1.2 Types of Antennas
- 1.3 Radiation Mechanism
- 1.4 Current Distribution on a Thin Wire Antenna
- 1.5 Historical Advancement

2 Fundamental Parameters of Antennas (8h)
- 2.1 Introduction
- 2.2 Radiation Pattern
- 2.3 Radiation Power Density
- 2.4 Radiation Intensity
- 2.5 Beam width
- 2.6 Directivity
- 2.7 Numerical Techniques
- 2.8 Antenna Efficiency
- 2.9 Gain
- 2.10 Beam Efficiency
- 2.11 Bandwidth
- 2.12 Polarization
- 2.13 Input Impedance
- 2.14 Antenna Radiation Efficiency
- 2.15 Antenna Vector Effective Length and Equivalent Areas
- 2.16 Maximum Directivity and Maximum Effective Area
- 2.17 Friis Transmission Equation and Radar Range Equation
- 2.18 Antenna Temperature

3 Radiation Integrals and Auxiliary Potential (6h)
- 3.1 Introduction
- 3.2 The Vector Potential A for an Electric Current Source J
- 3.3 T he Vector Potential F for a Magnetic Current Source M
- 3.4 Electric and Magnetic Fields for Electric (J) and Magnetic (M) Current Sources
- 3.5 Solution of the Inhomogeneous Vector Potential Wave Equation
- 3.6 Far-Field Radiation
- 3.7 Duality Theorem
- 3.8 Reciprocity and Reaction Theorems

4 Linear Wire Antennas (8h)
- 4.1 Introduction
- 4.2 Infinitesimal Dipole
- 4.3 Small Dipole
- 4.4 Region Separation
- 4.5 Finite Length Dipole
- 4.6 Half-Wavelength Dipole
- 4.7 Linear Elements Near or on Infinite Perfect Conductors
- 4.8 Ground Effects

5 Loop Antennas (4h)
- 5.1 Introduction1
- 5.2 Small Circular Loop
- 5.3 Circular Loop of Constant Current
- 5.4 Circular Loop with Nonuniform Current
- 5.5 Ground and Earth Curvature Effects for Circular Loops
- 5.6 Polygonal Loop Antennas
- 5.7 Ferrite Loop
- 5.8 Mobile Communication Systems Applications

6 Arrays: Linear, Planar, and Circular (8h)
- 6.1 Introduction
- 6.2 Two-Element Array
- 6.3 N-Element Linear Array: Uniform Amplitude and Spacing
- 6.4 N-Element Linear Array: Directivity
- 6.5 Design Procedure
- 6.6 N-Element Linear Array: Three-Dimensional Characteristics
- 6.7 Rectangular-to-Polar Graphical Solution
- 6.8 N-Element Linear Array: Uniform Spacing, Non-uniform Amplitude
- 6.9 Super directivity
- 6.10 Planar Array
- 6.11 Design Considerations
- 6.12 Circular Array

7 Antenna Synthesis and Continuous Sources (6h)
- 7.1 Introduction
- 7.2 Continuous Sources
- 7.3 Schelkunoff Polynomial Method
- 7.4 Fourier Transform Method
- 7.5 Woodward-LawsonMethod
- 7.6 Taylor Line-Source (Tschebyscheff-Error)
- 7.7 Taylor Line-Source (One-Parameter)
- 7.8 Triangular, Cosine, and Cosine-Squared Amplitude Distributions
- 7.9 Line-Source Phase Distributions
- 7.10 Continuous Aperture Sources

8 Integral Equations, Moment Method, and Self and Mutual Impedances (4h)
- 8.1 Introduction
- 8.2 Integral Equation Method
- 8.3 Finite Diameter Wires
- 8.4 Moment Method Solution
- 8.5 Self-Impedance
- 8.6 Mutual Impedance Between Linear Elements
- 8.7 Mutual Coupling in Arrays

III. Examination (2h)

IV. Textbook

C.A. Balanis, *Antenna Theory: Analysis and Design s,* John Wiley & Sons, 2005, Springer

Written by：CAO Qunsheng（曹群生） **Instructor**： CAO Qunsheng（曹群生）.

Course Code：6B042003L

Course Title (Chinese): 信道编码理论与应用

Course Title (English): Channel Coding: From Theory to Practice

College and Department：Col. of Electronic Information Engineering

Semester: Spring

Course hours: 32

Teaching methods：Lecturing, Assignments and Presentations

Suitable majors: Information Engineering

Assessment instruments：Examination, Research Presentations.

Pre-requisites：Digital Communications, Digital Signal Processing, Theory of Probability and Stochastic Process, Fundamental of Information Theory, Linear Algebra.

1. Course objectives and Requirements

Coding theory is still a young subject. One can sefely say that she was born in 1948 when Claude Elwood Shannon, who is credited as father of modern communication, published his landmark paper "A Mathematical Theory of Communication" in Bell System Technical Journal, vol. 27, pp. 379−423, 623–656, 1948.

This course is an introduction to the subjects of information and coding theory at the graduate or advanced undergraduate level. Prerequisites include a basic knowledge of *elementary probability and stochastic process*, as well as a foundation in modern and *linear algebra*, *digital communications* and *digital signal processing*.

The main problem of information and coding theory can be described in a simple way as follows: Imagine that a stream of source data, say in the form of bits (0's and 1's), is being transmitted over a communications channel, such as a telephone line. From time to time, disruptions take place along the channel, causing some of the 0's to be 1's, and vice-versa. The question is "How can we tell when the original source data has been changed, and when it has, how can we recover the original data?"

The contents of the course, which can solve the aforementioned puzzled problems, is outlined as follows.

2. Course contents and Schedule

Chapter 1. Introduction to Algebra (4 h)
- **1.1 Group**
- **1.2 Fields**
- **1.3 Binary Field Arithmetic**
- **1.4 Construction of Galois Fields**
- **1.5 Basic Properties of a Galois Fields**
- **1.6 Computations Using Galois Field Arithmetic**
- **1.7 Vector Spaces**
- **1.8 Matrices**
- **References**

Chapter 2 Error-Correcting Coding (4 h)
- **2.0. Introduction**
- **2.1. The Capacity Penalty of Binary Coding**
- **2.2. Binary Linear Block Codes**
  - 2.2.1. Performance of Soft Decoders
  - 2.2.2. Performance of Hard Decoders
  - 2.2.3. Parity-Check Matrix
  - 2.2.4. Hamming Codes
  - 2.2.5. Cyclic Codes
  - 2.2.6.BCH Codes: Binary BCH Codes and Nonbinary BCH Codes
  - 2.2.7. Reed-Solomon Codes
  - 2.2.8. Maximal-Length Shift Register Codes
- **2.3. Convolutional Codes**
  - 3.3.1. Performance of Soft Decoders
  - 3.3.2. Performance of Hard Decoders
- **2.4. Historical Notes and Further Reading**
- **References**

Chapter 3. General Linear Block Codes (4 h)
- **3.1 Introduction to General Linear Block Codes**
- **3.2 Syndrome and Error Detection**
- **3.3 The Minimum Distance of a Block Code**
- **3.4 Error-Detecting and Error-Correcting Capabilities of a Block Code**
- **3.5 Standard Array and Syndrome Decoding**
- **3.6 Probability of an Undetected Error for Linear Codes over a BSC**
- **3.7 Single-Parity-Check Codes, Repetition Codes, and Self-Dual Codes**
- **References**

Chapter 4 Probabilistic Detection (4 h)
- **4.0. Introduction**
- **4.1. Detection of a Signal Real-Value Symbol**
  - 4.1.1 Discrete-Value Observation
  - 4.1.2 Continuous-Valued Observation
- **4.2. Detection of a Signal Vector**
  - 4.2.1 ML Detection
  - 4.2.2 MAP Detector
  - 4.2.3 Probability of Error for BSC ML Detector
- **4.3. Known Signals in Gaussian Noise**
  - 4.3.1 Discrete-Time Received Signal
  - 4.3.2 Continuous-Time Reception

4.3.3 Sufficient Statistics
4.3.4 Optimal Detection for PAM with ISI
4.4. ML Sequence Detection with the Viterbi Algorithm
4.5. A Posteriori Probability Detection with BCJR
4.5.1. Special Case: Binary Alphabet
4.5.2. Normalization
4.6. Symbol-Error Probability for MLSD
4.6.1. Error Events
4.6.2. Calculating the Minimum-Distance for ISI
References
Chapter 5 Signal-Space Coding (4 h)
5.0. Introduction
5.1. Multidimensional Signal Constellation
5.1.1. Lattice Codes
5.1.2. Normalized SNR and Error Probability
5.1.3. Coding and Shaping Gains for Lattice Codes
The Continuous Approximation
Shaping and Coding Gain
Cartesian Product Constellations
Maximum Shaping Gain
Marginal Density for Spherical Shaping
Relation of Spectral Efficiency and Energy
5.2. Trellis Codes
5.2.1. Simple Trellis Codes
5.2.2. Total Gain of Trellis Codes
5.2.3. More Elaborate Trellis Codes
Mapping by Set Partitioning
Catastrophic Codes
Trellis Coding using Nonlinear Convolutional Codes
Multidimensional Trellis Codes
5.3. Coset Codes
5.3.1. Lattice Partitions and Cosets
5.3.2. Application to Trellis Coding
5.3.3. Coding Gain due to Redundancy
5.4. Signal-Space Coding and ISI
5.4.1 Trellis Coding and Linear Equalization
5.4.2.Trellis Coding and Transmitter Precoding
Coding Gain on Channel with ISI
Trellis Coding and Shaping Gain
5.4.3. RSSD of Trellis Codes
5.4.4. Signal-Space Coding and Multicarrier Modulation
5.5. Lattice and Trellis Codes in-depth View
References
Chapter 6. Turbo Codes and Iterative Turbo Decoding (4 h)
6.0 Introduction
6.1 General Interleaver for Burst Errors
6.2 Interleaving for Turbo Codes
6.3 Upper Bounds of Parallel Concatenated Codes
6.3.1 Probability Average for Weight Distribution of Turbo Codes
6.3.2 Recursive/Nonrecursive Constituent Convolutional Codes and Interleaver Gain of Turbo Codes
6.3.3 Effective Fee Distance
6.3.4 Performance Evaluation of Turbo Codes
6.3.5 Turbo Codes Design
6.4 Serially Concatenated Codes: Upper Bounds and Design Criterions
6.4.1 Serially Concatenated Block Codes
6.4.2 Serially Concatenated Convolutional Codes
6.4.3 Performance Bound of Serially Concatenated Convolutional Codes
6.5 Design of Code-Matched Interleavers for Parallel and Serially Concatenated Convolutional Codes
6.5.1 Several Important Low Weight Input Patterns for Turbo Codes
6.5.2 Interleaving Techniques for Breaking Low Input Weights, Uniform Protection and Trellis Termination
6.5.3 S-random Interleavers
6.5.4 Design of Code-Matched Interleavers for Turbo Codes Based on S-random Interleavers
6.5.5 Performance of Turbo Codes with Code-Matched Interleavers
6.5.6 Code-Matched Interleavers for Serially Concatenated Convolutional Codes

6.6 The MAP Algorithm
6.7 Extrinsic Information for Iterative Decoding
6.7.1 Extrinsic Information for Parallel Concatenated Codes
6.7.2 Conventional Gaussian Method for MAP Algorithm
6.7.3 Direct Method for MAP Algorithm
6.7.4. Extrinsic Information for Max-Log- MAP and Log-MAP Algorithms
6.7.5 Extrinsic Information for SOVA Decoder
6.7.6 Performance Comparison of the Two Basic Methods for Turbo Codes
6.7.7 Extrinsic Information for Serially Concatenated Codes
6.7.8 The Basic SISO Module
6.7.9 Performance Comparison of the Two Methods for SCCC's
6.8 Product Codes
6.8.1 Trellis Structure of Linear Binary Block Codes
6.8.2 The Construction of Product with Simple Identical Component Block Codes
6.8.3 An Exact MAP Algorithm for Short and Medium Lengths Product Codes
6.8.4 Performance Analysis and Comparison
References

Chapter 7. Low-Density Parity-Check Codes and Iterative LDPC Decoding (4 h)
7.1 Introduction
7.2 Regular LDPC Codes of Gallager's Type
7.2.1 Basic Notions of Regular LDPC Codes
7.2.2 Encoding of Regular LDPC Codes
7.3 Complexity Analysis for LDPC Encoding
7.3.1A Typical Example for LDPC Encoding Procedures
7.4 Message-Passing Decoder: Belief Propagation Algorithm by Probabilities and Likelihood Ratios
7.5 Extrinsic Information on Message- Passing Decoding
7.6 Probability Density Evolutions and Thresholds of Message-Passing Decoding
7.6.1 Gallager's Decoding Algorithm A over a BSC
7.6.2 Gallager's Decoding Algorithm B over a BSC
7.6.3 BSC with Erasures in the Iterative Decoder
7.6.4 BER Performance Comparison for Various Decoding Algorithms
7.7 Accurate Representations of LLR-Based Belief Propagation Algorithms
7.7.1 LLR-BP Algorithm Based on the Tanh Rule
7.7.2 LLR-BP Algorithm Based on the Gallager's Approach
7.7.3 LLR-BP Algorithm Based on the Jacobian Approach
7.7.4 Computational Complexity for LLR- BP Algorithms Based on Different Approaches
7.8 Probability Density Evolutions of Belief Propagation Decoding Algorithms with Continuous Message Alphabets
7.9 Thresholds of Belief Propagation Decoding Algorithms with Continuous Message Alphabets over Memoryless Binary-Input Continuous-Output Channels
7.9.1 Thresholds over Binary-Input Additive White Gaussian Noise (BIAWGN) Channel
7.9.2 Thresholds over Binary-Input Laplace (BIL) Channel
References

Chapter 8 One- and Two-Dimensional Modulation for TCM (4 h)
8.1. Introduction
8.2. Step-by-Step Design Procedure
8.2.1. Derivation of the Analytical Description
8.2.2. Design rules and procedure
8.3. One Dimensional Examples
8.4. Two Dimensional Examples
8.5. Trellis Coding Performance and realization
8.6. Trellis Coding with Asymmetric Modulations
8.6.1. Analysis and Design
8.6.2. Best Rate 1/2 Codes Combined with Asymmetric 4-PSK
8.6.3 Best Rate 2/3 Codes Combined with Asymmetric 8-PSK
8.6.4. Best Rate 1/2 Codes Combined with Asymmetric 4-AM
References

4.Textbook

[1] J. H. Van Lint, Introduction to Coding Theory, 3rd Edition, Spring-Verlag, Heideberg, New York, 2006.

Reference books

[2] Steven Roman, Coding and Information Theory, Springer-Verlag, Spring-Verlag, Berlin, Heideberg, New York, 2005.
[3] John G. Prokais, Digital Communications, 4th Edition, McGraw-Hill, Inc. 2001.
[4] M. B. Pursley, Introduction to Digital Communications, Prentice Hall, 2005.

[5] Mohinder Jankiraman, Space-Time Codes and MIMO Systems, Aretech House Inc. 2004.
[6] Kamilo Feher, Advanced Digital Communications: Systems and Signal Processing Techniques, Prentice Hall, Inc. 1987.
[7] Kamilo Feher, Digital Communications: Satellite/Earth Station Engineering, Noble Publishing Corporation, Atlantic, 1997.

Written by：YANG Fengfan（仰枫帆）

Principal Lecturer: YANG Fengfan（仰枫帆）

Co-lecturer: ZONG Peng（宗鹏） YE Ming（叶明）

Course Code：7D041007L

Course Title(Chinese)：高速电路的信号完整性

Course Title(English)：Signal Integrity for High-Speed Circuits

College and Department：Col. of Electronic Information Engineering

Semester：Spring

Class Hours：32

Teaching Methods：Lecture, Experiment, Homework

Suitable Majors: Electronic Science and Technology, Communications Engineering

Assessment Instruments：Examination, Project

Pre-requisites：Microwave Technology, Basic of Digital circuit and Integrated Circuit

1. Course Objective and Requirements

Signal integrity (SI) is a set of measures of the quality of an electrical signal. In digital electronics, a stream of binary values is represented by a voltage (or current) waveform. Over short distances and at low bit rates, a simple conductor can transmit this with sufficient fidelity. At high bit rates and over longer distances or through various mediums, various effects can degrade the electrical signal to the point where less-than-ideal conditions (errors) occur, and the system or device fails. Signal integrity engineering is the task of analyzing and mitigating these effects. Signal integrity engineering is an important activity at all levels of electronics packaging and assembly, from internal connections of an integrated circuit (IC), through the package, the printed circuit board (PCB), the backplane, and inter system connections. While there are some common themes at these various levels, there are also practical considerations, in particular the interconnect flight time versus the bit period, that cause substantial differences in the approach to signal integrity for on-chip connections versus chip-to-chip connections. Some of the main issues of concern for signal integrity are ringing, crosstalk, ground bounce, distortion, signal loss, and power supply noise.

Course objectives: This course will focus on fundamental signal design, analysis and modeling methodology in advanced electronic packaging. Main topics include transmission line theory, GHz differential serial link design, timing and jitter analysis fundamental, frequency and time domain analysis, power distribution networks design and modeling, measurement techniques for SI.

2. Course Content and Schedule

Chapter 1 The Importance of Interconnect Design（2h）
- 1.1 The Basic
- 1.2 The Past and the Future

Chapter 2 Ideal Transmission Line Fundamental （8h）
- 2.1 Transmission Line Structures on a PCB or MCM
- 2.2 Wave Propagation
- 2.3 Transmission Line Parameters
  - 2.3.1 Characteristic Impedance
  - 2.3.2 Propagation Velocity, Time, and Distance
  - 2.3.3 Equivalent Circuit Models for SPICE Simulation
- 2.4 Launching Initial Wave and Transmission Line Reflections
  - 2.4.1 Initial Wave
  - 2.4.2 Multiple Reflections
  - 2.4.3 Effect of Rise Time on Reflections
  - 2.4.4 Reflections from Reactive Loads
  - 2.4.5 Termination Schemes to Eliminate Reflections

Chapter 3 Crosstalk （8h）
- 3.1 Mutual Inductance and Mutual Capacitance
- 3.2 Inductance and Capacitance Matrix
- 3.3 Field Simulators
- 3.4 Crosstalk-Induces Noise
- 3.5 Simulating Crosstalk Using Equivalent Circuit Models
- 3.6 Crosstalk-Induced Flight Time and Signal Integrity Variations
- 3.7 Crosstalk Trends
- 3.8 Termination of Odd- and Even-Mode Transmission Line Paris
- 3.9 Minimization of Crosstalk

Chapter 4 Connectors, Packages, and Vias （6h）
- 4.1 Vias
- 4.2 Connectors

4.2.1 Series Inductance
4.2.2 Shunt Capacitance
4.2.3 Connector Crosstalk
4.2.4 Effects of Inductively Coupled Connector Pin Field
4.2.5 EMI
4.3 Chip Package
4.3.1 Common Types of Packages
4.3.2 Creating a Package Model
4.3.3 Effects of Package
4.3.4 Optimal Pin-Outs
Chapter 5 Digital Timing Analysis （4h）
5.1 Common-Clock Timing
5.1.1 Common-Clock Timing Equations
5.2 Source Synchronous Timing
5.2.1 Source Synchronous Timing Equations
5.2.2 Deriving Source Synchronous Timing Equations from an Eye Diagram
5.2.3 Alternative Source Synchronous Schemes

2. Experiments (Computer simulation and test) (2h)
Simulate and analysis crosstalk effect for via throughout a PCB using HFSS software.

3. Examination (2h)

4. Textbook
Howard Johnson，Advanced Signal Integrity for **High-Speed Digital Design**, John Wiley & Sons, Inc. 2009

Main Reference Books
Eric Bogatin, Signal Integrity: Simplified, House of Electronic Industry, 2004

Written by：CAO Qunsheng（曹群生） **Instructor**： CAO Qunsheng（曹群生）

Course Code：7D042011Y/7D042011L

Course Title(Chinese)：数字图像处理

Course Title(English)：Digital Image Processing

College and Department：Col. of Electronic and Information Engineering

Semester：Spring

Class Hours：40

Teaching Methods：Lecture 40h, Experiments 8h（extra）

Suitable Majors: Signal and Information Processing, Computer Science and technology, Communication Engineering, Medical Image Processing etc.

Assessment Instruments：Examination(60%), Final report(20%) with oral presentation(20%) based on laboratory projects

Pre-requisites：Matrix, Probability Theory, Digital Signal Processing

1.Course Objective and Requirements

The principal objectives of the course continue to be to provide an introduction to basic concepts and methodologies for digital image processing, and to develop a foundation that can be used as the basis for further study and research in this field. To achieve these objectives, we focused again on material that we believe is fundamental and whose scope of application is not limited to the solution of specialized problems. The mathematical complexity of the course remains at a level well within the grasp of college seniors and first-year graduate students who have introductory preparation in mathematical analysis, vectors, matrices, probability, statistics, linear systems, and computer programming. The relating Web site, www.imageprocessingplace.com, provides tutorials to support students needing a review of this background material.

The material of the course is timely, highly readable, and illustrated with numerous examples of practical significance. After an introduction to digital image processing, the course proceeds to address the mainstream areas of image processing. All mainstream areas of image processing covered include image fundamentals, image enhancement in the spatial and frequency domains, image transform, image restoration, color image processing, image compression, morphology image processing, image segmentation and detection, and image description. Coverage concludes with a discussion on the fundamentals of object recognition.

2.Course Content and Schedule

Chapter 1 Introduction (2h)
- 1.1 What is digital image processing
- 1.2 Historical perspective of digital image processing
- 1.3 Principle approaches used in digital image processing
- 1.4 Fundamental steps in digital image processing
- 1.5 Components of digital image processing system

Chapter 2 Digital Image Fundamentals (4h)
- 2.1 Elements of visual perception
- 2.2 Light & electromagnetic spectrum
- 2.3 Image sensing and acquisition
- 2.4 Image sampling and quantization

Chapter 3 Image Transform (4h)
- 3.1 Elements of image transform
- 3.2 Discrete Fourier Transform
- 3.3 Discrete Cosine Transform
- 3.4 Hadamard Transform
- 3.5 Haar Transform
- 3.6 K_L Transform

Chapter 4 Image Enhancement (8h)
- 4.1 Enhancement in Spatial Domain
  - 4.1.1 Basic gray level transformations
  - 4.1.2 Enhancement between images
  - 4.1.3 Histogram processing
  - 4.1.4 Smoothing spatial filters
  - 4.1.5 Sharpening spatial filters
- 4.2 Enhancement in Frequency Domain
  - 4.2.1 Smoothing frequency filters
  - 4.2.2 Sharpening frequency filters

4.2.3 Homomorphic filters
Chapter 5 Image Restoration (4h)
5.1 Noise models
5.2 Restoration in spatial filtering
5.3 Restoration in frequency filtering
5.4 Estimating the degradation function
5.5 Typical filtering methods
Chapter 6 Image Compression (4h)
6.1 Compression fundamentals
6.2 Error-free compression
6.3 Lossy compression
6.4 Compression standards
Chapter 7 Image Analysis (10h)
7.1 Segmentation and Detection
7.1.1 Detection of discontinuities
7.1.2 Edge linking & boundary detection
7.1.3 Thresholding
7.1.4 Region-based segmentation
7.1.5 Morphological image processing
7.1.6 Morphological watersheds
7.2 Representative and Description
7.2.1 Basic representation
7.2.2 Boundary descriptors
7.2.3 Regional descriptors
7.3 Object Recognition
7.3.1 Computing distance measures
7.3.2 Recognition based on decision-theoretic methods
7.3.3 Structural recognition
Chapter 8 Color Image Processing(4h)
8.1 Color Models
8.2 Color Transformations
8.3 Color Image Smoothing
8.4 Color Image Sharpening
8.5 Color Segmentation

3.Experiments

Experiments are shown in attached PDF file - Laboratory Projects modified by LN. The contents of the experimental projects are listed as follows:
Project 1 Zooming and Shrinking Images
Project 2 Image Enhancement Using Intensity Transformations
Project 3 Histogram Equalization
Project 4 Image Enhancement by High-boost Filtering
Project 5 Two-Dimensional Fast Fourier Transform
Project 6 Application: X-ray Image Enhancement by Combing Spatial Enhancement Methods
Project 7 Noise Reduction Using a Median Filter
Project 8 Image Restoration by Parametric Wiener Filter
Project 9 Application: Fingerprint image Pre-processing by Morphological Filtering
Project 10 Edge Detection by Different Edge Detectors
Project 11 Applications: Roofline Detection via Hough Transform
Project 12 Image Segmentation by Using Thresholding
Project 13 Application: Weld Porosity Detection by Region Growing
Project 14 Application: Marked-controlled Watershed Segmentation

Each student is required to choose 4-5 projects from 14 laboratory projects. The Information and Signal Processing Lab. will provide the programming environment needed to implement these projects. The final report must be finished under the experimental results of each student. In addition, the oral presentation of the project must be executed in the end of the term. Because the project you choose will be assigned to the score of final examination, it is suggested that project reports be kept short, and be organized in a uniform manner to simplify grading.

4.Textbooks

1. Rafael C. Gonzales and Richard E. Woods, Digital Image Processing, 3rd Edition, Pearson Prentice Hall, 2008.
2. Rafael C. Gonzales and Richard E. Woods, Digital Image Processing, 2nd Edition, Publishing House of

Electronics Industry, 2002.

Digital Image Processing is a completely self-contained course. However, the companion Web site, www.imageprocessingplace.com, offers additional support in a number of important areas.

For the Student, the site contains

- Reviews in areas such as probability, statistics, vectors, and matrices.
- Complete solutions to selected problems.
- Computer projects.
- A Tutorials section containing dozens of tutorials on most of the topics discussed in the book.
- A database containing all the images in the text book of digital image processing.

Main Reference Books

1. Rafael C. Gonzales, Digital I\mage Processing Using MATLAB, 2nd Edition, Pearson Prentice Hall, 2009.
2. Rafael C. Gonzales, Digital Image Processing Using MATLAB, 1st Edition, Publishing House of Electronics Industry, 2004.
2. 冈萨雷斯，数字图像处理（MATLAB 版），电子工业出版社，2004
3. 朱志刚等译，数字图像处理，电子工业出版社，2002
4. 赵荣椿，数字图象处理导论，西工大出版社，2000
5. 徐建华，图象处理与分析，科学出版社，1990

Written by：LI Ning（黎宁）　　**Instructor**：LI Ning（黎宁）

Course Code：7D153002L

Course Title(Chinese)：雷达网络技术

Course Title(English)：Techniques of Radar Networking

College and Department：Col. of Astronautics

Semester：Spring

Class Hours：32

Teaching Methods：Lecture, Report Homework

Suitable Majors: Telecommunication Engineering

Assessment Instruments：Design, Project

Pre-requisites：Signal and system, Electromagnetic, Telecommunication Theory

1.Course Objective and Requirements

Netted radar becomes a very important part of the C^4ISR (Command, Control, Communication, Computer, Information, Surveillance, Reconnaissance) system and it presents an important trend of radar development. It has a great future. The course is mainly concerned by radar principle, fundamental techniques and applications. It amalgamates traditional radar technology and signal processing with new networking technology. The objective of this course is to make the student acquiring how to solve the practical problem by using basic theory. Meanwhile, it improves the student's synthesizing and self learning ability.

2.Course Content and Schedule

Chapter 1 An Introduction and Overview of Radar (2h)
- 1.1 Types of Radars
- 1.2 The Radar Equations
- 1.3 Applications of Radar
- 1.4 Conceptual Radar System Design

Chapter 2 Radar Fundamentals (6h)
- 2.1 Radar Range Performance Computations
- 2.2 Statistical Relationships for Various Detection Processes
- 2.3 Introduction to MTI and MTD
- 2.4 Pulse Compression Radar
- 2.5 Target Acquisition And Range Tracking
- 2.6 Range and Doppler Ambiguity Resolution

Chapter 3 Radar Antennas (2h）
- 3.1 Principles of Reflector Antenna
- 3.2 Theory of Array Antenna
- 3.3 Digital Beamforming of Phased Array Systems
- 3.4 Radiation Pattern Nulling

Chapter 4 Radar Transceiver (2h）
- 4.1 Introduction to Radar Transmitters
- 4.2 Magnetron and Gyrotrons Amplifiers
- 4.3 Solid-State Transmitters
- 4.4 The Configuration of a Radar Receiver

Chapter 5 Radar Signal Processing (2h）
- 5.1 The Radar Ambiguity Function and Matched Filters
- 5.2 Optimum Waveforms for Detection
- 5.3 Range-Doppler Ambiguity
- 5.4 Digital Representation of Signals

Chapter 6 Digital Signal Processing (2h）
- 6.1 Radar Digital Signal Processing
- 6.2 Receive Channel Processing
- 6.3 Transmit Channel Processing
- 6.4 DSP Tools

Chapter 7 SAR Radar and Applications (4h）
- 7.1 Key Aspects of SAR
- 7.2 SAR Image Quality
- 7.3 Summary of Key SAR Equations
- 7.4 Special SAR Applications

Chapter 8 Conceptual Networking (6h）
- 8.1 Layered communication approaches

8.2 Multiple Access control
8.3 Switching Technology
8.4 Routing Algorithms
8.5 Distributed Network Systems

Chapter 9 Anti-Stealth and ECCM (2h）
9.1 Introduction to Stealth and Anti-Stealth
9.2 RCS Prediction Techniques RCS
9.3 Objectives and Taxonomy of ECCM Techniques

Chapter10 Netted Radar (4h)
10.1 The advantages of netted radar
10.2 Bistatic Radar Concept and Definitions
10.3 Bistatic Radar Equations
10.4 Multi-Target Tracking
10.5 Applications of Netted Radar

3.**Textbooks**

[1] *Radar Design Principles*，By Fred E. Nathanson, McGraw-Hill, Inc, ISBN 1-891 121-09-X.
[2] *Radar Handbook,* By Merrill I. Skolnik Hardcover, McGraw-Hill, ISBN10: 0071485473 ISBN 13: 9780071485470.
[3] *DISTRIBUTED NETWORK SYSTEMS, From Concepts to Implementations*, WEIJIA JIA, Springer Science, ISBN: 0-387-23839-5.

Main Reference Books

[4] *Fundamentals of Radar Signal Processing*, By Mark A. Richards, The McGraw-Hill Inc. ISBN 0-07-144474-2.
[5] *Synthetic Aperture Radar Systems and Signal Processing*，By John C. Curlander，John Wiley & Sons, Inc. ISBN 0-471-85770-X.
[6] *Computer Networking first-step*，By Wendell Odom，Cisco Press，ISBN: 1-58720-101-1.
[7] *Networks and Grids Technology and Theory,* Thomas G. Robertazzi, Springer Science, ISBN-13: 978-0-387-36758-3.

Written by：ZONG Peng（宗鹏）　　**Instructor**：ZONG Peng（宗鹏）

Course Code：6B162002L

Course Title(Chinese)：高级软件工程

Course Title(English)：Advanced Software Engineering

College and Department：Col. of Computer Science & Technology
Semester：Spring
Class Hours：48
Teaching Methods：Lecture, Discussion
Suitable Majors: Computer Science and Technology/Software Engineering
Assessment Instruments：Examination
Pre-requisites：Discrete Mathematics

1.Course Objective and Requirements

This course introduced advanced topics in software engineering -- modeling and verification of of safety-critical systems. In particular, this course will introduce model checking techniques for verifying safety-critical systems, including state transition systems, temporal logics, CTL model checking algorithms, symbolic model checking, abstraction, and software model checking. The students are expected to actively attend discussion on class, read and present research papers and projects on the above topics.

2.Course Content and Schedule

1、 Foundations of Software Engineering (4 hours)
   a) Software systems and process
   b) Software requirements and design
   c) Software development and verification
2、 Critical Systems (4 hours)
   a) System dependability
   b) Availability and reliability
   c) Safety and Security
3、 Formal Modeling of Software System (10 hours)
   a) State-transition system
   b) Kripke Structure
   c) Temporal Logic – CTL
   d) Temporal Logic - LTL
4、 Model Checking (10 hours)
   a) Fixpoing-based Model Checking
   b) CTL Model Checking Algorithms
   c) Counter-example Generation
   d) System modeling and verification
5、 Symbolic Model Checking (10 hours)
   a) Binary Decision Diagrams
   b) Lattice Theory
   c) Symbolic Model Checking Algorithms
   d) Symbolic Model Checking Tool
   e) Model Checking Practice
6、 Abstraction (4 hours)
   a) Simulation and Bisimulation
   b) Over-approximation and Under-approximation
   c) Abstract model checking
7、 Software Model Checking (4 hours)
   a) Program Model and Semantics

b) Predicate Abstraction
c) Counter-example guided refinement

8、 Course Review (2 hours)

3.Experiments

Project: Model Checking Elevator Control System (Design)

The project involves specifying the behavior of a simple elevator system, describing the expected temporal properties and verifying the system using a model checking tool.

4.Textbooks

ISBN 7111160533

Logic in Computer Science : Modelling and Reasoning about Systems (2nd Edition)

By Michael Huth, Mark Ryan

机械工业出版社 2005 年 4 月

Main Reference Books

ISBN 7-111-19770-4

Software Engineering （8th Edition） By Ian Sommerville

机械工业出版社 2006 年 9 月

Written by：WEI Ou（魏欧） **Instructor**：WEI Ou（魏欧）

Course Code：6B162003L

Course Title(Chinese)：软件质量分析与度量

Course Title(English)：Software Metrics

College and Department：Col. of Computer Science & Technology

Semester：Spring

Class Hours：40

Teaching Methods：Lecture, Experiment

Suitable Majors: Software Engineering

Assessment Instruments：examinationg

Pre-requisites：Programming, Software engineering

1. Course Objective and Requirements

The Software Metrics course systematically introduces the fundamental theory, methodology and tools about software metrics. The emphasis of the course is the fundamental theories, size measurement, structure measurement, object oriented measurement, software design measurement, software reliability measurement and so on. With the help of this course, as well as the associated practices on this subject, the students' ability on the software analysis and measurement improvement can be improved, and the understanding of the software quality and the solutions can be enhanced. On the other hand, we also emphasize the practical aspects, we utilizes specific tools and ask students to use and master them. In this way, the students can gradually be trained to have a good academic research habit and thus pave a ground for the future research and study.

2. Course Content and Schedule

Chapter 1 Introduction（4h）
- 1.1 Software quality introduction
- 1.2 The history of software metrics
- 1.3 Techniques of software evaluation

Chapter 2 Fundamental theory of testing and experiments（4h）
- 2.1 Fundamentals of software testing
- 2.2 Framework of software testing
- 2.3 Data collection
- 2.4 Empirical analysis
- 2.5 Data analysis

Chapter 3 Size metrics（4h）
- 3.1 Software size
- 3.2 Software length
- 3.3 Software reuse
- 3.4 Functionality
- 3.5 Complexity

Chapter 4 Structure metrics（6h）
- 4.1 Modules
- 4.2 Control flow structure
- 4.3 Modules and information flow properties

Chapter 5 Object oriented metrics（4h）
- 5.1 Coupling
- 5.2 Cohesion
- 5.3 Framework of OO metrics
- 5.4 OO models
- 5.5 Prism Elements

Chapter 6 Metrics of Software design phase（2h）
- 6.1 Software architecture metrics
- 6.2 Model driven language
- 6.3 UML metrics

Chapter 7 Resource metrics and process prediction（2h）
- 7.1 Productivity metrics
- 7.2 Cost estimation
- 7.3 Workload and cost model
- 7.4 Process predictioin

Chapter 8 Software reliability prediction and quality modeling（6h）
- 8.1 External properties

8.2 Quality modeling
8.3 Reliability theory
8.4 Data analysis techniques
8.1 Plate Theory
8.2 Plate Elements

3. **Experiments**

Project1: Experiments of software size and complexity metrics（4h，Design）
The project requires the implementation of software size and complexity metrics based on one of main programming languages.
Project2: Object oriented software metrics（4h，Design）
The project aims to develop a metrics software for object oriented software based on one of the main programming languages.

4. Textbooks

(1) Norman E.Fenton, Shari Laawrence Pfleeger. Software Metrics (2nd version). 2003.

Main Reference Books

1．侯红 (作者), 软件度量与软件过程管理，清华大学出版社，2009
2．张瑾，软件质量管理指南，电子工业出版社，2009

Written by：ZHOU Yu（周宇）　　**Instructor**：ZHOU Yu（周宇）

Course Code：6B169002L

Course Title(Chinese)：应用逻辑

Course Title(English)：Logic for Applications

College and Department：Col. of Computer Science & Technology

Semester：Spring

Class Hours：48

Teaching Methods：Lecture, Experiment, Homework

Suitable Majors: Computer Science

Assessment Instruments：Examination, Project

Pre-requisites：Discrete Mathematics

1.Course Objective and Requirements

Logic is the study of valid reasoning. It is used in most intellectual activities, and is studied primarily in the disciplines of philosophy, mathematics, semantics, and computer science. In this course we will study several major logic forms including description logics together with their important applications.

Topics include:

- Classical logic and its applications: propositional logic, predicate logic, modal logic
- description logic: concept descriptions and decidability of reasoning
- ontology web languages (OWL): the most important application of description logic
  - using ontology web languages: tools and applications
  - releted languages: rdf, sparql, rif, swrl, …
- extensions to description logics: temporal, uncertain, distributed, …

The course's goal is to provide participants with a general understanding of these logic forms, and the current state-of-the-art of their applications. The emphasis will be on a rigorous approach to use logic in practice. Students will acquire knowledge of a significant body of theoretical literature on logic, will gain practice in exploring the ideas, methods and approaches of the applications of logic, and will acquire skill of using logic in their subjects.

2.Course Content and Schedule

1 Introduction (2h)
- 1.1 What is logic?
- 1.2 History of logic
- 1.3 Logic for Applications
- 1.4 Guide for the Course

2 Propositional Logic (2h)
- 2.1 Orders and Trees
- 2.2 Propositions, Connectives and Truth
- 2.3 Proofs in Propositional Logic
- 2.4 Applications of Propositional Logic

3 Predicate Logic (4h)
- 3.1 Predicates and Quantifiers
- 3.2 Terms and Formulas
- 3.3 Formation Trees, Structures and Lists
- 3.4 Meaning and Truth
- 3.5 Proofs in Predicate Logic
- 3.6 Resolution

4 Modal Logic (2h)
- 4.1 Modal operators
- 4.2 Modal Tableaux

5 Logic Programming (6h)
- 5.1 PROLOG
- 5.2 SLD-Resolution
- 5.3 Searching and Backtracking
- 5.4 Controlling the Implementation
- 5.5 Termination Conditions
- 5.6 Equality
- 5.7 Negation as Failure
- 5.8 Computability and Undecidability

6 Description Logic (6h)
- 6.1 Basic Description Logics

6.2 Tableaux Algorithm
6.3 Complexity of Reasoning
6.4 Expressive Description Logics
6.5 Extensions to Description Logics
6.6 Implementation and Applications
7 Ontology Web Language (8h)
7.1 What is the Semantic Web
7.2 RDF: the Basis of the Semantic Web
7.3 Query and Inference of RDF
7.4 RDF Schema
7.5 RDFS-Plus
7.6 Basic OWL
7.7 Counting and Sets in OWL
7.8 OWL Levels and Logic
8 Applications (8h)
8.1 Building an Ontology
8.2 Ontology Reasoners
8.3 Semantic Web Programming
8.4 Web Services
8.5 Knowledge Representation
8.6 Software Engineering
9 Extensions to Description Logics (8h)
9.1 Temperal description logics
9.2 Fuzzy description logics
9.3 Probobalistic description logics
9.4 Distributed description logic
9.5 Other extensions
10 Conclusions (2h)
10.1 A Comparative Overview
10.2 The Future

3.Textbooks

1. Anil Nerode, Richard A. Shore. Logic for Applications (Texts in Computer Science). Springer, 1997. ISBN 0387948937 -- 应用逻辑（英文影印版•第 2 版）机械工业出版社 2006. ISBN 7111197720
2. The Description Logic Handbook: Theory, Implementation and Applications. Cambridge University Press, Second edition, 2010. ISBN 0521150116

4. Main Reference Books

1. R. Brachman and H. Levesque, Knowledge representation and reasoning. Morgan Kaufmann, 2004.
2. G. Antoniou and F. van Harmelen, A Semantic Web Primer, 2nd Editio. The MIT Press, 2008.
3. Hitzler, Pascal, Markus Krotzsch, and Sebastian Rudolph. Foundations of semantic web technologies. CRC Press, 2009.
4. Domingue, John, Dieter Fensel, and James A. Hendler, eds. Handbook of semantic web technologies. Springer Science & Business Media, 2011.

Written by：KANG Dazhou（康达周）
Instructor：MA Zongmin（马宗民） KANG Dazhou（康达周）， et.al.

Course Code：7D161010L

Course Title(Chinese)：数据挖掘

Course Title(English)：Data mining

College and Department：Col. of Computer Science &Technology

Semester：Spring

Class Hours：48

Teaching Methods：Lecture, Experiment, Homework

Suitable Majors: All the engineering majors, biology, economics,

Assessment Instruments：Examination, Project

Pre-requisites：Matrix Theory, Probability Theory, Data Structure

1. Course Objective and Requirements

This course introduces the basic theory and methods of data mining systematically. The data mining process includes data selection and cleaning, machine learning techniques to ``learn'' knowledge that is ``hidden'' in data, and the reporting and visualization of the resulting knowledge. This course will cover these issues and will illustrate different practical applications of data mining from the life sciences, computer science, and commerce. Several machine learning topics including classification, prediction, and clustering will be covered. Through this course, the graduate students should be able to understand the basic theory and methods of data mining, as well as designing data mining algorithm for the real-world applications. This course also helps students to build a solid foundation for academic research.

2. Course Content and Schedule

Chapter 1 Introduction to Data Mining（2h）
- 1.1 Data Mining in the Real World
- 1.2 Data Mining and Machine Learning
- 1.3 Data Mining and Database System

Chapter 2 Data Preprocessing（4h）
- 2.1 Data Cleaning
- 2.2 Data Integration and Transformation
- 2.3 Data Reduction
- 2.4 Data Discretization and Concept Hierarchy Generation

Chapter 3 Data Warehouse and Data Mining（2h）
- 3.1 Introduction of Data Warehouse
- 3.2 Data Warehouse and OLAP
- 3.3 From Warehouse to Data Mining

Chapter 4 Mining Frequent Patterns, Association, and Correlation（8h）
- 4.1 Basic Concepts and a Road Map
- 4.2 Frequent Itemset Mining Methods: The Apriori Algoirthm
- 4.3 Mining Association Rules
- 4.4 Correlation Analysis

Chapter 5 Machine Learning Techniques in Data Mining（16h）
- 5.1 Concept of Classification and Prediction
- 5.2 Decision Tree
- 5.3 Bayesian Classification
- 5.4 Rule-based Classification
- 5.5 Neural Network and Backpropagation
- 5.6 Support Vector Machine
- 5.7 Accuracy and Error Measures
- 5.8 Ensemble Methods
- 5.9 Model Selection

Chapter 6 Clustering（6h）
- 6.1 Density based Methods
- 6.2 Partitioning Methods
- 6.3 Grid Based Methods
- 6.4 Outlier Analysis

Chapter 7 Regression and optimization in Data Mining（6h）
- 7.1 Linear and Non-linear Regression
- 7.2 Genetic Algorithm
- 7.3 Particle Swarm Optimization
- 7.4 Ant Colony optimization
- 7.5 Multi-objective optimization

Chapter 8 The Applications of Data Mining（4h）
- 8.1 Introduction of Applications of Data Mining
- 8.2 Stream, Time Series, Sequence Data
- 8.3 Graph Mining
- 8.4 Social Network
- 8.5 Text Mining
- 8.6 Web Mining

3. Experiments

Project: Implement 1-2 Classic Data Mining Approaches for a real world application in MATLAB, options include:

1. Apriori algorithm
2. Bayesian Network
3. Neural Networks and Backpropagation algorithm
4. Bayesian Network
5. SVM

4. Textbooks

1. Jiawei Han, Micheline Kamber，Data Mining: Concepts and Techniques，Morgan Kaufmann Publisher，Second Edition，2006

Main Reference Books

1. P.-N. Tan, M. Steinbach, V. Kumar. Introduction to Data Mining, Addison-Wesley, 2006.

2. I. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques with Java Implementations, 2nd edition, Morgan Kaufmann, 2005. 1st edition, 2000

3. D. Hand, H. Mannila, and P. Smyth. Principles of Data Mining, MIT Press, 2001.

Written by：ZHANG Daoqiang（张道强）　　**Instructor**：ZHANG Daoqiang（张道强）

Mechanical and Material Engineering

Course type	Course Code	Course Title	Hours	Credits	Semester	College	Remark
Compulsory Course	6A120007L	Chinese Culture	45	3	Spring	Col. of Foreign Languages	
	8A080002L	Linear Algebra in System and Control Theory	60	4	Spring	Col. of Science	Compulsory for master Students
Optional Course	6B052004L	Metal Cutting Principle	48	3	Spring	Col. of Mechanical &Electrical Engineering	
	6B054001L	Computer-Aided Design and Its Applications	48	3	Spring	Col. of Mechanical &Electrical Engineering	
	7D052001L	Contemporary Engineering Economics	32	2	Spring	Col. of Mechanical &Electrical Engineering	
	7D061001L	Modern Analysis Theory of Materials	48	3	Spring	Col. of Material Science&Technology	
	7D061023L	Thermodynamics of Materials	32	2	Spring	Col. of Material Science&Technology	
	7D061025L	Laser Processing of Materials	32	2	Spring	Col. of Material Science&Technology	
	7D061027L	Surface Engineering of Metals	32	2	Spring	Col. of Material Science&Technology	
	7D062008L	Special Functional Coatings	32	2	Spring	Col. of Material Science&Technology	

Course Code：6A120007L

Course Title(Chinese)：中国文化

Course Title(English)：Chinese Culture

College and Department：Col. of Foreign Languages
Semester：Spring
Class Hours：45
Teaching Methods：Lecture
Suitable Majors: International postgraduates
Assessment Instruments：Report
Pre-requisites：Elementary Chinese

1.Course Objective and Requirements

In the time of globalization, cross-cultural communication appears to be more and more important for nowadays students. With the rapid growth of Chinese economy, China now once again stands up on the world stage. The world is looking at China, and eager to know about this old and young, traditional but fashionable country, especially for the international students. Therefore it's necessary for overseas students to know something about Chinese culture and tradition, which will greatly help them to adapt themselves to the life in China.

After the 12 weeks of lectures and presentations, students of this class are expected to be familiar with some aspects of Chinese culture mentioned in the textbook. Furthermore, the students are recommended to make some comparative studies between Chinese culture and western culture.

2.Course Content and Schedule

Unit 1 The Origin of Chinese Culture 中国文化溯源（4 小时）
1.1Chinese Culture 祠 ast and Present 中国文化—传统与现代
1.2The Appellation of China 国名由来
1.3Chinese Mythology 神话传说
1.4Cultural Mosaic 文化常识
Heavenly Stems and Earthly Branches 天干地支
The Twenty-four Solar Terms 二十四节气
Chinese Zodiac 十二生肖
Unit 2 Chinese Language 中国的语言（4 小时）
2.1Han Chinese Language 汉语
2.2The Chinese Written Language 中国的文字
2.3The Origins of Chinese Writing 汉字的源流
2.4Chinese Calligraphy 书法
2.5Chinese Seals 印章
2.6Traditional System & Simplified System 繁体与简体
2.7 Cultural Mosaic 文化常识
The Chinese Character Classification 六书
The Components of Characters 偏旁部首
Four Treasures of the Study 文房四宝
Lanting Xu by Wang Xizhi 王羲之的《兰亭序》
Unit 3 Ancient Capitals and Heritages 古都与文化遗产（4 小时）
3.1The Seven Great Ancient Capitals 七大古都
3.2Tourist Resources in China 旅游资源
3.3Cultural Mosaic 文化常识
The Great Wall of China 长城
The Forbidden City 紫禁城
Terracotta Army 兵马俑
China's Top Ten 中国的"十大之最"
Unit 4 Crafts and Skills 传统工艺（4 小时）

4.1Traditional Chinese Crafts 传统工艺品
4.2Jade Culture 玉文化
4.3Ancient Chinese Bronze 青铜器
4.4Chinese Silk 丝绸
4.5Chinese Embroidery 刺绣
4.6Chinese Porcelain 瓷器
4.7Chinese Knots 中国结
4.8Paper Cuttings 剪纸
4.9 Cultural Mosaic 文化常识
Si Mu Wu Ding 司母戊鼎
Galloping Horse Overtaking a Flying Swallow 马踏飞燕
Unit 5 Traditional Sports and Athletics 传统运动与竞技（4 小时）
5.1Traditional Sports 传统运动
5.2Chinese Martial Arts 中国武术
5.3Taijiquan 太极拳
5.4Cuju 蹴鞠
5.5Qigong 气功
5.6Chinese Chess 象棋
5.7Traditional Acrobatic Acts 传统杂技
5.8Cultural Mosaic 文化常识
Five-Animal Play 五禽戏
The Mongolian Horsemanship 蒙古马术
Martial Arts in Popular Culture 流行文化中的武术
Unit 6 Ancient Science and Technology 中国古代科技（4 小时）
6.1History of Science and Technology 科技简史
6.2Early Technological Achievements 早期科技成就
6.3The Four Great Inventions 四大发明
6.4Scientific Achievements in the Middle Ages 中古科学发明
6.5Mongol Transmission & Jesuit Activity 科技传播与交流
6.6Joseph Needham 李约瑟
6.7Science and Technology in the PRC 现代科技发展
6.8 Cultural Mosaic 文化常识
Science and Civilization in China Series 李约瑟的《中国科学技术史》
Unit 7 Operas and Music 戏曲与音乐（4 小时）
7.1Chinese Opera 中国戏曲
7.2Kunqu Opera 昆曲
7.3Introduction of Beijing Opera 京剧简介
7.4Quyi 曲艺
7.5Chinese Music 中国音乐
7.6Butterfly Lovers 梁祝
7.7Legend of the White Snake 白蛇传
7.8 Cultural Mosaic 文化常识
The Story of High Mount Flowing Water 高山流水
Changing Faces 变脸
The Meaning of Colors in Chinese Opera Masks 脸谱的含义
Bronze Chime-Bells of Marquis Yi of the Zeng State 曾侯乙编钟
Unit 8 Education and Aesthetics 古代教育与审美（4 小时）
8.1Education in Ancient China 中国古代教育
8.2Imperial Examination 科举考试
8.3Institutions of Higher Education 古代高等教育衍变
8.4Chinese Aesthetics 中国人的审美观
8.5Chinese Painting 国画
8.6Ancient Chinese Architecture 古代建筑
8.7Cultural Spirit in Classical Gardens 古典园林的文化内涵

8.8 Cultural Mosaic 文化常识
Some Details of the Imperial Examination 科举考试细则
Academies of Classical Learning 四大书院
Wu Daozi, Sage in Chinese Painting 画圣吴道子
Unit 9 Thoughts and Philosophy 思想与哲理（4 小时）
9.1Traditional Philosophy 传统哲学
9.2Confucius 孔子
9.3Confucianism, Taoism and Buddhism 儒、道、释
9.4Neo-Confucian Zhu Xi 理学家朱熹
9.5Harmony between Man and Nature 天人合一
9.6 Cultural Mosaic 文化常识
Laozi and Zhuangzi 老子与庄子
Mencius 孟子
Four Books and Five Classics 四书五经
Unit 10 Religions and Beliefs 宗教与信仰（4 小时）
10.1What Do Chinese People Believe in? 中国人的信仰
10.2Heaven Worship 祭天
10.3Ancestor Worship 拜祖
10.4Taoism in China 道教
10.5Buddhism in China 佛教
10.6Feng Shui 风水
10.7 Cultural Mosaic 文化常识
The God of Wealth 财神
King Yam 阎王
The God of Kitchen 灶神
The Matchmaker 月老
Unit 11 Exchanges with Foreign Countries 中外往来述要（4 小时）
11.1The Silk Road 丝绸之路
11.2The Influences of Silk Road 丝绸之路的影响
11.3The Tea Horse Road 茶马古道
11.4Zheng He’s Voyages 郑和下西洋
11.5Did Zheng He Discover the World? 郑和发现了世界？
11.6 Cultural Mosaic 文化常识
Great Ming Amalgamated Map 《大明混一图》
Jian Zhen 鉴真东渡
Matteo Ricci 利玛窦
Unit 12 Review 复习（1 小时）

2.Textbooks

《中国文化概览》 *A Panoramic View of Chinese Culture* 编著 吴鼎民，译林出版社，2010 年

Written by：WANG Zheng（王征）
Instructor：LIANG Hongfei（梁红飞）,WANG Zheng（王征）, et al.

Course Code：8A080002L

Course Title(Chinese)：系统与控制理论中的线性代数

Course Title(English)：Linear Algebra in System and Control Theory

College and Department：Col. of Science
Semester：Spring
Class Hours：60
Teaching Methods：Lecture, Homework
Suitable Majors: All Specialities in Engineering
Assessment Instruments：Examination, Project
Pre-requisites：Linear Algebra, Matrix Theory

5. Course Objective and Requirements

The theories and methods of linear algebra are indispensable to science and technology, are especially fundamental to studying modern system and control theory. In this course, the theories, methods of linear algebra with applications to system and control are introduced. The main contents may be divided into three parts. The first part is the basic concepts of modern mathematics including mapping, algebraic operation, group, ring，field and so on. The second part is contains the theories and methods of linear algebra including linear space, subspace, linear mapping and transformation, inner product space, orthogonal projection, normed space, best approximation and so on. The third part contains some topics of numerical linear algebra including matrix factorizations, generalized inverse of a matrix, matrix equation, least squares problem, total least squares problem, matrix perturbation analysis and so on. Course objectives: enhance the mathematical quality of graduates, provide the mathematical foundations for studying follow-up courses and carrying out scientific research.

6. Course Content and Schedule

Chapter 1 Basic Concepts（8h）
- 1.15 Sets
- 1.16 Mapping
- 1.17 Algebraic Operations
- 1.18 Homomorphism and Isomorphism
- 1.19 Equivalence and Classification of Set
- 1.20 Ordered Spaces
- 1.21 Metric Spaces

Chapter 2 Groups （8h）
- 6.1 Basic Concepts of Groups
- 6.2 Subgroups
- 6.3 Homomorphism and Isomorphism of Groups
- 6.4 Normal Subgroups and Quotient Groups
- 6.5 Groups of Transformations

Chapter 3 Rings and Fields （4h）
- 3.9 Basic Concepts of Rings
- 3.10 Subrings and Homomorphism of Rings
- 3.11 Ideals and Quotient Rings
- 3.12 Fields

Chapter 4 Linear Spaces （10h）
- 4.13 Linear Spaces
- 4.14 Subspaces
- 4.15 Homomorphism and Isomorphism of Linear Spaces
- 4.16 Linear Manifold and Quotient Spaces
- 4.17 Modules and Linear Algebra
- 4.18 Invariant Subspaces

Chapter 5 Inner Product Spaces （6h）
- 5.9 Inner Product Spaces
- 5.10 Gram-Schmidt Orthogonalization and QR factorization
- 5.11 Orthogonal Projection and Best Approximation
- 5.12 Linear Transformations of Inner Product Spaces

Chapter 6 Normed Linear Spaces（6h）
- 6.9 Normed Linear Spaces
- 6.10 Best Approximation
- 6.11 Banach Spaces
- 6.12 Norms of Linear Operators and Matrices

Chapter 7 Generalized Inverse and Least Squares Problems（10h）
- 7.17 Matrix Factorizations
- 7.18 Singular Value Decomposition and Its Generalization
- 7.19 Generalized Inverse of a Matrix
- 7.20 Linear Least Squares Problem
- 7.21 Total Least Squares Problem
- 7.22 Robust Least Squares Problem
- 7.23 Matrix Approximation with Constraints
- 7.24 Matrix Perturbation Analysis

Chapter 8 Matrix Functions and Matrix-Valued Functions（4h）
- 8.7 Matrix Functions
- 8.8 Matrix-Valued Functions with Applications
- 8.9 Eigenvalue Sensitivity Analysis with Applications

Chapter 9 Matrix Equations and Matrix Inequalities （4h）
- 9.11 Kronecker Product of Matrices
- 9.12 Linear Matrix Equations
- 9.13 Algebraic Riccati Equations
- 9.14 Matrix Inequalities
- 9.15 Pole Assignment Problems

11 Textbooks

(5) Lancaster P, Tismenetsky M. The Theory of Matrices with Applications. Academic Press, 1985.
(6) Greub W. Linear Algebra. Springer-Verlag，1981.

Main Reference Books

(5) Horn R A, Johnson C R. Matrix Analysis. Cambridge University Press, 1985.
(6) Golub G H, Van Loan C F. Matrix Computation. Third Edition, The John Hopkins University Press, 1996.

Written by：DAI Hua（戴华）　　**Instructor**：DAI Hua（戴华）

Course Code： 6B052004L

Course Title(Chinese)：金属切削原理

Course Title(English)：Metal Cutting Principle

College and Department：Col. of Mechanical and Electrical Engineering
Semester：Spring
Class hours：48
Teaching methods：Lecture, Seminar
Suitable majors: Mechanical Engineering
Assessment instruments：Literature Review
Pre-requisites：Manufacturing Engineering and Technology

1. Course objective and Requirements

In addition to providing basic information on metal cutting, the course also describes the lever of modern technology adopted, by varying degrees, by industry in general. Metal cutting is a dynamic technology, involving the range of disciplines of science, which must be mastered to become a practitioner of advanced machining technology. Some of these disciplines are the province of machining technologist; others concern both machine tool manufacturers and machine tool builders and users. Nonetheless, it can be helpful for all machining-related businesses to have a good grasp of the relevant issues in each area.

2. Course content and Schedule

Chapter 1 Introduction (4h)
- 1.1 Subject matter
- 1.2 Historical

Chapter 2 Metal Cutting Operations and terminology (4h)
- 2.1 Turning
- 2.2 Boring
- 2.3 Drilling
- 2.4 Facing
- 2.5 Milling
- 2.6 Broaching

Chapter 3 The essential features of metal cutting (8h)
- 3.1 Chip formation
- 3.2 The tool/chip interface
- 3.3 Cutting equation
- 3.4 The BUE
- 3.5 Machined surfaces

Chapter 4 Force in metal cutting (6h)
- 4.1 Stress on the shear plane
- 4.2 Forces in the flow-zone
- 4.3 Methods of cutting force measurement

Chapter 5 Heat in metal cutting (6h)
- 5.1 Heat in chip formation
- 5.2 Heat at the tool/work interface
- 5.3 Methods of tool temperature measurement

Chapter 6 Tools wear (6h)
- 6.1 Types of tools wear
- 6.2 Tools wear process
- 6.3 Mechanisms of tools wear
- 6.4 Tool life equations

Chapter 7 Machinability (6h)

7.1 General observations on machinability

7.2 Optimization of cutting parameters

7.3 Coolants and lubrication

Chapter 8 Grinding Principle (8h)

8.1 Grinding wheel

8.2 Grinding parameters

8.3 Force in metal grinding

8.4 Heat in metal grinding

8.5 Different between cutting and grinding

3. Experiments

None.

4. Textbooks

（1）Fritz Klocke. Manufacturing Processes 1 & 2: Cutting & Grinding. Springer. 2010

（2）E.M. Trent. Metal Cutting (4th Edition). Butterworth. 2001

Main reference books

(1) WIT GRZESIK. Advanced Machining Processes of Metallic Materials-theory, modeling and applications. ELSEVIER. 2008

(2) M.C. Shaw. Metal Cutting Principle. OXFORD University Press. 2005

(3) Thomas Childs. Metal Machining-*Theory and Applications*. rnold. 2000

Written by：FU Yucan（傅玉灿）

Instructor：FU Yucan（傅玉灿）， LI Liang（李亮） etal.

Course Code：6B054001Y /6B054001L

Course Title(Chinese)：CAD 技术及其应用

Course Title(English)：Computer-Aided Design and Its Applications

College and Department：Col. of Mechanical & Electrical Engineering

Semester：Spring

Class Hours：48

Teaching Methods：Lecture, Presentation, Homework

Suitable Majors: Mechanical Engineering

Assessment Instruments：Examination

Pre-requisites：The Theory of Matrix

1.Course Objective and Requirements

Computer Aided Design(CAD) is one of the fastest growing areas in the engineering industry today. It is widely utilized in the design of mechanical products by using the speed and efficiency of a computer.

This course provides the fundamental theories and applications for developing of CAD systems. The principles, methods and computer algorithms in the field of graphic displaying, freeform curve representation, geometry modeling, and new technologies in CAD are introduced. Some applications are presented on class as the product models designed by the widely used CAD software---CATIA system. Over the course of the semester, students will undertake several homework assignments for displaying and designing freeform curves using C++ programming. Students will also be grouped into several study teams to present some extension materials related to the course under the lecturer's instructions.

The primary requirements are: (1) to have undertaken the course "The theory of matrix", (2) to be proficient in using a recent version of CATIA or another CAD software.

2.Course Content and Schedule

Chapter 1 Introduction to CAD(2h)
- 1.1 Definitions of CAD
- 1.2 History of CAD development
- 1.3 The application of CAD

Chapter 2 Basic Concepts of Graphics Programming (4h)
- 2.1 Graphics Libraries
- 2.2 Coordinate Systems
- 2.3 Windows and Viewports
- 2.4 Transformation matrix
- 2.5 Introduction to OpenGL

Chapter 3 Geometric Modeling System (8h)
- 3.1 Introduction to Geometric Modeling
- 3.2 Solid Modeling
- 3.2.1 Modeling Functions
- 3.2.2 Data structure
- 3.2.3 Euler operators
- 3.3 Non-manifold Modeling
- 3.4 Parametric and Feature-based Modeling
- 3.4.1 Parametric modeling
- 3.4.2 Feature modeling

Chapter 4 Preliminary Knowledge of Curves(8h)
- 4.1 Vector and the parametric representation
- 4.2 The derivative of curves and tangent vector
- 4.3 Arc length and normal vector
- 4.4 The second derivative and curvature
- 4.5 Frenet–Serret Frame
- 4.6 Continuities

Chapter 5 Representation and Manipulation of Curves(20h)
- 5.1 Hermite curves
  - 5.1.1 Hermite function
  - 5.1.2 Representation of Hermite curve
  - 5.1.3 Properties of Hermite curve
- 5.2 Bezier Curve
  - 5.2.1 Definition of Bezier curve
  - 5.2.2 Properties of Bernstein polynomials
  - 5.2.3 De Casteljau algorithm
  - 5.2.4 Join two Bezier Curves
- 5.3 B-Spline Curve
  - 5.3.1 Definition of Basis functions
  - 5.3.2 Properties of Basis functions

5.3.3 Knot Multiplicity
5.3.4 Knot manipulation
5.3.5 De Boor algorithm
5.3.6 Uniform B-Spline curve
5.3.7 Derivatives of B-Spline curve
5.4 NURBS Curve
5.4.1 Three types of equivalent definition
5.4.2 Definition of NURBS curve
5.4.3 The effect of the weights
5.4.3 NURBS representation for conic section
5.5 Curve Interpolation
5.5.1 Interpolation for Hermite curve
5.5.2 Interpolation for B-Spline curve
Chapter 6 Preliminary Knowledge of Surfaces(2h)
6.1 Types of surface equations
6.2 Isoparametric curves
6.3 Partial derivatives
6.4 Surface curvatures
Chapter 7 Representation and Manipulation of Surfaces (4h)
7.1 Bilinear surface
7.2 Coons patch
7.3 Bicubic Coons Patch
7.4 Bezier surface
7.5 B-Spline surface
7.6 NURBS surface
Chapter 8 New Technology for CAD
8.1 Subdivision surface
8.2 Implicit surface
8.3 Deformation method for modeling
8.4 Reverse engineering
8.5 Knowledge based engineering

3.**Assignments**

Project1: Displaying squares using OpenGL and VC6.0
The project involves setting environmental parameters and running OpenGL libraries in VC6.0.
Project2: C++ programming for showing a mesh file
Triangular meshes are one of the main representations for arbitrary free form shapes and are widely used in the 3D printing objects. The project involves programming and showing a triangular mesh which has the file format of *.obj.
Project3: C++ programming for drawing a Bezier curve
The project involves programming a Bezier curve with n degree using De Casteljau algorithm by linking with OpenGL libraries in VC6.0.

4.Textbooks

(1) Kunwoo Lee, Principles of CAD/CAM/CAE Systems, Addison Wesley, 1999.
(2) Gerald Farin, Curves and Surface for CAGD, Academic Press, 1997.

Main Reference Books and Materials

(1) C.-K. Shene，Introduction to Computing with Geometry Notes, http://www.cs.mtu.edu/~shene/COURSES/cs3621/NOTES/。
(2) 施法中，计算机辅助几何设计与非均匀有理 B 样条，北京航空航天大学出版社，1994.

Written by：LIU Shenglan（刘胜兰）
Instructor：LIU Shenglan（刘胜兰）,ZHANG Chen（张臣）et al.

Course Code：7D052001L

Course Title(Chinese)：工程经济学

Course Title(English)：**Contemporary** Engineering Economics

College and Department：Col. of Mechanical & Electrical Engineering
Semester：Spring
Class Hours：32
Teaching Methods：Lecture, Presentation, Homework
Suitable Majors: Master or Ph.D students in Engineering
Assessment Instruments：Examination（60%）, Presentation（40%）
Pre-requisites：Probability and Statistics

1.Course Objective and Requirements

This course combines a number of project examples, describes the basic principles of modern economics, engineering, analysis and calculation methods, the main targets for the future will be taught in engineering technology development, engineering and technology management and business of engineering students hope to achieve the following objectives:, for the financial project analysis theory and practice of establishing a comprehensive conceptual basis; 2, to meet the engineers as project managers or project team members to make financial decisions of the actual needs; 3, with the existing types of decision analysis for financial decision-making tools to adapt ; 4, many areas, such as industrial, construction, machinery, electronics, computer, aerospace, chemical and manufacturing engineering, we need the concept of this course, theory and methods, with the course book to arouse all the projects related to areas of interest ; 5, to understand and master the jargon of economics and English expression. Fundamental objective is to establish economic minds of students in engineering.

The course used the original English teaching materials, and condensed into eight chapters. Require students to have English and basic probability and mathematical statistics. In addition to teachers lecture, there are discussion sessions and presentation classes, training students in the organization and expression.

2.Course Content and Schedule

CH.1 Engineering Economic Decisions (3h)
- 1.1 Economic decisions
- 1.2 Role of Engineers in Business
- 1.3 Large-scale Engineering projects
- 1.4 Types of Strategic Engineering Economic Decisions
- 1.5 Short-Term Operational Economic Decisions

CH. 2 Equivalence and Interest Formulas (3h)
- 2.1 Interest: The Cost of Money
- 2.2 Economic Equivalence
- 2.3 Development of Interest Formulas
- 2.4 Unconventional Equivalence Calculations

1

CH. 3 Present Worth Analysis （3h）
- 3.1 Describing Project Cash Flows
- 3.2 Initial Project Screening Methods
- 3.3 Present Worth Analysis
- 3.4 Variations of Present Worth Analysis
- 3.5 Mutually Exclusive Alternatives

CH. 4 Rate of Return Analysis （3h）
- 4.1 Rate of Return
- 4.2 Computational Methods for Determining i*
- 4.3 Internal Rate of Return Criterion
- 4.4 Mutually Exclusive Alternatives

CH. 5 Depreciation （5h）
- 5.1 Asset Depreciation
- 5.2 Factors Inherent to Asset Depreciation
- 5.3 Book Depreciation Methods
- 5.4 Tax Depreciation Methods
- 5.5 Depletion (损耗)
- 5.6 Repairs or improvements to Depreciable Assets

CH. 6 Developing Project Cash Flows （6h）
- 6.1 Project Proposals and classifications
- 6.2 Incremental Cash Flows
- 6.3 Developing Cash Flow Statements
- 6.4 Generalized Cash Flow Approach

CH. 7 Project risk and Uncertainty （4h）
- 7.1 Origins of Project Risk
- 7.2 Methods of Describing Project Risk
- 7.3 Probability Concepts for Investment Decisions
- 7.4 Probability Distribution of NFW (NPW 的概率分布)

CH. 8 Capital Budgeting Decisions （5h）
- 8.1 Methods of Financing
- 8.2 Cost of Capital
- 8.3 Choice of Minimum Attractive Rate of Return
- 8.4 Capital Budgeting

4.Textbooks

（1） Chan S. Park, Contemporary Engineering Economics, 6th edition，Pearson Higher Education, Inc. , 2015

（2） 钱帕克著, 邵颖红译，工程经济学，中译版・第五版，中国人民大学出版社（Pearson Education），2012

（3） 帕克著，邵颖红改编，Contemporary Engineering Economics，英文版・第五版，中国人民大学出版社，2012

Main Reference Books

（1） W.G. Sullivan, E. E.M. Wicks, C.P. Koelling，Engineering Economics 清华大学出版社（Pearson Education）14th Edition 2011

（2） 李南，工程经济学，第四版，科学出版社，2016

Written by：HE Ning（何宁）

Instructor：HE Ning（何宁）,Zhao Wei（赵威）, Yang Yinfei（**杨吟飞**），Hao Xiuqing（郝秀清），Zhao Guolong（赵国龙）.

Course Code：7D061001L

Course Title(Chinese)：材料的现代分析原理

Course Title(English)：Modern Analysis Theory of Materials

College and Department：Col.of Materials Science & Technology

Semester：Spring

Class Hours：48

Teaching Methods：Lecture, Experiment

Suitable Majors: Materials Science and Engineering

Assessment Instruments：Examination

Pre-requisites： Matrix, University Physics, Fundamentals of Materials Science and Engineering

1. Course Objective and Requirements

The Modern Analysis Theory of Materials is a very versatile and powerful analytical tool for the students majoring in materials science and engineering. In this course, the principles, methods and some applications are introduced. At the end of this course, the students should be able to describe a variety of analysis methods and tell in general what are they good for, identify the most appropriate method or methods to probe specific materials characteristics and become familiar with modern methods of materials characterization. This course is a required junior level course in Materials Science and Engineering. Its purpose is to allow the students to become familiar with characterization methods and data analysis techniques, through a combination of hands-on experience, measurement demonstration and data analysis.

2. Course Content and Schedule

Chapter 1 Introduction to Materials Characterization（2h）
- 1.1 The General Principles of Materials Analysis
- 1.2 An Overview of the Methods of Diffraction Analysis
- 1.3 An Overview of the Spectral Analysis
- 1.4 An Overview of Electron Spectroscopy
- 1.5 An Overview of the Electron Microscopy
- 1.6 Other Analysis Methods

Chapter 2 X -Ray Diffraction（8h）
- 2.1 Basics of X –Ray Physics
- 2.2 The Direction of X-Ray Diffraction
- 2.3 The Intensity of X-Ray Diffraction
- 2.4 The Methods of X-Ray Diffraction
- 2.5 Phase Characterization by X-ray Diffraction
- 2.6 Accurate Determination of the Crystal Lattice Constant

Chapter 3 Electron Microscopy in Materials（10h）
- 3.1 Basic Electron Optics
- 3.2 The Structure of the Transmission Electron Microscope (TEM) and Principles of Image Contrast
- 3.3 TEM Diffraction Pattern
- 3.4 TEM Diffraction Contrast
- 3.5 The Structure of Scanning Electron Microscopy (SEM)
- 3.6 New Developments in Electron Microscopy

Chapter 4 Physical Methods of the Chemical Composition Analysis（6h）
- 4.1 Electron Probe Microanalysis
- 4.2 Ion Probe Microanalysis
- 4.3 Auger Electron Spectroscopy
- 4.4 X-ray Photoelectron Spectroscopy
- 4.5 X-ray Fluorescence

Chapter 5 Thermal Analysis（4h）
- 5.1 Differential Thermal Analysis
- 5.2 Differential Scanning Calorimetry
- 5.3 Thermal Gravimetric Analysis
- 5.4 Thermal Mechanical Analysis

Chapter 6 Other Analytical Technique（2h）
- 6.1 Fourier Transform Infrared Spectroscopy (FTIR)
- 6.2 Raman Spectroscopy
- 6.3 Scanning Tunneling Microscope and Scanning Force Microscope

3.**Experiments**（16h）

Experiment1: Powder Diffractometers Structure, Specimen Preparation, Phase Qualitative Analysis（4h）
Experiment2: TEM Structure, Specimen Preparation, Image Observation and Selected-Area Diffraction（4h）
Experiment3: SEM Structure, Specimen Preparation, Morphology Observation and Composition Analysis by EDS（4h）
Experiment4: Specimen Preparation and Glass Transition Temperature Measurement by DSC（4h）

4.Textbooks

David Brandon, Wayne D. Kaplan. Microstructural Characterization of Materials, 2nd Edition (Wiley, 2008)

Main Reference Books

J. P. Eberhart.Structural and Chemical Analysis of Materials: X-Ray, Electron and Neutron Diffraction; X-Ray, Electron and Ion Spectrometry, Electron Microscopy

Written by：LUO Xinyi（骆心怡）　　**Instructor**：LUO Xinyi（骆心怡）

Course Code：7D061023L

Course Title(Chinese)：材料热力学

Course Title(English)：Thermodynamics of Materials

College and Department：Col. of Material Science & Technology

Semester：Spring

Class Hours：32

Teaching Methods：Lecture, Homework

Suitable Majors: Material Science and Engineering

Assessment Instruments：Examination, Project

Pre-requisites：Physical chemistry, Material Science and Engineering

1.Course Objective and Requirements

The Thermodynamics of Materials is a very important course for Material Science and Engineering. In this course, the first Law and the second Law are introduced. Chapters include the defects in solids, surfaces and interfaces, diffusion and transformations are also covered. Course objectives: develop comprehensive knowledge in the fundamental thermodynamics; know how to analysis the phase transformation.

2.Course Content and Schedule

Chapter 1 Introduction—An Overview of Microstructure in Materials （2h）
Chapter 2 Free Energy of Pure Substances （4h）
- 2.1 Energy Relating to Microstructure
  - 2.1.1 Units of Energy
  - 2.1.2 Energy of Atoms and Molecules and Macroscopic Energy
  - 2.1.3 Heat Capacity and Enthalpy of Transformation
- 2.2 Entropy and Free Energy
  - 2.2.1 Stability Condition in Thermal Equilibrium
  - 2.2.2 Boltzmann Entropy Relation
  - 2.2.3 Maxwell-Boltzmann Distribution Law (M-B Statistics)
- 2.3 Statistical Thermodynamics of Thermal Vibration of Crystal
  - 2.3.1 Energy of Thermal Vibration
  - 2.3.2 Entropy and Free Energy of Thermal Vibration
- 2.4 Thermodynamics of Magnetic Transition (Iron Hardens Twice!)
  - 2.4.1 Magnetic Domain Structure of Ferromagnetic Materials
  - 2.4.2 Magnetization and Magnetic Transition of Ferromagnetic Materials
  - 2.4.3 Analysis of Magnetic Transition Using the Ising Model
  - 2.4.4 Thermodynamics of A3 Transformation of Pure Iron
- 2.5 Free Energy of Amorphous Phase
  - 2.5.1 Is the Amorphous a Solid Phase or a Liquid Phase?
  - 2.5.2 Is the Amorphous a Stable Phase or a Metastable Phase?
- Appendix: Synthesis of Diamond by Very High Pressure

Chapter 3 Thermodynamics of Solutions （6h）
- 3.1 Solutions, Mixtures, and Compounds
  - 3.1.1 The Ways of Mixing of Atoms and Molecules
  - 3.1.2 Components, Systems, and Composition Axes
  - 3.1.3 Entropy of Solutions and Mixtures
- 3.2 Approximation of Free Energy by Regular Solution Model
  - 3.2.1 Nearest-Neighbor Assumption and Random Distribution Assumption—Basic Assumptions for Bragg-Williams-Gorski (B-W-G) Model
  - 3.2.2 B-W-G Approximation of Enthalpy in Solid Solution
  - 3.2.3 B-W-G Approximation of Entropy in Solid Solution
  - 3.2.4 B-W-G Approximation of Free Energy in Solid Solution
- 3.3 Approximation of Free Energy by Sublattice Model
  - 3.3.1 Free Energy of III–V Compound Solutions
  - 3.3.2 Free Energy of Interstitial Solutions
- 3.4 Chemical Potential
  - 3.4.1 Partial Molar Quantity
  - 3.4.2 Activity and Activity Coefficient of Solute Atoms
- 3.5 Nonrandom Distribution of Solute Atoms
  - 3.5.1 I-S Bonding between Interstitial Atoms (I) and Substitutional Atoms (S)
  - 3.5.2 Estimation of I-S Bonding Energy (DeI-S)

Chapter 4 Thermodynamics of Phase Diagrams （6h）
4.1 Basic Rules of Heterogeneous Equilibrium
4.1.1 Common Tangent Law
4.1.2 Enhancement to Multicomponent Systems
4.1.3 Gibbs Phase Rule
4.2 Liquidus Line and Solidus Line
4.2.1 Phase Diagram of Completely Miscible Type
4.2.2 Liquidus Line and Solidus Line at Low Concentration Region
4.2.3 Primary Crystallization Line (Liquidus Line) of Compounds
4.3 Solubility Curve (Solid Solubility Curve)
4.3.1 Mutual Solubility Curve
4.3.2 Solubility Curve of Compound
4.3.3 Solubility Product of Compound
4.4 Binodal Curve
4.4.1 Miscibility Gap and Spinodal Curve
4.4.2 Miscibility Gap Island (MGI)
Chapter 5 Thermodynamics of Interfaces （6h）
5.1 Energy of Surface and Interface
5.2 Gibbs-Thomson Effect
5.2.1 Experiment on Soap Bubbles
5.2.2 Transformation Temperature and Pressure of Fine Particles
5.2.3 Solubility of Fine Particles
5.3 Thermodynamics of Grain-Boundary Segregation
5.3.1 Monolayer Adsorption and Multilayer Adsorption
5.3.2 McLean's Grain-Boundary Segregation Equation
5.3.3 Analysis of Grain-Boundary Segregation by "Boundary Phase Model"
5.3.4 Relationship between Ultrarefinement of Grains and Grain-Boundary Segregation
5.4 "Roughness" and Mobility of Interface
5.4.1 Smooth Interface and Rough Interface
5.4.2 Adhesion Growth and Lateral Growth
5.4.3 Kinetic Description of Mobility of Interface
5.4.4 Analysis of Velocity of Solidification
5.5 Thermodynamics of Grain Growth
5.5.1 Grain Growth of Pure Substances
5.5.2 Solute Drag Effect
5.5.3 Grain-Boundary Pinning by Dispersed Particles
Chapter 6 Thermodynamics of Diffusion （2h）
6.1 Brownian Motion and Diffusion
6.1.1 Random Walk Model
6.1.2 Einstein's Equation for Brownian Motion
6.2 Fick's Diffusion Laws
6.2.1 The First Law and the Second Law
6.2.2. Examples of Analysis of Diffusion Law
6.3 Review of Solid Phase Diffusion
6.3.1 Kirkendall Effect
6.3.2 Dependency of Interdiffusion Coefficient on Concentration
6.3.3 Uphill Diffusion
6.3.4 Thermodynamic Modification of Fick's Diffusion Laws
6.4 Mechanism of Diffusion and Diffusion Coefficient
6.4.1 Frequency Factor of Diffusion Coefficient and Activation Energy
6.4.2 Diffusion by Vacancy Mechanism and Interstitial Diffusion
6.4.3 Surface Diffusion and Grain-Boundary Diffusion
Chapter 7 Thermodynamics of Ordering （6h）
7.1 Ordering Phenomena
7.1.1 Ordering in Microscopic Structure
7.1.2 Short-Range Ordering
7.2 Analysis of CuZn Ordering by B-W-G Model
7.2.1 Sublattice and Order Parameter
7.2.2 Change in Enthalpy and Entropy According to Ordering
7.2.3 Equilibrium Order Parameter
7.3 Analysis of Cu3Au Ordering by B-W-G Model
7.3.1 Degree of Order and Number of Atomic Pairs
7.3.2 Change in Free Energy According to Ordering
7.3.3 Discontinuous Change in Equilibrium Order Parameter
7.4 Phase Separation due to Ordering
7.4.1 Symbiosis of Ordering and Phase Separation

7.4.2 Analysis on Ordering by B-W-G Model Considering Second Nearest Neighbor Atoms
7.4.3 Miscibility Gap Island in Consideration of Ordering

3.Textbooks

Taiji Nishizawa, Thermodynamics of Microstructures, ASM International@ Materials Park, Ohio 44073-0002, www.asminternational.org, 2008

Eugene Machlin. An Introduction to Aspects of Thermodynamics and Kinetics Relevant to Materials Science, Newyork: Elsevier, 2007.

Main Reference Books

(1) David v. Ragone.Thermodynamics of Materials,John Wily&Sons. Inc.1995
(2) Robert T. DeHoff, Thermodynamics in materials science, CRC/Taylor & Francis, 2006
(2) 材料热力学/徐祖耀主编，北京:高等教育出版社,2009.

Written by：FENG Xiaomei（冯晓梅）　　**Instructor**：FENG Xiaomei（冯晓梅）

Course Code：7D061025L

Course Title(Chinese)：材料的激光成型

Course Title(English)：Laser Processing of Materials

College and Department：Col. of Materials Science and Technology

Semester：Spring

Class Hours：32

Teaching Methods：Lecture, Experiment, Homework

Suitable Majors: Materials Science and Engineering

Assessment Instruments：Examination, Project

Pre-requisites：Physics, Materials Science, Math

1.Course Objective and Requirements

The term "laser" originates as an acronym for Light Amplification by Stimulated Emission of Radiation. Laser is distinguished from other electromagnetic radiation mainly in terms of its coherence, spectral purity and ability to propagate in a straight line. Especially the extreme possibilities of modulation in time, space and frequency enable exact adoption to the demands of process technology. Laser technology can be applied in a vast field of applications e.g., cutting, drilling, joining, ablation, soldering, hardening, alloying, cladding, polishing, generating and marking. We see applications in products of all relevant areas of our society, in mobility, energy, environment, health or production technology in general. The actual trend shows an increasing number of new applications every year. Thus laser technology is seen to provide the momentum for innovations which are necessary to meet the global challenges. The course splits up in two parts: Part 1: Fundamentals of laser materials processing. The relevant physical phenomena are displayed, which form the basis of laser material processing by laser radiation. In Part 2, Applications. This section contains applications in manufacturing and production technology. Broadly diffused and practically integrated applications can be found as well as new perspectives in laser materials processing.

2.Course Content and Schedule

Part 1 Laser Materials Processing: Fundamentals

Chapter 1 The Behavior of Electromagnetic Radiation at Interfaces (1h)
- 1.1 The FRESNEL Formula
- 1.2 Applications of the FRESNEL Formulae in the Field of Laser Technology

Chapter 2 Absorption of Laser Radiation and Energy Transport and Heat Conduction (2h)
- 2.1 The DRUDE Model of Absorption
- 2.2 Temperature Dependence of the Absorption of Metals
- 2.3 Influence of the Surface Conditions
- 2.4 Energy Transport Equation
- 2.5 Heat Conduction Mechanisms

Chapter 3 Thermomechanics and Phase Transformations (2h)
- 3.1 Deformations
- 3.2 Thermal Induced Stress
- 3.3 Phase Transformations

Chapter 4 Melt Flow (1h)
- 4.1 Mass, Momentum, and Energy Conservation
- 4.2 Plane Potential Flow
- 4.3 Laminar Boundary Layers

Chapter 5 Laser-Induced Vaporization (2h)
- 5.1 Vapor Pressure in Thermodynamic Equilibrium
- 5.2 Vaporization Rate
- 5.3 Particle and Energy Conservation during Laser-Induced Vaporization
- 5.4 Kinetic Model of the Evaporation

Part 2 Laser Materials Processing: Applications

Chapter 6 Laser Beam Sources (2h)
- 6.1 CO_2 Laser
- 6.2 Solid-State Lasers
- 6.3 Diode Lasers
- 6.4 Excimer Laser

Chapter 7 Surface Treatment (4h)
- 7.1 Transformation Hardening
- 7.2 Remelting
- 7.3 Polishing with Laser Radiation

7.4 Alloying and Dispersing
Chapter 8 Forming (2h)
8.1 Bending
8.2 Cutting
8.3 Drilling
Chapter 9 Laser-Based Rapid Manufacturing (4h)
9.1 Selective Laser Sintering (SLS)
9.2 Selective Laser Melting (SLM)
9.3 Laser Metal Deposition (LMD)
Chapter 10 Joining (4h)
10.1 Heat Conduction Welding
10.2 Deep Penetration Welding
10.3 Hybrid Welding
10.4 Laser Beam Welding of Thermoplastics
10.5 Soldering
10.6 Laser Beam Microwelding

3.**Experiments**

Project 1: Laser welding of aerospace components made from aluminum alloys（2h，演示性）
Project 2: Laser beam microwelding of electronic components（2h，综合性）
Project 3: Selective Laser Melting (SLM) rapid manufacturing of complex shaped metal components（4h，设计性）

4.Textbooks

(1) Reinhart Poprawe. Tailored Light 2 Laser Application Technology. Springer-Verlag Berlin Heidelberg, 2011.

Main Reference Books

(1) Antonio Miotello, PaoloM. Ossi. Laser-Surface Interactions for New Materials Production Tailoring Structure and Properties. Springer-Verlag Berlin Heidelberg 2010.
(2) William M. Steen, yotirmoyMazumder. Laser Material Processing, 4th Edition, Springer-Verlag London Limited 2010.
(3) Colin E Webb, Julian D C Jones. Handbook of Laser Technology and Applications Volume III: Applications. Institute of Physics Publishing, lOP Publishing Ltd 2004.

Written by：GU Dongdong（顾冬冬）
Instructor：GU Dongdong（顾冬冬），ZHAN Xiaohong（占小红）, et al.

Course Code：7D061027L

Course Title(Chinese)：金属表面工程

Course Title(English)：Surface Engineering of Metals

College and Department：Col. of Materials Science and Technology

Semester：Spring

Class Hours：32

Teaching Methods：Lecture, Experiment, Homework

Suitable Majors: Materials Science and Engineering

Assessment Instruments：Examination, Project

Pre-requisites：Foundation of Materials Science, The Physics and Chemistry of Materials

1.Course Objective and Requirements

Surface engineering encompasses all scientific and technical problems connected with the manufacture of surface layers prior to end use or service (technological layers) or during service (service-generated layers), on or under the surface (superficial layers) or on a substrate (coatings), with properties differing from those of the material which may be introduced to the surface of the core in the form of gas, liquid or solid. It also includes research of connected phenomena and of potential and usable properties of surface layers, as well as problems connected with layer design. Thus, surface engineering encompasses the total field of research and technical activity aimed at the design, manufacture, investigation and utilization of surface layers, both technological and for end use, with properties better than those of the core, such as mainly anti-corrosion, anti-fatigue, anti-wear and decorative. Other applications include properties such as optical, thermophysical, electrical, magnetic, adhesive, ablation, passivation, inhibition,catalytic, biocompatibility, diffusion and others. magnetism, etc.

The object of material science and material engineering - the material constitutes the fundamental substance, the surface properties of which are improved, enhanced and controlled by surface engineering. The knowledge of material substrate or core structure is the basic condition of producing layers on it. Methods of formation (producing) surface layers are included in the area of machine building, as manufacturing methods. The utilization of surface layers or their production during the course of service belongs to the area of machine service and takes into account, first and foremost, problems of tribology and corrosion protection.

2.Course Content and Schedule

Part I. ***General Fundamentals of Surface Engineering*****（*12h*）**

1. The concept of surface engineering（2h）

1.1 The term ”surface engineering”

1.2 Scope of topics forming the concept of surface engineering

2. Development of surface engineering（2h）

2.1 History of development of surface engineering

2.2 Surface engineering today

2.3 Directions of development of surface engineering

3. The solid surface（2h）

3.1 The significance of the surface

3.2 The surface - geometrical concept

3.3 The surface - mechanical concept

3.4 The surface - physico-chemical concept

4. Surface layers（2h）

5. The superficial layer（2h）

5.1 Development of concepts regarding the superficial layer

5.2 Shaping of the superficial layer

5.3 Structure of the superficial layer

5.4 A general characteristic of the superficial layer obtained by machining

5.5 Physical description of the superficial layer

5.6 Strengthening and weakening of the superficial layer

5.7 Potential properties of the superficial layer

5.8 Practically usable properties of the superficial Layer

5.9 The significance of the superficial layer

6. Coatings（2h）
6.1 The concept of the coatings
6.2 Structure of the coating
6.3 Types of coatings
6.4 Potential properties of coatings
6.5 Service properties of coatings
6.6 Significance and directions of development of coatings

Part II. *The newest techniques of producing surface layers*（*18h*）

1. Formation of technological surface layers (2h)
1.1 Techniques of formation of technological surface layers
1.2 Classification of techniques of producing technological surface layers

2. Electron beam technology (2h)
2.1 Advent and development of electron beam technology
2.2 Physical principles underlying the functioning of electron beam equipment
2.3 Electron beam heaters
2.4 Physical fundamentals of interaction of electron beam with treated material
2.5 Electron beam techniques

3. Laser technology (4h)
3.1 Development of laser technology
3.2 Physical fundamentals of lasers
3.3 Lasers and laser heaters
3.4 Physical fundamentals of laser heating
3.5 Laser techniques
3.6 Application of laser heating in surface engineering

4. Implantation techniques (ion implantation) (2h)
4.1 Development of ion implantation technology
4.2 Plasma source ion implantation
4.3 Physical principles of ion beam implantation
4.4 Ion beam implantation equipment
4.5 Ion beam implantation techniques
4.6 Modification of properties of implanted materials
4.7 Application of implantation technology
4.8 Advantages and disadvantages of ion implantation techniques

5. Glow discharge methods and CVD technology (4h)
5.1 Conception and development of glow discharge methods
5.2 Physico-chemical basis of glow discharge process treatment
5.3 Glow discharge furnaces
5.4 Glow discharge applications
5.5 CVD methods

6. Vacuum deposition by physical techniques (PVD) (4h)
6.1 Development of PVD techniques
6.2 PVD techniques
6.3 Equipment for coating deposition by PVD techniques
6.4 Coatings deposited by PVD techniques
6.5 Service characteristics of coatings deposited by PVD technique

3.**Experiments**（2h）

Project1: Thin film deposition by PVD techniques（1h，演示性）
Project2: Plasma Nitriding of stainless steel（1h，演示性）

4.Textbooks

(1) Tadeusz Burakowski and Tadeusz Wierzchon. Surface Engineering of Metals, CRC Press., 1999
（2）赵文轸主编，材料表面工程导论，西安交通大学出版社出版, 1998

Main Reference Books

(1) Krishna Seshan, Handbook of thin-film deposition process and techniques, 2Ed, Noyes Publications, 2002
(2) Enrico Gnecco and Ernst Meyer. Fundamentals of Friction and Wear, Springer-Verlag Berlin Heidelberg, 2007.
(3) 戴达煌等编著, 现代材料表面技术科学, 冶金工业出版社, 2004

Written by：ZHANG Pingze（张平则）

Instructor：ZHANG Pingze（张平则）,MIAO Qiang（缪强）et al.

Course Code：7D062008L

Course Title(Chinese)：特种功能涂层

Course Title(English)：Special Functional Coatings

College and Department：Col. of Material Science & Technology

Semester：Spring

Course hours：32

Course Credit：2

Teaching methods：Lecture, Homework

Suitable majors: Chemistry, Engineering

Assessment instruments：Report, examination

Pre-requisites：General Chemistry, Principles of Chemical Engineering

1.Course objective and Requirements

Special Founctional coatings applicate in various areas, including the energy, petrochemical, textile, Ocean, water resources engineering, construction, machinery, aerospace, transportation, military, and many other areas. In this course, some special founctional coatings are introduced, with emphasis on the principles, preparation, application and development trend. Course objectives: develop comprehensive knowledge in the special founctional coatings; know the principles and application of some founctional coatings; know how to prepare some founctional coatings.

2.Course contents and Schedule

Chapter 1 Energy saving coatings（8h）
1.1 Introduction
1.2 heat protection coatings
1.3 phase change coatings
Chapter 2 Anticorrosive coatings （4h）
2.1 Introduction
2.2 polyurethane anticorrosive coatings
2.3 epoxy anticorrosive coatings
2.4 ploy urea anticorrosive coatings
Chapter 3 Anti-fouling coatings （2h）
3.1 Introduction
3.2 biocide-containing coatings
3.3 foul release coatings
Chapter 4 Camouflage coatings（6h）
4.1 Introduction
4.2 infrared camouflage coatings
4.3 radar camouflage coatings
4.4 optics camouflage coatings
Chapter 5 Fire-protection and waterproofing coatings（4h）
5.1 Introduction
5.2 fire-resistant coating for steel structure
5.3 waterproofing coatings
Chapter 6 Self-healing coatings (2h)
6.1 Introduction
6.2 examples and applications
Chapter 7 other functional coatings (4h)

3.Experiments（2h）

Preparations and properties characterization of low-emissivity coatings

4. Textbooks

The teacher makes up the teaching materials

Main reference books

(1) Zeno W. Wicks Jr., Organic Coatings: Science and Technology, Wiley-Interscience; 3, 2007
(2) William Von Fischer, Edward George Bobalek, Organic Protective Coatings, Literary Licensing, LLC, 2012
(3) Marino Xanthos, Functional Fillers for Plastics, Wiley-VCH; 2 ,2010
(4) Sudhangshu Bose, High Temperature Coatings, A Butterworth-Heinemann Title , 2007
(5) A.B. Port, Chemistry and Physics of Coatings, Royal Society of Chemistry; 2nd Revised edition, 2004
(6) Swapan Kumar Ghosh, Functional Coatings: by Polymer Microencapsulation, Wiley-VCH Verlag GmbH, 2006
(7) 胡传炘，隐身涂层技术，化学工业出版社，2004
(8) 胡传炘，杨爱弟，特种功能涂层，北京工业大学出版社，2009

Written by：TAN Shujuan(谭淑娟)　　**Instructor**：TAN Shujuan(谭淑娟)

Science

Course type	Course Code	Course Title	Hours	Credits	Semester	College	Remark
Compulsory Course	6A120007L	Chinese Culture	45	3	Spring	Col. of Foreign Languages	
	8A080002L	Linear Algebra in System and Control Theory	60	4	Spring	Col. of Science	Compulsory for master Students
Optional Course	6B082004L	Theory of Solid State Physics	48	3	Spring	Col. of Science	
	7D081025L	Partial Differential Equations	48	3	Spring	Col. of Science	

Course Code：6A120007L

Course Title(Chinese)：中国文化

Course Title(English)：Chinese Culture

College and Department：Col. of Foreign Languages
Semester：Spring
Class Hours：45
Teaching Methods：Lecture
Suitable Majors: International postgraduates
Assessment Instruments：Report
Pre-requisites：Elementary Chinese

1.Course Objective and Requirements

In the time of globalization, cross-cultural communication appears to be more and more important for nowadays students. With the rapid growth of Chinese economy, China now once again stands up on the world stage. The world is looking at China, and eager to know about this old and young, traditional but fashionable country, especially for the international students. Therefore it's necessary for overseas students to know something about Chinese culture and tradition, which will greatly help them to adapt themselves to the life in China.

After the 12 weeks of lectures and presentations, students of this class are expected to be familiar with some aspects of Chinese culture mentioned in the textbook. Furthermore, the students are recommended to make some comparative studies between Chinese culture and western culture.

2.Course Content and Schedule

Unit 1 The Origin of Chinese Culture 中国文化溯源（4 小时）
1.1Chinese Culture 祠 ast and Present 中国文化—传统与现代
1.2The Appellation of China 国名由来
1.3Chinese Mythology 神话传说
1.4Cultural Mosaic 文化常识
Heavenly Stems and Earthly Branches 天干地支
The Twenty-four Solar Terms 二十四节气
Chinese Zodiac 十二生肖
Unit 2 Chinese Language 中国的语言（4 小时）
2.1Han Chinese Language 汉语
2.2The Chinese Written Language 中国的文字
2.3The Origins of Chinese Writing 汉字的源流
2.4Chinese Calligraphy 书法
2.5Chinese Seals 印章
2.6Traditional System & Simplified System 繁体与简体
2.7 Cultural Mosaic 文化常识
The Chinese Character Classification 六书
The Components of Characters 偏旁部首
Four Treasures of the Study 文房四宝
Lanting Xu by Wang Xizhi 王羲之的《兰亭序》
Unit 3 Ancient Capitals and Heritages 古都与文化遗产（4 小时）
3.1The Seven Great Ancient Capitals 七大古都
3.2Tourist Resources in China 旅游资源
3.3Cultural Mosaic 文化常识
The Great Wall of China 长城
The Forbidden City 紫禁城
Terracotta Army 兵马俑
China's Top Ten 中国的"十大之最"
Unit 4 Crafts and Skills 传统工艺（4 小时）

4.1Traditional Chinese Crafts 传统工艺品
4.2Jade Culture 玉文化
4.3Ancient Chinese Bronze 青铜器
4.4Chinese Silk 丝绸
4.5Chinese Embroidery 刺绣
4.6Chinese Porcelain 瓷器
4.7Chinese Knots 中国结
4.8Paper Cuttings 剪纸
4.9 Cultural Mosaic 文化常识
Si Mu Wu Ding 司母戊鼎
Galloping Horse Overtaking a Flying Swallow 马踏飞燕
Unit 5 Traditional Sports and Athletics 传统运动与竞技（4 小时）
5.1Traditional Sports 传统运动
5.2Chinese Martial Arts 中国武术
5.3Taijiquan 太极拳
5.4Cuju 蹴鞠
5.5Qigong 气功
5.6Chinese Chess 象棋
5.7Traditional Acrobatic Acts 传统杂技
5.8Cultural Mosaic 文化常识
Five-Animal Play 五禽戏
The Mongolian Horsemanship 蒙古马术
Martial Arts in Popular Culture 流行文化中的武术
Unit 6 Ancient Science and Technology 中国古代科技（4 小时）
6.1History of Science and Technology 科技简史
6.2Early Technological Achievements 早期科技成就
6.3The Four Great Inventions 四大发明
6.4Scientific Achievements in the Middle Ages 中古科学发明
6.5Mongol Transmission & Jesuit Activity 科技传播与交流
6.6Joseph Needham 李约瑟
6.7Science and Technology in the PRC 现代科技发展
6.8 Cultural Mosaic 文化常识
Science and Civilization in China Series 李约瑟的《中国科学技术史》
Unit 7 Operas and Music 戏曲与音乐（4 小时）
7.1Chinese Opera 中国戏曲
7.2Kunqu Opera 昆曲
7.3Introduction of Beijing Opera 京剧简介
7.4Quyi 曲艺
7.5Chinese Music 中国音乐
7.6Butterfly Lovers 梁祝
7.7Legend of the White Snake 白蛇传
7.8 Cultural Mosaic 文化常识
The Story of High Mount Flowing Water 高山流水
Changing Faces 变脸
The Meaning of Colors in Chinese Opera Masks 脸谱的含义
Bronze Chime-Bells of Marquis Yi of the Zeng State 曾侯乙编钟
Unit 8 Education and Aesthetics 古代教育与审美（4 小时）
8.1Education in Ancient China 中国古代教育
8.2Imperial Examination 科举考试
8.3Institutions of Higher Education 古代高等教育衍变
8.4Chinese Aesthetics 中国人的审美观
8.5Chinese Painting 国画
8.6Ancient Chinese Architecture 古代建筑
8.7Cultural Spirit in Classical Gardens 古典园林的文化内涵

8.8 Cultural Mosaic 文化常识
Some Details of the Imperial Examination 科举考试细则
Academies of Classical Learning 四大书院
Wu Daozi, Sage in Chinese Painting 画圣吴道子
Unit 9 Thoughts and Philosophy 思想与哲理（4 小时）
9.1Traditional Philosophy 传统哲学
9.2Confucius 孔子
9.3Confucianism, Taoism and Buddhism 儒、道、释
9.4Neo-Confucian Zhu Xi 理学家朱熹
9.5Harmony between Man and Nature 天人合一
9.6 Cultural Mosaic 文化常识
Laozi and Zhuangzi 老子与庄子
Mencius 孟子
Four Books and Five Classics 四书五经
Unit 10 Religions and Beliefs 宗教与信仰（4 小时）
10.1What Do Chinese People Believe in? 中国人的信仰
10.2Heaven Worship 祭天
10.3Ancestor Worship 拜祖
10.4Taoism in China 道教
10.5Buddhism in China 佛教
10.6Feng Shui 风水
10.7 Cultural Mosaic 文化常识
The God of Wealth 财神
King Yam 阎王
The God of Kitchen 灶神
The Matchmaker 月老
Unit 11 Exchanges with Foreign Countries 中外往来述要（4 小时）
11.1The Silk Road 丝绸之路
11.2The Influences of Silk Road 丝绸之路的影响
11.3The Tea Horse Road 茶马古道
11.4Zheng He’s Voyages 郑和下西洋
11.5Did Zheng He Discover the World? 郑和发现了世界？
11.6 Cultural Mosaic 文化常识
Great Ming Amalgamated Map 《大明混一图》
Jian Zhen 鉴真东渡
Matteo Ricci 利玛窦
Unit 12 Review 复习（1 小时）

2.Textbooks

《中国文化概览》 *A Panoramic View of Chinese Culture* 编著 吴鼎民，译林出版社，2010 年

Written by：WANG Zheng（王征）
Instructor：LIANG Hongfei（梁红飞）,WANG Zheng（王征）, et al.

Course Code：8A080002L

Course Title(Chinese)：系统与控制理论中的线性代数

Course Title(English)：Linear Algebra in System and Control Theory

College and Department：Col. of Science
Semester：Spring
Class Hours：60
Teaching Methods：Lecture, Homework
Suitable Majors: All Specialities in Engineering
Assessment Instruments：Examination, Project
Pre-requisites：Linear Algebra, Matrix Theory

7. Course Objective and Requirements

The theories and methods of linear algebra are indispensable to science and technology, are especially fundamental to studying modern system and control theory. In this course, the theories, methods of linear algebra with applications to system and control are introduced. The main contents may be divided into three parts. The first part is the basic concepts of modern mathematics including mapping, algebraic operation, group, ring，field and so on. The second part is contains the theories and methods of linear algebra including linear space, subspace, linear mapping and transformation, inner product space, orthogonal projection, normed space, best approximation and so on. The third part contains some topics of numerical linear algebra including matrix factorizations, generalized inverse of a matrix, matrix equation, least squares problem, total least squares problem, matrix perturbation analysis and so on. Course objectives: enhance the mathematical quality of graduates, provide the mathematical foundations for studying follow-up courses and carrying out scientific research.

8. Course Content and Schedule

Chapter 1 Basic Concepts（8h）
- 1.22 Sets
- 1.23 Mapping
- 1.24 Algebraic Operations
- 1.25 Homomorphism and Isomorphism
- 1.26 Equivalence and Classification of Set
- 1.27 Ordered Spaces
- 1.28 Metric Spaces

Chapter 2 Groups （8h）
- 8.1 Basic Concepts of Groups
- 8.2 Subgroups
- 8.3 Homomorphism and Isomorphism of Groups
- 8.4 Normal Subgroups and Quotient Groups
- 8.5 Groups of Transformations

Chapter 3 Rings and Fields （4h）
- 3.13 Basic Concepts of Rings
- 3.14 Subrings and Homomorphism of Rings
- 3.15 Ideals and Quotient Rings
- 3.16 Fields

Chapter 4 Linear Spaces （10h）
- 4.19 Linear Spaces
- 4.20 Subspaces
- 4.21 Homomorphism and Isomorphism of Linear Spaces
- 4.22 Linear Manifold and Quotient Spaces
- 4.23 Modules and Linear Algebra
- 4.24 Invariant Subspaces

Chapter 5 Inner Product Spaces （6h）
- 5.13 Inner Product Spaces
- 5.14 Gram-Schmidt Orthogonalization and QR factorization
- 5.15 Orthogonal Projection and Best Approximation
- 5.16 Linear Transformations of Inner Product Spaces

Chapter 6 Normed Linear Spaces（6h）
- 6.13 Normed Linear Spaces
- 6.14 Best Approximation
- 6.15 Banach Spaces
- 6.16 Norms of Linear Operators and Matrices

Chapter 7 Generalized Inverse and Least Squares Problems（10h）
- 7.25 Matrix Factorizations
- 7.26 Singular Value Decomposition and Its Generalization
- 7.27 Generalized Inverse of a Matrix
- 7.28 Linear Least Squares Problem
- 7.29 Total Least Squares Problem
- 7.30 Robust Least Squares Problem
- 7.31 Matrix Approximation with Constraints
- 7.32 Matrix Perturbation Analysis

Chapter 8 Matrix Functions and Matrix-Valued Functions（4h）
- 8.10 Matrix Functions
- 8.11 Matrix-Valued Functions with Applications
- 8.12 Eigenvalue Sensitivity Analysis with Applications

Chapter 9 Matrix Equations and Matrix Inequalities （4h）
- 9.16 Kronecker Product of Matrices
- 9.17 Linear Matrix Equations
- 9.18 Algebraic Riccati Equations
- 9.19 Matrix Inequalities
- 9.20 Pole Assignment Problems

12 Textbooks

(7) Lancaster P, Tismenetsky M. The Theory of Matrices with Applications. Academic Press, 1985.
(8) Greub W. Linear Algebra. Springer-Verlag，1981.

Main Reference Books

(7) Horn R A, Johnson C R. Matrix Analysis. Cambridge University Press, 1985.
(8) Golub G H, Van Loan C F. Matrix Computation. Third Edition, The John Hopkins University Press, 1996.

Written by：DAI Hua（戴华）　　**Instructor**：DAI Hua（戴华）

Course Code：6B082004L

Course Title(Chinese)：固体理论

Course Title(English)：Theory of Solid State Physics

College and Department：Col. of Science
Semester：Spring
Class Hours：48
Teaching Methods：Lecture, Homework
Suitable Majors: Physics, nano-science
Assessment Instruments：Examination
Pre-requisites：solid state physics, Quantum Mechanics

1.Course Objective and Requirements

The course shall provide a better understanding of central concepts in solid state physics and their relation to the basic theories of quantum mechanics and electrodynamics. The students shall learn how these concepts can be applied to model physical effects quantitatively. Particular emphasis is given towards topics relevant to ongoing research in solid state physics and nanoscience in Lund.

2.Course Content and Schedule

Chapter 1: Band structure of crystals and semiconductor heterostructures (10h)
Chapter 2: Electron transport and scattering processes (10h)
Chapter 3: Magnetism (8h)
Chapter 4: Introduction to dielectric function and semiconductor lasers (8h)
Chapter 5: Electron-electron interaction (8h)
Chapter 6: Superconductivity (4h)

3. Textbooks

Quantum Theory of the Solid State (Second Edition), Joseph Callaway, Elsevier, 2010

Main Reference Books

Quantum Theory of Solids, 2nd Revised Edition, Charles Kittel

Written by：ZHOU Tao（周涛） **Instructor**：ZHOU Tao（周涛）

Course Code：7D081025L

Course Title(Chinese)：偏微分方程

Course Title(English)：Partial Differential Equations

College and Department：Col. of Science

Semester：Spring

Class Hours：48

Teaching Methods：Lecture, Homework

Suitable Majors: Mathematics

Assessment Instruments：Examination, Project

Pre-requisites：Differential and integral calculus, real analysis and functional analysis

1. Course Objective and Requirements

Course objective: In mathematics, a partial differential equation (PDE) is a differential equation that contains unknown multivariable functions and their partial derivatives. PDEs can be used to describe a wide variety of phenomena such as sound, heat, electrostatics, electrodynamics, fluid dynamics, elasticity, or quantum mechanics. Just as ordinary differential equations often model one-dimensional dynamical systems, partial differential equations often model multidimensional systems. The objective of this course is to give an introduction of steady and evolution equations, and to give an insight into how to establish the well-posedness and the solution regularity.

Requirements: A solid foundation in differential and integral calculus, real analysis and functional analysis

2. Course Content and Schedule

Chapter 1 Introduction (4h)

1.1 partial differential equations and examples

1.2 Strategies for studying PDEs

Exercises for Chapter 1

Chapter 2 Four important linear PDEs (8h)

2.1 Transport equation

2.2 Laplace's equation

2.3 Heat equation

2.4 Wave equation

Exercises for Chapter 2

Chapter 3 Nonlinear first-order PDEs (8h)

3.1 Complete integrals, envelopes

3.2 Characteristics

3.3 Introduction to Hamilton-Jacobi equations

3.4 Introduction to conservation laws

Exercises for Chapter 3

Chapter 4 Other ways to represent solutions (10h)

4.1 Separation of variables and similarity solutions

4.2 Transform methods

4.3 Converting nonlinear into linear PDEs

4.4 Asymptotics

4.5 Power series

Exercises for Chapter 4

Chapter 5 Sobolev spaces (10h)

5.1 Holder spaces and Sobolev spaces

5.2 Approximation

5.3 Extensions and traces

5.4 Sobolev inequalities and compactness

5.5 Additional topics and other spaces of functions

Exercises for Chapter 5

Chapter 6 Second-order elliptic equations (8h)

6.1 Definitions and existence of weak solutions

6.2 Regularity

6.3 Maximum principles

6.4 Eigenvalues and eigenfunctions

Exercises for Chapter 6

4. Textbooks

(1) Lawrence C. Evans, Partial Differential Equations, American Mathematical Society, 2010.

Main Reference Books

(1) Lawrence C. Evans, Partial Differential Equations, American Mathematical Society, 2010.
(2) Vladimir I. Arnold, Lectures on Partial Differential Equations, Springer 2009.
(3) Gerald B. Folland, Introduction to Partial Differential Equations, Princeton University Press, 2011.

Written by：Gong Rongfang (龚荣芳)　　**Instructor**：Gong Rongfang (龚荣芳)

Economics and Management

Course type	Course Code	Course Title	Hours	Credits	Semester	College	Remark
Compulsory Course	6A120007L	Chinese Culture	45	3	Spring	Col. of Foreign Languages	
	8A080002L	Linear Algebra in System and Control Theory	60	4	Spring	Col. of Science	Compulsory for master Students
Optional Course	6B091018L	Decision Analysis and Making	48	3	Spring	Col. of Economics and Management	
	6B092006L	Technical and Economic Analysis	32	2	Spring	Col. of Economics and Management	
	6B093007L	International Trade	32	2	Spring	Col. of Economics and Management	
	6B093008L	Macroeconomics	32	2	Spring	Col. of Economics and Management	
	6B093010L	Energy and Environmental Economics	32	2	Spring	Col. of Economics and Management	

Course Code：6A120007L

Course Title(Chinese)：中国文化

Course Title(English)：Chinese Culture

College and Department：Col. of Foreign Languages
Semester：Spring
Class Hours：45
Teaching Methods：Lecture
Suitable Majors: International postgraduates
Assessment Instruments：Report
Pre-requisites：Elementary Chinese

1.Course Objective and Requirements

In the time of globalization, cross-cultural communication appears to be more and more important for nowadays students. With the rapid growth of Chinese economy, China now once again stands up on the world stage. The world is looking at China, and eager to know about this old and young, traditional but fashionable country, especially for the international students. Therefore it's necessary for overseas students to know something about Chinese culture and tradition, which will greatly help them to adapt themselves to the life in China.

After the 12 weeks of lectures and presentations, students of this class are expected to be familiar with some aspects of Chinese culture mentioned in the textbook. Furthermore, the students are recommended to make some comparative studies between Chinese culture and western culture.

2.Course Content and Schedule

Unit 1 The Origin of Chinese Culture 中国文化溯源（4 小时）
1.1Chinese Culture 祠 ast and Present 中国文化—传统与现代
1.2The Appellation of China 国名由来
1.3Chinese Mythology 神话传说
1.4Cultural Mosaic 文化常识
Heavenly Stems and Earthly Branches 天干地支
The Twenty-four Solar Terms 二十四节气
Chinese Zodiac 十二生肖
Unit 2 Chinese Language 中国的语言（4 小时）
2.1Han Chinese Language 汉语
2.2The Chinese Written Language 中国的文字
2.3The Origins of Chinese Writing 汉字的源流
2.4Chinese Calligraphy 书法
2.5Chinese Seals 印章
2.6Traditional System & Simplified System 繁体与简体
2.7 Cultural Mosaic 文化常识
The Chinese Character Classification 六书
The Components of Characters 偏旁部首
Four Treasures of the Study 文房四宝
Lanting Xu by Wang Xizhi 王羲之的《兰亭序》
Unit 3 Ancient Capitals and Heritages 古都与文化遗产（4 小时）
3.1The Seven Great Ancient Capitals 七大古都
3.2Tourist Resources in China 旅游资源
3.3Cultural Mosaic 文化常识
The Great Wall of China 长城
The Forbidden City 紫禁城
Terracotta Army 兵马俑
China's Top Ten 中国的"十大之最"
Unit 4 Crafts and Skills 传统工艺（4 小时）

4.1Traditional Chinese Crafts 传统工艺品
4.2Jade Culture 玉文化
4.3Ancient Chinese Bronze 青铜器
4.4Chinese Silk 丝绸
4.5Chinese Embroidery 刺绣
4.6Chinese Porcelain 瓷器
4.7Chinese Knots 中国结
4.8Paper Cuttings 剪纸
4.9 Cultural Mosaic 文化常识
Si Mu Wu Ding 司母戊鼎
Galloping Horse Overtaking a Flying Swallow 马踏飞燕
Unit 5 Traditional Sports and Athletics 传统运动与竞技（4 小时）
5.1Traditional Sports 传统运动
5.2Chinese Martial Arts 中国武术
5.3Taijiquan 太极拳
5.4Cuju 蹴鞠
5.5Qigong 气功
5.6Chinese Chess 象棋
5.7Traditional Acrobatic Acts 传统杂技
5.8Cultural Mosaic 文化常识
Five-Animal Play 五禽戏
The Mongolian Horsemanship 蒙古马术
Martial Arts in Popular Culture 流行文化中的武术
Unit 6 Ancient Science and Technology 中国古代科技（4 小时）
6.1History of Science and Technology 科技简史
6.2Early Technological Achievements 早期科技成就
6.3The Four Great Inventions 四大发明
6.4Scientific Achievements in the Middle Ages 中古科学发明
6.5Mongol Transmission & Jesuit Activity 科技传播与交流
6.6Joseph Needham 李约瑟
6.7Science and Technology in the PRC 现代科技发展
6.8 Cultural Mosaic 文化常识
Science and Civilization in China Series 李约瑟的《中国科学技术史》
Unit 7 Operas and Music 戏曲与音乐（4 小时）
7.1Chinese Opera 中国戏曲
7.2Kunqu Opera 昆曲
7.3Introduction of Beijing Opera 京剧简介
7.4Quyi 曲艺
7.5Chinese Music 中国音乐
7.6Butterfly Lovers 梁祝
7.7Legend of the White Snake 白蛇传
7.8 Cultural Mosaic 文化常识
The Story of High Mount Flowing Water 高山流水
Changing Faces 变脸
The Meaning of Colors in Chinese Opera Masks 脸谱的含义
Bronze Chime-Bells of Marquis Yi of the Zeng State 曾侯乙编钟
Unit 8 Education and Aesthetics 古代教育与审美（4 小时）
8.1Education in Ancient China 中国古代教育
8.2Imperial Examination 科举考试
8.3Institutions of Higher Education 古代高等教育衍变
8.4Chinese Aesthetics 中国人的审美观
8.5Chinese Painting 国画
8.6Ancient Chinese Architecture 古代建筑
8.7Cultural Spirit in Classical Gardens 古典园林的文化内涵

8.8 Cultural Mosaic 文化常识
Some Details of the Imperial Examination 科举考试细则
Academies of Classical Learning 四大书院
Wu Daozi, Sage in Chinese Painting 画圣吴道子
Unit 9 Thoughts and Philosophy 思想与哲理（4 小时）
9.1Traditional Philosophy 传统哲学
9.2Confucius 孔子
9.3Confucianism, Taoism and Buddhism 儒、道、释
9.4Neo-Confucian Zhu Xi 理学家朱熹
9.5Harmony between Man and Nature 天人合一
9.6 Cultural Mosaic 文化常识
Laozi and Zhuangzi 老子与庄子
Mencius 孟子
Four Books and Five Classics 四书五经
Unit 10 Religions and Beliefs 宗教与信仰（4 小时）
10.1What Do Chinese People Believe in? 中国人的信仰
10.2Heaven Worship 祭天
10.3Ancestor Worship 拜祖
10.4Taoism in China 道教
10.5Buddhism in China 佛教
10.6Feng Shui 风水
10.7 Cultural Mosaic 文化常识
The God of Wealth 财神
King Yam 阎王
The God of Kitchen 灶神
The Matchmaker 月老
Unit 11 Exchanges with Foreign Countries 中外往来述要（4 小时）
11.1The Silk Road 丝绸之路
11.2The Influences of Silk Road 丝绸之路的影响
11.3The Tea Horse Road 茶马古道
11.4Zheng He’s Voyages 郑和下西洋
11.5Did Zheng He Discover the World? 郑和发现了世界？
11.6 Cultural Mosaic 文化常识
Great Ming Amalgamated Map 《大明混一图》
Jian Zhen 鉴真东渡
Matteo Ricci 利玛窦
Unit 12 Review 复习（1 小时）

1. Textbooks

《中国文化概览》 *A Panoramic View of Chinese Culture* 编著 吴鼎民，译林出版社，2010 年

Written by：WANG Zheng（王征）
Instructor：LIANG Hongfei（梁红飞）,WANG Zheng（王征）, et al.

Course Code：8A080002L

Course Title(Chinese)：系统与控制理论中的线性代数

Course Title(English)：Linear Algebra in System and Control Theory

College and Department：Col. of Science
Semester：Spring
Class Hours：60
Teaching Methods：Lecture, Homework
Suitable Majors: All Specialities in Engineering
Assessment Instruments：Examination, Project
Pre-requisites：Linear Algebra, Matrix Theory

9. Course Objective and Requirements

The theories and methods of linear algebra are indispensable to science and technology, are especially fundamental to studying modern system and control theory. In this course, the theories, methods of linear algebra with applications to system and control are introduced. The main contents may be divided into three parts. The first part is the basic concepts of modern mathematics including mapping, algebraic operation, group, ring，field and so on. The second part is contains the theories and methods of linear algebra including linear space, subspace, linear mapping and transformation, inner product space, orthogonal projection, normed space, best approximation and so on. The third part contains some topics of numerical linear algebra including matrix factorizations, generalized inverse of a matrix, matrix equation, least squares problem, total least squares problem, matrix perturbation analysis and so on. Course objectives: enhance the mathematical quality of graduates, provide the mathematical foundations for studying follow-up courses and carrying out scientific research.

10. Course Content and Schedule

Chapter 1 Basic Concepts（8h）
- 1.29 Sets
- 1.30 Mapping
- 1.31 Algebraic Operations
- 1.32 Homomorphism and Isomorphism
- 1.33 Equivalence and Classification of Set
- 1.34 Ordered Spaces
- 1.35 Metric Spaces

Chapter 2 Groups （8h）
- 10.1 Basic Concepts of Groups
- 10.2 Subgroups
- 10.3 Homomorphism and Isomorphism of Groups
- 10.4 Normal Subgroups and Quotient Groups
- 10.5 Groups of Transformations

Chapter 3 Rings and Fields （4h）
- 3.17 Basic Concepts of Rings
- 3.18 Subrings and Homomorphism of Rings
- 3.19 Ideals and Quotient Rings
- 3.20 Fields

Chapter 4 Linear Spaces （10h）
- 4.25 Linear Spaces
- 4.26 Subspaces
- 4.27 Homomorphism and Isomorphism of Linear Spaces
- 4.28 Linear Manifold and Quotient Spaces
- 4.29 Modules and Linear Algebra
- 4.30 Invariant Subspaces

Chapter 5 Inner Product Spaces （6h）
- 5.17 Inner Product Spaces
- 5.18 Gram-Schmidt Orthogonalization and QR factorization
- 5.19 Orthogonal Projection and Best Approximation
- 5.20 Linear Transformations of Inner Product Spaces

Chapter 6 Normed Linear Spaces（6h）
- 6.17 Normed Linear Spaces
- 6.18 Best Approximation
- 6.19 Banach Spaces
- 6.20 Norms of Linear Operators and Matrices

Chapter 7 Generalized Inverse and Least Squares Problems（10h）
- 7.33 Matrix Factorizations
- 7.34 Singular Value Decomposition and Its Generalization
- 7.35 Generalized Inverse of a Matrix
- 7.36 Linear Least Squares Problem
- 7.37 Total Least Squares Problem
- 7.38 Robust Least Squares Problem
- 7.39 Matrix Approximation with Constraints
- 7.40 Matrix Perturbation Analysis

Chapter 8 Matrix Functions and Matrix-Valued Functions（4h）
- 8.13 Matrix Functions
- 8.14 Matrix-Valued Functions with Applications
- 8.15 Eigenvalue Sensitivity Analysis with Applications

Chapter 9 Matrix Equations and Matrix Inequalities （4h）
- 9.21 Kronecker Product of Matrices
- 9.22 Linear Matrix Equations
- 9.23 Algebraic Riccati Equations
- 9.24 Matrix Inequalities
- 9.25 Pole Assignment Problems

13 Textbooks

(9) Lancaster P, Tismenetsky M. The Theory of Matrices with Applications. Academic Press, 1985.
(10) Greub W. Linear Algebra. Springer-Verlag，1981.

Main Reference Books

(9) Horn R A, Johnson C R. Matrix Analysis. Cambridge University Press, 1985.
(10) Golub G H, Van Loan C F. Matrix Computation. Third Edition, The John Hopkins University Press,
1996.

Written by：DAI Hua（戴华）　　**Instructor**：DAI Hua（戴华）

Course Code：6B091018L

Course Title(Chinese)：决策分析

Course Title(English)：Decision Analysis and Making

College and Department：Col. of Economics & Management

Semester：Spring

Course hours：48

Course Credit：3

Teaching methods：Lecture, Presentation, Report, Homework

Suitable majors: System Engineering, Economics and Management

Assessment instruments：Examination, Project

Pre-requisites：Calculus, Linear Algebra, and Probability

1. Course objective and Requirements

Decision Analysis is a very important course for students in College of Economics and Management, College of Automation, and College of Civil Aviation. In this course, the concept, principle, and application are introduced. Specifically, topics include introduction to decision methods, evaluation approach, forecasting method, and conflict analysis. In addition, some basic tools are introduced to help make decision, such as some decision support systems and some tool boxes. The overriding objectives of this course are to introduce the important concepts and the newest development in decision analysis for students. After this course, students can use the knowledge from the course to solve the challenging decision problems arising in management science, engineering and other fields. The overall structure of the book consists of eight chapters. The main contents of each part are highlighted below:

2. Course contents and Schedule

Chapter 1 Decision Making in a Complex World（4h）
- 1.1 Real World Decision
- 1.2 Introduction to Decision Models and Decision Methods
- 1.3 Sensitivity Analysis
- 1.4 Analysis of Cases

Chapter 2 Multiple Criteria Decision Analysis (MCDA)（14h）
- 2.1 AHP Model
- 2.2 DEA Model
- 2.3 TOPSSESS Model
- 2.4 Rough Set
- 2.5 Inventory Model
- 2.5 Introduction to Software
- 2.6 Analysis of Cases

Chapter 3 Classical Game Theory （8h）
- 3.1 Introduction
- 3.2 Definitions and Theories of Game Theory
- 3.3 Introduction to Software
- 3.4 Applications

Chapter 4 Graph Model for Conflict Resolution（10h）
- 4.1 Introduction to the Graph Model
- 4.2 Modeling
- 4.3 Stabilities Analysis
- 4.4 Analysis of Cases

Chapter 5 Regression and Forecasting（6h）
- 5.1 Correlation
- 5.2 Regression
- 5.3 Multiple Regressions
- 5.4 Forecasting Models
- 5.5 Analysis of Cases

Exam (2h) and Presentation (4h)

3.Experiments

Project: Construct a model from the real world to make decision analysis for the model.

4.Textbooks

[1] Introduction to Decision Analysis (2nd Edition) [Hardcover]. David C. Skinner (Author).

Main reference books

[1] Fang, L., Hipel, K.W., Kilgour, D.M. (1993), Interactive Decision Making: The Graph Model for Conflict Resolution, New York: Wiley.
[2] Game Theory (徐海燕编)

Written by：XU Haiyan（徐海燕） **Instructor**：XU Haiyan（徐海燕）

□

Course Code: 6B092006L

Course Title (Chinese): 技术经济分析

Course Title (English): Technical Economic Analysis

College and Department: Col. of Economy & Management

Semester: Spring

Class Hours: 32

Teaching Methods: Lecture, Homework

Suitable Majors: Business administration, Management Science and Engineering, Economics

Assessment Instruments: Assignments and Presentation

Pre-requisites: Basic Knowledge of Economics, Management, Systems Engineering

1. Course Objective and Requirements

This course covers the principles and models and tools for economic analysis. Topics mainly include the structure and properties of systems, evaluation and approaches selection, explanation of several approaches such as TOPSIS, AHP and DEA, and value analysis program.

This course aims to equip students with fundamental models and approaches for technological economic analysis. Through the study of this course, students are expected to improve their analytical ability which is very important for solving real-world problems.

Students should have some fundamental analytical ability in using quantitative analysis tools to solve real-world management problems. Students are expected to have taken basic courses such as Economics, Management, Systems Engineering, and Probability and Statistics.

2. Course Content and Schedule

Lecture 1 (4h)
(1) Introduction to the Course
(2) System
Lecture 2 (4h)
(3) What is Evaluation
(4) Selecting an Evaluation: Qualitative, Quantitative, and Mixed Methods Approaches
Lecture 3 (4h)
(5) An Illustrated Guide to the NALYTIC HIERARCHY PROCESS
(6) Supplier Selection Based On AHP Method
Lecture 4 (4h)
(7) Consistency in the ANALYTIC HIERARCHY PROCESS
(8) TOPSIS
Lecture 5 (4h)
(9) Analytic Hierarchy Process & TOPSIS Method to Evaluate Faculty Performance in Engineering Education
(10) Introduction to VE
Lecture 6 (4h)
(11) Project Cycle
(12) VE Over a System's life cycle
Lecture 7 (4h)
(13) Function Analysis Systems Techniques–The Basics
(14)The Theoretical Explanation for the Ways Improving the VALUE of a Product or System
Lecture 8 (4h)
(15) Value Calculation
(16) Value Innovation Through Value Engineering– A strategic objective

3. Assignments

(1) Group work (20)
Please make use of AHP & TOPSIS to evaluate your teachers performance in your study program.
(2) Individual work (30)
Please design a FAST Diagram for your study program in NUAA.
(3) Individual work (30)
Please evaluate the technical efficiency, allocative efficiency and scale efficiency of at least five DMUs.
(4) Attendance (20)

4. Textbooks

(1) VALUE ENGINEERING—Analysis and Methodology, DEL L. YOUNKER. Value Consulting Winter Springs, Florida, U.S.A. MARCEL DEKKER, INC 2003

(2) SUBHASH C. RAY. Data Envelopment Analysis—Theory and Techniques for Economics and Operations Research. Cambridge university press 2004

Main Reference Books

(1) JOHN W. CRESWELL. RESEARCH DESIGN: Qualitative, Quantitative, and mixed methods approaches. SAGE Publications, Inc; Fourth Edition edition (12 May 2013)

(2) Pali, P. and Swaans, K. 2013. Guidelines for innovation platforms. ILRI Manual 8. Nairobi, Lenya: ILRI.

(3) Communication Promoters Group of the Industry-Science Research Alliance. Recommendations for implementing the strategic initiative INDUSTRIE 4.0, April 2013.

(4) VALUE STANDARD and BODY OF KNOWLEDGE, SAVE International Value Standard, 2007 edition

(5) Jay Mandelbaum Danny L. Reed. Value Engineering Handbook. INSTITUTE FOR DEFENSE ANALYSES. 2006.

(6) A Comprehensive Value Engineering Approach for Gas Pipeline Projects Using Mathematical Models and FAST: A Case Study of Mazandaran Gas Company, International Journal of Business and Information, Volume 6, Number 2, December 2011.

(7) Techno-Economic Analysis of Aircraft, University of Cambridge, 2008.

Written by：TAN Qingmei（谭清美）　　**Instructor**：TAN Qingmei（谭清美）

Course Code：6B093007L

Course Title(Chinese)：国际贸易

Course Title(English)：International Trade

College and Department： Col. of Economics & Management

Semester：Spring

Class Hours：32

Teaching Methods：Lecture, Discussion, Inquiry Learning

Suitable Majors: International Trade, Industrial Economics, Regional Economics, Finance

Assessment Instruments：Group presentation, Project Report, Examination

Pre-requisites：Microeconomics, Macroeconomics

1. Course Objective and Requirements

This course uses economic analysis to study the causes, pattern and consequences of international trade, as well as key policy debates relating to trade issues. As a graduate level course, this course tries to bring together theoretical and empirical studies scattered over the pages of learned journals and books, and discuss the contemporary literature and cutting-edge issues in the research of international trade theory and policy, so as to provide considerable trainings in both international trade theory and empirical analysis, which is meant to bring students up to date with current work in international trade and to prepare them for doing research in this or other related fields. The course arrangements have accordingly been designed to help the students grasp the basic theory of international trade and learn to read papers critically, as well as to develop and execute their own independent research ideas.

2. Course Content and Schedule

Chapter 1 Introduction to the course (2h)
- 1.1 Hot issues in international trade
- 1.2 Syllabus of the course
- 1.3 Course requirements and grading

Chapter 2 Structure of international trade (4h)
- 2.1 Measurement of international trade structure
- 2.2 Change of international trade structure

Chapter 3 International trade theory (8h)
- 3.1 A general picture of trade theory
- 3.2 Ricardian Model
- 3.3 Heckscher-Ohlin Model
- 3.4 New Trade Theory
- 3.5 New-new Trade Theory

Chapter 4 Trade policy (6h)
- 4.1 Classification of trade policy
- 4.2 Trade policy analysis

Chapter 5 Inquiry Learning – special topics (8h)

Presentation or discussion (2h)

Examination (2h)

3. Textbooks

Dennis R. Appleyard, International Trade (Seventh Edition), 中国人民大学出版社, 2012

Main Reference Books

Robert C. Feenstra, Advanced International Trade: Theory and Evidence (2e), Princeton University Press, 2016

Written by：WANG Ying（王英） **Instructor**：WANG Ying（王英）et al.

Course Code：6B093008L

Course Title(Chinese)：宏观经济学

Course Title(English)：Macroeconomics

College and Department：Col. of Economics and Management

Semester：Spring

Course hours：32

Teaching methods：Lecture, Presentation, Report, Homework

Suitable majors: Economics and Management

Assessment instruments：Examination

Pre-requisites：Microeconomics

1. Course Objective and Requirements

Macroeconomics is the branch of economics that examines the economic behavior of the entire economy. It deals with national income, national output, and national employment and so on. It is concerned with the study of real life economic issues and problems. It teaches the macroeconomic issues such as unemployment, inflation, cyclical business fluctuations, economic growth, the role of money, theories of interest rates, stabilization policies, foreign exchange rates, and balance of payments difficulties, and comparative economic advantages among nations.

This course provides a common sense approach to the world of macroeconomic decisions and their impact on society. It is aimed at providing the necessary background in the economic issues of establishing, running and managing a business in today's society.

2.Course Contents and Schedule

Module 1. ***What is Macroeconomics?: Fundamentals and some jargon***

Chapter 1 The fundamentals of macroeconomics (1h)

A. introduction
B. the three problems of economic organization
C. society's technological possibility

Chapter 2 Markets and government in the modern economy (2h)

A. What is a market
B. Trade, money and capital
C. The economic role of government

Module 2. ***Measuring Economic Activity: Data and Definitions***

Chapter 3 Overview of macroeconomics (2h)

A. key concepts of macroeconomics
B. Aggregate supply and demand

Chapter 4 Measuring economic activity (2h)

A. GDP and GNP
B. Price indexes

Module 3. ***Introducing some analytical tools: Aggregate Supply and Demand***

Chapter 5 Business fluctuations and the theory of aggregate demand (2h)

A. Business fluctuations
B. Foundations of aggregate demand

Chapter 6 the multiplier model (2h)

A. The basic multiplier model
B. Fiscal policy in the multiplier model

Chapter 7 Unemployment and the foundations of aggregate supply (2h)

A. The foundations of aggregate supply
B. Unemployment

Module 4. Consumption, Savings and Investment

Chapter 8 Consumption and investment (2h)

A. Consumption and saving
B. Investment

Module 5. ***Monetary Policy: Money, Inflation and Central Banks***

Chapter9 Money, Banking, and Financial Markets (3h)

A. The modern financial system
B. The special case of money
C. Banking and the supply of money
D. The stock market

Chapter 10 Central Banking and Monetary Policy (3h)

A. Central banking and the federal reserve system
B. The effect of money on output and prices

Module 6. ***Fiscal Policy: The Role of Government***

Chapter 11 Ensuring price stability (2h)
A. Definition an d impact of inflation
B. Modern inflation theory

Chapter 12 the warring school of macroeconomics (2h)
A. Classical stirring and Keynesian Revolution
B. The modern approach
C. New approaches to Macroeconomics

Module 7. ***Economic Growth***

Chapter 13 The Process of Economic Growth (3h)
A. Theories of economics growth
B. The patterns of growth in the US

Chapter 14 The Challenge of Economic Development (2h)
A. Economic growth in poor countries
B. Alternative models for development

Chapter 15 Policies for growth and stability (2h)
A. The economics consequences on the government debt
B. Stabilizing the economy
C. Economics Prospects in the new century

3.Experiments

Class lectures and discussions. Students are expected to participate actively in class discussions. They are required to keep abreast of current macroeconomic events in the media to be able to participate in discussions of these issues.

Homework. Students are expected to work on exercises and questionsperiodically assigned, and to discuss them in class.

Class presentation: I will split the class into groups of two people and assign to each group a country. Each group will have the responsibility to prepare a 30 minute presentation explaining how the economic system of the country assigned works as well as a brief comment on its current macroeconomic situation. Presentations will be held one country per class, using for that purpose the first 30 minutes of the time allocated for the class.

4.Textbooks

[1] Samuelson, P.A. & Nordhaus, W.D., "Economics", 18th edition, 人民邮电出版社 2008

Main Reference Books

[1] Campbell R McConnel,Macroeconomics, 16/e,Mcgraw-hill,2005

Written by：CHEN Qiting（陈其霆） **Instructor**：CHEN Qiting（陈其霆）

Course Code： 6B093010L

Course Title(Chinese)：能源与环境经济学

Course Title(English)：Energy and Environmental Economics

College and Department：Col. of Economics & Management

Semester：Spring

Class Hours：32

Teaching Methods：Lecture, Project,

Suitable Majors：International Business

Assessment Instruments：Exam, Presentation in Class, Topic Proposal

Pre-requisites：Microeconomics, Macroeconomics, Econometrics

1.Course Objective and Requirements

The course provides a broad coverage of energy and environmental economics for Master-level students.

The course examines the role of energy in economic activity, economic methods of assessing energy technologies, projects, and policies, and debates concerning alternative future energy scenarios. Both fossil fuels and renewable and nuclear energy sources will be studied as well as energy efficiency and conservation. Additional topics include the economics of pollution control, market-based instruments, environmental cost-benefit analysis.

2. Course Content and Schedule

Chapter 1 Introduction（2h）
- 1.1 Global energy trends and current situation
- 1.2 Energy and the economy – biophysical foundations

Chapter 2 Energy Evaluation Methods（4h）
- 2.1 Goals and key criteria of energy modelling and evaluation
- 2.2 Energy analysis
- 2.3 Cost-benefit analysis
- 2.4 Input-output modelling
- 2.5 Neoclassical production theory
- 2.6 Computable general equilibrium modelling
- 2.7 Energy quality and index numbers

Chapter 3 Energy and Economic Growth（4h）
- 3.1Energy and economic growth: The stylised facts
- 3.2Energy and economic growth: Alternative theories

Chapter 4 Fossil Fuels（2h）
- 4.1 Fossil fuel types and formation
- 4.2 Resources and reserves
- 4.3 Hubbert curve and related models
- 4.4 Economic models of fossil fuel exploitation
- 4.5 Oil markets

Chapter 5 Renewables and Nuclear（4h）
- 5.1 Non-fossil fuel energy overview
- 5.2 Alternative energy: shortcomings
- 5.3 EROI and alternative energy
- 5.4 Innovation, experience curve, and costs

5.5 Nuclear energy
Chapter 6 Energy Efficiency（4h）
6.1 Energy conservation
6.2 Energy efficiency – Economic perspective
6.3 The rebound effect
6.4 Barriers to the adoption of energy efficiency
Chapter 7 The Environment and the Economy（4h）
7.1 Environment-economy interdependence
7.2 Substituting for environmental services
7.3 EKC
7.4 Sustainable development
Chapter 8 Emissions Taxes and Abatement Subsidies（4h）
8.1 Emissions tax
8.2 Double dividend
8.3 Abatement subsidies
Chapter 9 Environmental Cost-benefit Analysis（2h）
9.1 The foundation of cost-benefit analysis
9.2 Decision rules
9.3 Total economic value
Chapter 10 Final Project Presentation （2h）

3. Final Project Presentation (2h)

Project1: Group1（*h，演示性）
The project involves Energy and Economic Growth.
Project2: Group2（*h，演示性）
The project involves Emissions Taxes and Abatement Subsidies.
Project3: Group3（*h，演示性）
The project involves Energy Efficiency and Conservation.
Project4: Group4（*h，演示性）
The project involves Energy Evaluation and Modelling.

4. Textbooks

(1) Subhes C. Bhattacharyya (2011) Energy Economics: Concepts, Issues, Markets and Gove rnance,
Springer, London.

Main Reference Books

(1) Grubler, A. et al. (2012) Energy primer, in: Global Energy Assessment, Cambridge Universit y Press:
99-150.
(2) Perman, R., Y. Ma, J. McGilvray, and M. Common (2011) Natural Resource and Enviro nmental
Economics, 4rd edition, Addison-Wesley.
(3) Kolstad, CD (2011) Environmental Economics, 2nd edn, Oxfor University Press.

Written by：ZHA Donglan（查冬兰） **Instructor**：ZHA Donglan（查冬兰）