浙江理工大学

机械设计制造及其自动化（全英文授课）专业课程教学大纲

机械与自动控制学院

教 务 处

二〇二一年六月

ZhejiangSci-TechUniversity

Teaching Syllabi of Mechanical Design manufacture and Automation Major Major

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Foreword

Syllabus serves not only as the basis for textbook compiling and teaching, but also as the important standard for the evaluation of students' academic achievements and teachers' teaching quality. This new round of syllabus revision is organized by the Academic Affairs Office and supported by all Schools and Departments of Zhejiang Sci-Tech University (ZSTU). The aim is to thoroughly carry forward the spirit of the National Education Conference and implement *The Outline on Ideological and Political Construction of University Curriculum* issued by the Ministry of Education. It is also an effort to carry out the requirements for courses set by both major accreditation (evaluation) and national standards for teaching quality of different majors. The revised syllabi are expected to ensure the successful implementation of the 2020 edition of *the ZSTU Undergraduate Students Cultivation Plan* and to promote the construction of the first-class majors and the first-class courses.

After revision, each volume of the syllabi is centered on one major, including its general education courses, basic courses, core courses and practice courses. The syllabi of all the non-major general education courses are compiled into a separate volume.

The syllabi was revised based on the 2020 edition of the ZSTU Undergraduate Students Cultivation Plan. Some obsolete courses and content are deleted. New additions include: (1) The ideological and political education is incorporated into the course design, teaching content and seminars. (2) Three criteria for a gold course are emphasized by highlighting the integration of knowledge, ability and quality. (3) Quality textbooks are selected; in particular, mandatory textbooks listed by the Marxist Theory Research and Development Project are designated as the only textbooks for some specific majors as required.

The revision and compilation is finished by the joint efforts of the deans and head teachers in charge of teaching in all the Schools and Departments. Participation of many teachers and support from the leaders of the University guarantee its successful completion. Their efforts and support are hereby acknowledged.

It is our sincere hope that teachers will follow the revised syllabi, exploring new teaching contents and models to develop more first-class courses.

Syllabus revision is like a systematic project, involving many factors. Although we have tried our best, there might still exist some errors. Please do not spare your comments to help us make constant improvements, so that a solid foundation is laid to push the education and teaching quality of our university to a higher level.

Academic Affairs Office
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《工程材料与热处理*》教学大纲

Engineering Materials and Heat treatment

Course Name(Chinese)：工程材料与热处理*　　　Course Code：29902

Course Name(English)： Engineering Materials and Heat Treatment

Category of this Course：Specialized course(required）

Total credit hours：32 lessons (including lectures：28 lessons, experiment: 4 lessons)

Credits：2.0

Prerequisite courses：Metal working courses, Mechanics of Materials

Applicable major：Mechanical Engineering

Department：Institute of mechanical design and manufacture

I. Course introduction

This course is an elementary technology course provided for students majored in Mechanical design and manufacture. It is the only undergraduate course introducing the fundamental knowledge on materials and heat treatment methods, which plays a requisite role in further scientific research and graduate education. This course aims at cultivating undergraduate students with systematic knowledge structure, capability in analyzing and solving engineering problems on materials. The teaching goal of this course is to introduce basic theories on materials and the intrinsic chemical composition, synthesis, microstructure, properties and performances of materials. After this course, students will be able to discriminate the different properties related microstructures and how to enhance the performances of materials, as well as the appropriate selection of engineering materials in application aspect. Engineering materials and heat treatment is a very important requisite course of undergraduate education due to the ever-increasing significance of materials, energy and information for the modern world. The teaching of this course focuses on knowledge transmitting, ability training and value shaping, so as to guide students to set up lofty ideals and carry forward patriotism. On the basis of teaching and practice, we should further cultivate the students' innovative spirit and professional quality of loving their posts and dedication, and cultivate the work style of keeping improving.

II. Course objectives

Objective 1：By the end of this course, the students will be able to grasp the evolution and development history, current situation and future trend of engineering materials as a whole; to understand the significant roles of engineering materials in aerospace, biomedical, energy information technology and other fields, and to understand the development prospects and challenges of "made in China 2025", and consciously explore the independent research development process and manufacturing-based new materials and devices; to lay the foundations for the students to become a responsible, ideal and responsible engineer in future career.

Objective 2： By the end of this course, undergraduate students are able to understand the chemical composition, synthetic methods, microstructure and properties of engineering materials and to reveal the relationship between structures and performances of materials. On the basis, students will also be familiar with the classifications, names, chemical composition, textiles, property and use of various typical engineering materials; be able to select raw materials for mechanic components, blades and moulds, appropriately.

Objective 3： By the end of this course, undergraduate students are able to select proper heat treatment method and determine efficient procedure and steps for engineering components. Be able to analyze the materials failure cases and provide proper solution. Be able to understand the basic logic in analyzing objective laws in the field of engineering materials and determine the core problems by using these analyzing methods.

Objective 4： Be able to understand the manufacturing and application of various classifications of engineering materials on environment and to take this factor into consideration in application.

III. Graduation requirements supported by teaching objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the teaching objectives of this course and the index points supporting graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Engineering Materials and Heat treatment*

Index points of graduation requirements	Content of the index points of graduation requirements
1.4	Be able to use the knowledge and mathematical model of design, manufacturing, control and other related knowledge to compare and form the solutions to complex engineering problems in the field of mechanical engineering.
7.1	Understand the impact of the implementation and operation of mechanical engineering on the ecological environment, and fully consider the conflict between mechanical engineering practice and environmental protection

Table 2 The supporting relationship between the course objectives of *Engineering Materials and Heat treatment* and the index points supporting graduation requirements

（Note: the first choice of graduation requirements is 1 to 1, followed by many to 1, not many to many）

Index points of graduation requirements	1.4		7.1	
Objectives	2	3	1	4
Intensity of support	H	H	L	H
Percentage	0.5	0.5	0.3	0.7

IV. Basic teaching content and class arrangement

Table 3 Relationship between course objectives and teaching content

Chapters	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
0	0. Introduction （1）Engineering materials and human history （2）Significance of engineering materials （3）Classifications of three major engineering materials （4）Design and selection of materials	1. Introduce the knowledge system framework of the course, the course, teaching content, assessment method and score ratio; 2. Understand the purpose and nature of the course, master the learning methods and requirements of this course, understand the development and classification of engineering materials, understand the general situation of engineering materials and the significance and methods of learning this course. 3.Introduce the history, current situation and future development of engineering materials, and cultivate students' correct view of history; Learn the development frontier of engineering materials, be familiar with the research and development of new materials, new processes, new technologies and new materials, and guide students to establish national pride, patriotism and professional confidence.	1	Teaching in class	1
1	1. Atomic structure and chemical bonding (1) Atoms (2) Bonding (3) Bonding & property relationship of engineering materials	1. Understand the atomic structure of metal materials, chemical bond and the effect of chemical bond on the properties of engineering alloys.	5	Teaching in class	1

Chapters	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
2	2. crystal and amorphous structure (1) space lattice (2) crystal systems and Bravais lattices (3) Principal metallic crystal structures (4) directions in unit cells (5) comparison on FCC, BCC, HCP (6) X-ray diffraction	1. Understand and master the crystallization process and its influence on properties; the plastic processing of metal materials and its influence on properties; the heat treatment principle and basic heat treatment process of steel and its application in the machining process of mechanical parts; 2. Understand the effect of alloying elements on improving the properties of metallic materials. Understand the characteristics and application of common surface treatment technology.	6	Teaching in class	1、2、3
3	3. Solidification and crystalline imperfections （1）solidification of metals （2）metallic solid solutions （3）crystalline imperfections	1.understand the solidification and crystals of pure metal system 2.crystallization of alloys 3.imperfections in solids	10	Teaching in class	1、2、3
4	4.Mechanic properties of Metals-1 （1）The processing of metals and Alloys （2）stress and strain of metals （3）Hardness, plastic deformation of metal single/polycrystals.	Mechanic properties of metallic and alloy systems-1	1	Teaching in class	1、2、3
5	5. Mechanic properties of Metals-2 （1）Fracture of metals （2）fatigue of metals （3）creep and stress rupture	Mechanic properties of metallic and alloy systems-2	1	Teaching in class	1、3
6	6.Phase diagram （1）Phase diagram of pure substances （2）Cooling curves （3）Binary isomorphous alloy system （4）Binary eutectic, pertectic, eutectoid alloy systems.	1. diagram of binary alloy systems 2. experiment	5	Teaching in class	1、3

Chapters	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
	（5）Summary of binary phase diagram.				
7	7.Engineering alloys （1）production of iron and steel （2）Iron-Carbon system （3）Other alloys	1. Having a good understand engineering alloy	1	Teaching in class	1、2、3
8	8. Ceramics （1）Introduction （2）crystal structure （3）classification, property	1. Understand and being able to use the knowledge on the manufacturing, design, performance characteristics and application scope of common ceramics and special ceramics.	1	Teaching in class	1、2、3
9	9.Polymers （1）Introduction （2）micro structure （3）classification, property	1. understand knowledge of engineering polymers.	1	Teaching in class	1、3

Table 4 Relationship between experiment content and lesson arrangement

Experiement	content	Method/instrument	lesson	Studnets/Group	实验属性（基本/综合/设计/研究创新）	开出要求(必做/选做)	对应课程目标
Equilibrium microstructure of steel	1. Understand the microstructure of Fe-C alloy in equilibrium state. 2. Analyze the influence of composition on the microstructure of Fe-C alloy, so as to understand the relationship between composition,	1.Metallographic microscope; 2.Metallographic sample; 3.Metallographic phase-diagram; 4. Cutting machine, polishing machine, sandpaper;	2	30	basic	Compulsory	2

	microstructure and properties. 3. Observe the microstructure of carbon steel after different forms of heat treatment. 4. Understand the significance of Austenite Isothermal Transformation Curve to actual production.						
Comprehensive experiment of heat treatment	1. Be familiar with the common heat treatment process (annealing, normalizing, quenching, tempering), understand the influence of heating temperature, cooling rate and other main factors on the performance of carbon steel after heat treatment, integrate theory with practice, and cultivate students' practical ability, innovative consciousness and comprehensive analysis and thinking ability. 2. Master the basic principle and application scope of different kinds of hardness measurement, be familiar with the	1.Box type electric furnace; 2.Brinell hardness tester and Rockwell hardness tester; 3.Coolant: water; 4. Sample: 45 steel;	2	30	basic	必做	2

	operation method and equipment characteristics of hardness tester, and cultivate students' ability to choose corresponding hardness detection methods according to the mechanical properties of materials. 3. Understand the structure and working principle of box type heat treatment furnace, and learn how to use it.						

V. Teaching method

The teaching mainly relies on the in-class teaching, assisted by practice and homework.

VI. Evaluation method

The assessment of *Engineering Materials and Heat treatment* is to evaluate the degree of students achieving the teaching objectives of the course, which reflects the degree of students achieving the objectives of ability cultivation. The assessment methods are shown in Table 5 below.

Table 5 Course objectives and assessment methods

Scores	**Evaluation parts**	**perce ntage**	**Evaluation details**	**Related objectives**
Usual performance	In-class performance	10%	It mainly assesses students' understanding and mastery of basic knowledge and skills. Evaluate students' answers to questions and their participation in class discussions. Practice effect in class. will count 10% towards the course grade.	1、2、3、4

Scores	Evaluation parts	percentage	Evaluation details	Related objectives
	homework	30%	It mainly assesses students' understanding and mastery of each lesson. Calculate the average score of all assignments and count it into the total score by 30%	2、3、4
Experiment	Experimental report	10%	It mainly assesses the measurement of strain-stress relationship in iron and steel samples. Scores are given on the basis of experiment results and report.	2、3
Final Exam	Exam result	50%	It mainly assesses students' mastery of software and their ability of using software to design and analyze complex mechanical system simulation. Students are required to complete a set of mechanical system modeling, simulation and testing tasks within the specified time, including 40 points for modeling, 40 points for simulation, and 20 points for testing. The Computer test score will be counted as 60% of the course total score.	2、3、4

The grading standards of this course for each assessment link of the course are shown in Table 6.

Table 6 The grading standards of this course

Evaluation parts	Grading standards	
Usual performance	According to the situation of answering questions, there are five grades: excellent (90-100), good (80-89), middle (70-79), passed (60-69), failed (below 60 points), on the basis of grades combined with class performance as appropriate to give points.	
Experiment	课程实验（10%）	According to the completion of the experiment report and result, there are five grades: Excellent (90-100), good (80-89), middle (70-79), passed (60-69), failed (below 60).
Final Exam	According to the completion of the test, according to the scoring rules will be graded.	

The score distribution matrix of assessment methods and course objectives is shown in Table 7.

Table 7 Assessment methods and course target score distribution matrix

		Part 1（in-class performance）（K1）	Part 2（experiment）（K2）	Part 3（exam）（K3）
Percentage		0.40	0.10	0.50
Percentage of the objectives	Objective 1（M1）	0.30	1.0	0.50
	Objective 2（M2）	0.40	0	0.30
	Objective 3（M3）	0.30	0	0.20

VII. Recommended teaching materials and reference materials

Textbook:

[1] William F. Smith， Foundations of Materials Science and Engineering, (Edition 3). McGraw-Hill Higher Education, 2009.

References：

[1] Zhangxiao Zhu, Kefu Yao. Engineering Materials, Edition 5, Beijing, Tsinghua university Press, 2011.

[2] Xinjia Liu. Engineering Materials, Edition 2, Chemical and industry Press, 2013.

Online literature：

[1]

[2]

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Modified on May, 11th, 2021

《机械振动*》教学大纲

Mechanical Vibrations

Course name： Mechanical Vibrations　　**Course code：** 31911

Course type： Profession education course (Elective)

Total teaching hours： 32 (Classroom Hours: 32)

Credit： 2.0

Prerequisites: Advanced mathematics, Linear algebra, Theoretical mechanics, Mechanics of materials,

Major： Mechanical design, manufacturing and automation

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

Mechanical vibrations course is an elective course for senior students of various majors in machinery. This course mainly introduces the basic theory of vibration of discrete systems such as single, two and multiple degrees of freedom and continuous systems such as rods and beams. The course focuses on establishing the basic concept of vibration and the method to analyze and solve problems, to master the method of time domain and frequency domain response analyses, and to introduce the modern matrix method and the computer calculation method. The ideological and political theory courses must be introduced into the course teaching. The patriotic feelings of undergraduates should be cultivated through introducing the requirements of vibration level in the field of bridges, the reliability of aerospace structures, turbine blades and the precision and life of big science equipments. Thus, the students should have the ability to solve complicated problems in mechanical engineering involved in structural dynamics analysis, healthy state prediction, structural optimization of practical problems such as preliminary ability.

II. Course Objectives

Course Objective 1： Master the requirements for vibration environment, such as safety and reliability of aerospace structures, stealthy characteristics of ships and submarines, precision and life of large scientific equipments. Establish patriotism and sense of responsibility of The Times. Develop a good personal culture of hard working and lifelong learning.

Course Objective 2： Master the classification of mechanical vibrations, the free vibration and forced vibration of one degree of freedom, two degrees of freedom and forced vibration, understand and master the free and forced vibrations of multiple degrees of freedom, master the vibration isolation and damping principle of mechanical vibrations, and lay a foundation for the study of dynamics course in future.

Course Objective 3： It should have the ability to analyze the current situation, consequences and countermeasures of vibration of mechanical structures, the ability to calculate the natural frequencies and modal shapes of vibrations generated in the work of structures, and the ability to design the structure to avoid and isolate vibration.

Course Objective 4： Understand the principle of vibrations in mechanical systems, master the basic law of mechanical vibrations, so as to effectively eliminate or isolate vibrations, and try to use the positive side of mechanical vibrations.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by this course

Index points of graduation requirements	**Content**
1.3	Master the mechanical design principles and methods required for mechanical design, and other professional knowledge, can be used to solve the design problems in complex mechanical engineering.
2.1	Be able to apply the basic principles of mathematics, natural science and engineering science to accurately identify and express complex mechanical engineering problems.
5.2	Be able to select and use appropriate technical means and modern engineering tools for modeling, prediction and simulation of complex mechanical engineering problems, and be able to understand the limitations of relevant tools in the process of practice.
8.2	Understand the core socialist values, understand the national conditions, safeguard national interests, and have a sense of responsibility to promote national rejuvenation and social progress.

Table 2. The supporting relationship between the course objectives and the index points of graduation requirements

(Note: 1 to 1 is the first choice for the target points supporting graduation requirements, followed by 1 to 1, but not many to many)

Index points of graduation requirements	**1.3**	**2.3**	**3.1**	**8.2**

Course objectives	2	3	4	1
Intensity of support	M	M	M	L
Percentage	0.2	0.4	0.2	0.2

IV. Basic course content and teaching arrangement

Table 3 Relationship between the course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	1. Vibration of a linear system with one degree of freedom (1) Expressions of solutions for free vibration and forced vibration of a single degree of freedom system; (2) Equivalent mass, equivalent stiffness, resonance, etc; (3) Forced vibration response; (4) The response to any excitation.	1. Introduce the knowledge system framework of this course, teaching objectives, graduation requirements, position in the curriculum system of the major, teaching content, assessment methods and score ratio; 2. It is required to master the expressions of the solutions of free vibration and forced vibration of a single degree of freedom system; 3. Understand the concepts of equivalent mass, equivalent stiffness, resonance, etc; 4. It can analyze the forced vibration of general excitation; 5. Understand the response to any excitation. 6. To stimulate the students' feelings of patriotism, pride and sense of mission were stimulated by introducing the achievements made by Chinese scholars in the design of high-performance vibration isolators in aerospace structures.	8	Lecture	1,2,4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
2	2. Vibration of a two degree of freedom system (1) The solution of the response of the two-degree-of-freedom system; (2) Natural mode and natural frequency of the 2-DOF system; (3) Solutions of two-degree-of-freedom systems.	1. Proficient in the solution process of the response of the two-degree-of-freedom system; 2. Master the calculation of the natural mode and natural frequency of the 2-DOF system; 3. The matrix can be used to solve the two-degree-of-freedom system. 4. Arouse students' patriotism, pride and sense of mission through group discussion on the design of dynamic vibration absorber for Guangzhou Tower.	4	Lecture	1,2,3,4
3	3.Vibration of a multi-degree of freedom system (1) Natural frequency and mode of vibration of the multi-degree of freedom system; (2) The system's response to the initial conditions; (3) Frequency and mode of vibration of the multi-degree of freedom system; (4) Response of undamped multi-degree of freedom system to arbitrary excitation; (5) Response of the system to the movement of the support; (6) Steady-state response of the damped system.	1. Master the calculation of natural frequency and natural mode of vibration of multi-degree of freedom system; 2. Master the response of the system to the initial conditions; 3. Master the mode truncation method to solve the frequency and mode of the multi-degree of freedom system; 4. Master the calculation of arbitrary excitation for the multi-degree of freedom system without damping; 5. Master the response of the system to the movement of the support; 6. Master the steady-state response of the damping system.	10	Lecture	1,2,3,4
4	4. Vibration of a continuum system (1) Transverse vibration of the string; (2) Calculation of frequency and mode of vibration of longitudinal and transverse vibration of the bar; (3) Analysis of boundary conditions and initial conditions; (4) Vibration test experiment of beam.	1. Master the transverse vibration of the string; 2. Master the frequency and mode calculation of longitudinal and transverse vibration of the bar; 3. Grasp the analysis of boundary conditions and initial conditions. 4. Arouse the students' feelings of home, pride and mission by discussing the vibration problems of	4	Lecture	1,2,3,4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		Humen Bridge.			
5	5. The approximate solution (1) Basic methods of vibration approximate analysis by computer, such as Rayleigh-Leeds method and subspace iteration method; (2) Methods to eliminate or isolate vibration.	1. Master the basic approximate methods for vibration analysis with computer, such as Rayleigh-Leeds method and subspace iteration method; 2. Master the method of eliminating or isolating vibrations.	6	Lecture	1,2,3,4

V. Teaching method

The teaching method is based on classroom teaching, supplemented by homework and curriculum design report.

VI. Assessment method

The examination of mechanical Vibration is to evaluate the degree of students achieving the teaching objectives of the course, which reflects the degree of students' ability to achieve the objectives. The assessment methods are shown in Table 4.

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Attendance and class performance	10%	Students' attendance and class performance are their usual scores, which will be counted as 10% of the total score of the course.	1
Usual homework	Class, homework and essays	50%	Finish the homework in accordance with the content of chapter 5 in a flexible way, and creatively design the homework and essay in the form of heuristic and scientifically guided small paper for no less than 4 times. Finally, grade the homework according to the grade, and 50% of the grade will be included in the course grade.	1、2、3、4
The final exam	Test scores	40%	In the written test, questions are generally set according to the outline requirements, mainly aiming at the understanding and mastery of basic concepts and methods of university mathematics, as well as the application ability of basic methods.	1、2、3、4

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
			The content of the test is not beyond the outline. We can also design course essays and adopt flexible methods to improve students' comprehensive ability of understanding, analysis, modeling and simulation of mechanical vibration.	

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Standard for evaluation
Attendance and class performance	According to class performance, there are five grades: Excellent (90-100), good (80-89), medium (70-79), pass (60-69), fail (below 60)
Homework and essays	According to the completion of homework, grades are divided into five grades: Excellent (90-100), good (80-89), medium (70-79), pass (60-69), fail (below 60).
The final exam	According to the completeness and rationality of the final assessment. There are five grades: Excellent (90-100), good (80-89), medium (70-79), Pass (60-69), fail (below 60).

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（Classroom performance）（K1）	Assessment 2（Usual homework）（K2）	Assessment 4（The final exam）（K3）
The proportion of assessment methods in the total score		0.1	0.5	0.4
Score percentage of course objective for each assessment method	Objective 1（M1）	0.3	0	0
	Objective 2（M2）	0.3	0.4	0.4
	Objective 3（M3）	0.2	0.4	0.4
	Objective 4（M4）	0.2	0.2	0.2

VII. Recommended textbooks and reference materials

Textbook:

Vibration Theory and Engineering Applications (2nd Edition), Liu Xijun, JIA Qifen, ZHANG Suxia, China Machine Press, 2018

Reference books:

[1] Ni Zhenhua. Vibration mechanics. Xi 'an: Xi 'an Jiaotong University Press, 2008.

[2]Hu Haiyan. Foundation of mechanical vibration. Beijing: Beijing University of Aeronautics and Astronautics Press, 2005.
[3] Inman D. J. Engineering Vibrations, 3rd edition, Pearson Education, 2007.
[4] Merovitch, L. Elements of Vibration Analysis, Mc Graw-Hill, 1975.

Network resource:

[1] http://www.chinavib.com/forum/

[2] http://www.vibrationcenter.com/

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Written by: Yan Bo **Reviewed by**: Li Jianmin

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

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《机械基础实验 2*》教学大纲

Experiments on Basic Machinery 2

Course name：Experiments on Basic Machinery 2　　**Course code**：31927

Course type：Basic Course (Compulsory)

Total teaching hours：16

Credit：0.5

Prerequisites: Principle of mechanical parts、Mechanical design

Major：Mechanical design, manufacturing and automation, Mechatronics engineering, Energy and power engineering

Department: Department of Mechanical Design and Manufacturing

I Course Introduction

Experiments on Basic Machinery 2 belongs to the professional basic course experiment supporting mechanical design. It verifies and deepens the understanding, consolidates the theoretical knowledge learned, and improves students' practical ability, comprehensive quality, and design innovation ability. It is important for students majoring in mechanical and near-machine majors.

This course mainly includes three types of experiments: the first is basic experiments (including verification and cognitive experiments), which is a verification experiment of classroom theoretical knowledge, including belt transmission characteristic experiments, chain and single universal joint transmission experiments; The second type is a comprehensive experiment, the malleability experiment on the theoretical knowledge of the classroom, including the closed power flow gear transmission efficiency measurement experiment, the hydrodynamic radial sliding bearing experiment, the disassembly and assembly of the reducer and the structure analysis experiment, and the shaft structure analysis Experiment; The third type of experiment is a comprehensive and innovative experiment including a comprehensive experiment of mechanical transmission.

The teaching purpose of this course is to enable students to master the basic laws and research methods of mechanical design such as mechanical part design, mechanical transmission efficiency and common mechanical transmission, so that students can initially learn to apply mechanical design theories and methods to analyze and solve practical engineering problems, and provide follow-up The study of related courses lays the foundation.

Besides the basic teaching content, the course combines the explanation of the professional quality, professional ethics of the mechanical equipment design and manufacturing talents in the socialist modernization construction. During the experiment, students are guided to form a careful and rigorous attitude to the experiment operation, help students to establish their learning goals, further establish professional awareness and confidence, and set up the goal of striving for the modernization of the motherland as a qualified engineer in the future.

II Course teaching objectives

Course objective 1: To understand the gap of technology and talents at home and abroad in the field of mechanical design and manufacturing, and to be aware of the "craftsman spirit" is of great importance to the development of China's machinery industry. Students should establish a serious, rigorous, hardworking, studious and diligent professional quality to better serve China's goal of accelerating the development of advanced manufacturing industry, and building an advanced manufacturing power, establish good study habits and attitude, and make contributions to the better construction of the motherland.

Course objective 2: Ability to comprehensively use the knowledge and principles of various disciplines such as mechanical design and mechanics to process experimental data to obtain experimental results; compare experimental results with theoretical analysis results to find the reasons for the differences between experimental and theoretical results, so that students The ability to use existing knowledge to analyze and process experimental data and summarize experimental results has been improved.

III Graduation requirements supported by curriculum teaching goals

The graduation requirements index points supported by this course are shown in Table 1, and the supporting relationship of the course teaching objectives to the index points supporting graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by "Experiments on Basic Machinery 2"

Index points of graduation requirements	Content
4-3	Compare the experimental data and results, explain the difference between the experimental and theoretical model results, and get reasonable and effective conclusions.

Table 2. The supporting relationship between the course objectives of "Experiments on Basic Machinery 1"and the index points of graduation requirements

Index points of graduation requirements	**4-3**
Course objectives	2
Intensity of support	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Number	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	1 Belt drive characteristic experiment (1) Belt drive test bench operation (2) Elastic sliding and slipping phenomenon of belt drive (3) Calculation of elastic sliding rate and efficiency of belt drive	1. Distinguish the elastic sliding and slipping phenomena of belt drive, and understand the causes of each. 2. Understand the influence of changes in the initial tension and speed of the belt on the belt transmission capacity, and map the belt transmission efficiency and elastic sliding curve 3. Master the measurement methods of speed, torque, speed difference and efficiency.	2	Experiment	1
2	2 Measurement experiment of transmission efficiency of closed power flow gear (1) The principle of efficiency calculation of closed power flow gear (2) Operation of closed power flow gear transmission test bench	1. Understand the basic principles, characteristics and methods of measuring gear transmission efficiency of the closed power flow gear test bench. 2. Master the derivation and application of calculation formulas for mechanical power and transmission efficiency. 3.Tell about the application evolution of gear mechanism in human history shows that people's pace of scientific exploration is endless, so as to stimulate students' spirit of exploration and research.	2	Experiment	1
3	3 chain and single universal joint transmission experiment (1) The characteristics and reasons of chain drive and single universal joint drive (2) The replacement of the two chains of chain and universal joint transmission test bench and the measurement method of the uneven rate of the two transmission speeds	1. Observe the polygonal effect of chain transmission, understand the reasons for chain transmission speed fluctuations, and analyze the conditions of constant velocity chain transmission. 2. Analyze the kinematic characteristics of a single universal joint, understand the causes of speed fluctuations in the universal joint transmission process, and analyze the conditions for realizing universal joint constant velocity transmission.	2	Experiment	1
4	4 Hydrodynamic pressure radial sliding bearing experiment (1) Conditions for establishing a radial oil film under hydrodynamic pressure (2) Working principle	1. Test the numerical value of the oil film radial pressure of the hydrodynamic radial sliding bearing, and draw the bearing circumferential oil film pressure distribution curve and load curve. 2. Draw the axial oil film pressure distribution curve.	2	Experiment	1

Number	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	and operation of vertical sliding bearing test bench	3. Draw the relationship curve between friction system f and bearing characteristic parameters			
5	5 Disassembly and assembly of the reducer and structure analysis experiment (1) The name and function of each part of the reducer (2) Measurement of structure size of reducer	1. Familiar with the basic structure of the gearbox, understand the purpose and characteristics of commonly used gearboxes. 2. Understand the structure and function of each component of the gearbox, and analyze its structure and technology. 3. Understand the assembly relationship and installation and adjustment process of the parts in the gearbox. 4. Learn the basic parameter measurement method of the gearbox. 5. Students are guided to cultivate the professional spirit of scientific observation, seeking truth from facts, unity and cooperation, not afraid of dirty and tired during assemble, disassemble and measuring the reducer, and to cultivate the basic professional quality to participate in the industrial construction of the motherland.	2	Experiment	1
6	6-axis structure analysis experiment (1) Type of shafting structure (2) Use the shafting experiment box to recognize shaft parts and their positioning methods	1. Familiar with the common positioning and fixing methods of parts on the shaft. 2. Familiar with the basic form of common shafting structure. 3. Master the structural design of the shaft and the design requirements of the shaft structure.	2	Experiment	1

Number	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
7	7 Comprehensive experiment of mechanical transmission (1) Selection of mechanical transmission device (2) Adjustment of coaxiality of mechanical transmission shaft (3) Operation of transmission efficiency test bench test	1. The design of mechanical transmission scheme and the construction of transmission components. 2. Understand the working principle of magnetoelectric sensor and torque speed tester. 3. Master the working principles and methods of comprehensive testing of mechanical transmission performance. 4. Test the characteristic parameter curves of common mechanical transmission devices in the process of transmitting motion and power. 5. Guide students to build and debug mechanical transmission system through cooperation, stimulate the spirit of teamwork, hard work, meticulous spirit of "craftsman".	4	Experiment	1

V. Teaching method

Explore and improve teaching methods, advocate heuristic, discussion, and research teaching, avoid emphasizing experimental results and process, and highlight the cultivation of students' engineering ability and innovative consciousness.

Course teaching is mainly in-class, and the specific content is as follows.

In-class teaching: experiment

In teaching methods, traditional teaching and modern teaching methods are combined. In addition to live demonstrations of experimental equipment in the classroom, the use of broadcast courseware enables students to have a deeper understanding of experimental principles. For the comprehensive design experiment, introduce a variety of new teaching methods such as "referring to formal", "heuristic", "discussion", "problem inquiry", etc., so that students can gradually form a combination of independent, cooperative, and research methods The learning method effectively improves students’ learning enthusiasm and learning quality.

VI. Assessment

"Experiments on Basic Machinery 2" course assessment is to evaluate the degree to which students have reached the teaching goals of the course, reflecting the degree of achievement of students' ability training goals. The specific assessment methods, proportions and corresponding teaching objectives of the courses are shown in Table 4.

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual grades	Classroom performance	40%	It mainly assesses students' ability to clarify experimental tasks and complete experiments in teamwork. The usual results are comprehensively given according to the attendance rate, participation, experimental results, participation in discussions, and experimental arrangement of students in classroom experiments.	1
Report grades	Experiment report after class	60%	It mainly assesses students' ability to understand the principles of experimental theory, the ability to analyze experimental data, and the ability to think about experiments. The results of the experimental report are comprehensively given based on the timeliness of the experimental report submitted by students after class, experimental data, data analysis and thinking, etc.	1

The grading standards for each assessment link of the "Experiments on Basic Machinery 2" course are shown in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria
Classroom performance	Adopting a hierarchical system, according to the experiment process, the selection of experimental components, the construction and debugging of the experimental platform, points are given as appropriate. Can complete the experimental operation quickly and accurately and meet the experimental requirements, excellent (90-100); can complete the experimental operation quickly and meet the experimental requirements, good (80-89); can basically complete the experimental operation and experimental requirements after guidance , Moderate (70-79); Pass (60-69) for those who can complete the basic operation and experimental requirements after instruction; fail (<60) for those who cannot complete the experimental operations.
Experiment report after class	Adopting a hierarchical system, able to submit experimental reports in time after class, detailed and reliable experimental data, capable of in-depth data analysis and thinking, excellent (90-100); able to submit experimental reports in time after class, detailed experimental data, data analysis and Thinking, good (80-89); submitting the experiment report after class, the experimental data is basically detailed, and some data analysis and thinking have been carried out, medium (70-79); there are delays in the submission of the experiment report after class, and the experimental data is basically complete. Those who have not conducted data analysis and thinking will pass (60-69); those who have delayed submitting the experiment report after class, lack of experimental data, and have not conducted data analysis and thinking will fail (<60).

Refer to Table 6 for the score distribution matrix of "Experiments on Basic Machinery 2" course assessment methods and course objectives.

Table 6 Assessment methods and score allocation matrix

		Assessment 1 (usually) K1	**Assessment 2 (report) K2**
The proportion of assessment methods in the total score		0.4	0.6
The proportion of course objectives in each assessment	Course Objective 1 (M1)	0.2	0
	Course Objective 2 (M2)	0.8	1

According to the course assessment method, grading standard and course objective distribution matrix of "Experiments on Basic Machinery 2", the evaluation standard of the achievement of course teaching objectives can be determined as shown in Table 7.

Table 7 Evaluation criteria of the course objectives

Course objectives	**Evaluation criteria**				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
To understand the gap of technology and talents at home and abroad in the field of mechanical design and manufacturing, and to be aware of the "craftsman spirit" is of great importance to the development of China's machinery industry. Students should establish a serious, rigorous, hardworking, studious and diligent professional	Have a deep understanding of the important role of "craftsman spirit" in the development of China's machinery industry, the key role of establishing the habits of being serious, rigorous, hardworking, studious and diligent in	Have a better understanding of the important role of "craftsman spirit" in the development of China's machinery industry, and the key role of establishing the habit	Recognize the important role of "craftsman spirit" in the development of China's machinery industry, the key role of establishing the habits of being serious, rigorous,	Basically realize the important role of "craftsman spirit" in the development of China's machinery industry, the key role of establishing the habits of being serious,	Don't realize the important role of "craftsman spirit" in the development of China's machinery industry, the key role of establishing the habits of being

quality to better serve China's goal of accelerating the development of advanced manufacturing industry, and building an advanced manufacturing power, establish good study habits and attitude, and make contributions to the better construction of the motherland.	cultivating professional quality, and have excellent learning habits and handling situations.	of being serious, rigorous, hardworking, studious and diligent in the cultivation of professional quality, and have a better learning habit and degree of handling affairs.	hardworking, studious and diligent in cultivating professional quality, and have good learning habits and handling situations.	rigorous, hardworking, studious and diligent in cultivating professional quality, and have basic learning habits and handling situations.	serious, rigorous, hardworking, studious and diligent in cultivating professional quality, and have no learning habits and handling situations.
Under the requirements of the experimental instruction book and the guidance of the teacher, understand and master relevant experimental measurement techniques, principles and methods, and experimental skills, be able to use relevant experimental equipment proficiently, complete all experimental processes in accordance with established or actively designed experimental procedures, and use experimental instruments Equipment for raw data collection	Be able to reasonably and accurately apply basic professional knowledge such as mechanical principles to analyze experimental phenomena and complete experimental content.	Be able to correctly apply basic professional knowledge such as mechanical principles to analyze experimental phenomena and complete experimental content.	Be able to correctly apply basic professional knowledge such as mechanical principles to analyze experimental phenomena and complete experimental content.	Be able to apply basic professional knowledge such as mechanical principles to analyze experimental phenomena and complete experimental content.	It is not possible to apply basic professional knowledge such as mechanical principles to analyze experimental phenomena and complete experimental content.

VII. Recommended textbooks and reference materials

Textbooks:

[1] Zhichao Zhu.The machine design foundation experiment course[M]. Science Press, 2012.02

References:

[1] Huan Sun, Zuomo Chen, Wenjie Ge. Theory of Machines and Mechanisms[M]. Higher Education Press, 2013.05

[2] Harbin Institute of Technology. Theoretical Mechanics[M]. Harbin Institute of Technology Press,2016.

Network Resources:

[1]Chinese University mooc, Harbin Institute of Technology Mechanical Basic Realistic Teaching (Mechanical Principles) Course:
https://www.icourse163.org/learn/HIT-1002331007?tid=1002447010#/learn/announce

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Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 31, 2021

《机械认知实习*》教学大纲

Cognitive Practice for Machinery

Course name： Cognitive practice for machinery **Course code：** 30902

Course type： practice

Total teaching hours： 20

Credits: 1

Prerequisites: Principle of mechanical parts、Drawing of Mechanical

Major： Mechanical design, manufacturing and automation, Mechatronics engineering, Energy and power engineering

Department: Mechanical basis experimental teaching demonstration center

I. Course Introduction

The mechanical cognitive internship is a practical course designed to strengthen the perceptual understanding of engineering practice of chemical engineering students, improve the efficiency and effect of classroom theory teaching, and cooperate with subsequent mechanical professional courses. The internship is divided into organization, structure cognition, manufacturing basic cognition, typical product cognition and enterprise production practice. The teaching goal is to train students to improve their ability to analyze problems and hands-on skills through personal observation and hands-on learning, knowledgeable and broadened horizons; to enrich students' design knowledge, inspire innovative thinking and cultivate students' craftsmanship spirit by accumulating materials and experience.

II. Course objectives

Course Objective 1： to cultivate students' ability and craftsmanship spirit to analyze problems and improve their hands-on ability through personal observation, hands-on learning, knowledgeable and broad horizons, strengthen students' sense of responsibility, and stimulate national pride.

III. Graduation requirements supported by course objectives

The graduation requirements index points supported by this course are shown in Table 1, and the supporting relationship of the course teaching objectives to the index points supporting graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by "Mechanical Cognitive Practice"

Index points of graduation requirements	Content
6.1	Experience in mechanical engineering internship and social practice

Table 2 The supporting relationship between the teaching objectives of the "Mechanical Cognitive Practice" course and the index points supporting graduation requirements

Index points of graduation requirements	6-1
Course objectives	1
Intensity of support	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	Automobile engine disassembly and assembly	Understand the working principle and structure, map the typical parts drawing, train the students' practical craftsman spirit.	4	Lecture	1
2	PLC basic knowledge	Understand the principle and cases of PLC programmable control, train the students to improve the ability to analyze problems and practical ability, and train the students to practical craftsman spirit.	2	Lecture	1
3	Understanding of injection and die casting	Understand the working principle of injection molding and die casting equipment, enlighten students' thinking and cultivate their sense of responsibility.	2	Lecture	1
4	Virtual assembly and adjustment experiment of machining center	Understand the processing center virtual installation and adjustment of the operation steps, through the observation of the processing center operation,	3	Lecture	1

		understand the development of CNC equipment in China, to cultivate students' national pride.			
5	Virtual simulation experiment of CNC lathe	Understand the operation steps of CNC lathe, through personal observation, observation of the operation of CNC lathe, understand the development of CNC equipment in China, to cultivate students' national pride.	3	Lecture	1
6	Typical mechanical cognition experiment	Understand the working principle, draw the schematic diagram of the organization, enlighten the thinking, and train the students' practical craftsman spirit.	2	Lecture	1

V. Teaching method

Explore and improve teaching methods, advocate heuristic, discussion, and research teaching, avoid emphasizing experimental results and process, and highlight the cultivation of students' engineering ability and innovative consciousness.

In teaching methods, traditional teaching and modern teaching methods are combined. In addition to live demonstration of experimental equipment in the classroom, the use of broadcast courseware enables students to have a deeper understanding of experimental principles. For the comprehensive design experiment, introduce a variety of new teaching methods such as "referring to formal", "heuristic", "discussion", "problem inquiry", etc., so that students can gradually form a combination of independent, cooperative, and research methods. The learning method effectively improves students' learning enthusiasm and learning quality.

VI. Assessment

The course assessment of "Mechanical Cognitive Practice" is to evaluate the degree to which students have reached the teaching goals of the course and reflect the degree of achievement of students' ability training goals. The specific assessment methods, proportions and corresponding teaching objectives of the courses are shown in Table 4.

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Classroom performance	40%	Mainly based on the work attitude of the internship and the quality of the completed internship (including the ability to answer questions, etc.)	1
Report	Internship report after class	60%	It mainly assesses the students' ability to understand the principles of experimental theory, the ability to analyze experimental data, and the ability to think about internships. The results of the experimental report are comprehensively given based on the timeliness of the experimental report submitted by the students after class, experimental data, data analysis and thinking, etc.	1

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria
Usual performance	A hierarchical system is adopted, and points are given as appropriate according to the practical ability and answering questions during the experiment. Can complete the experimental operation quickly and accurately and meet the experimental requirements, excellent (90-100); Can complete the experimental operation quickly and meet the experimental requirements, good (80-89); Can basically complete the experimental operation and experimental requirements after guidance , Moderate (70-79); Pass (60-69) for those who can complete the basic operation and experimental requirements after instruction; fail (<60) for those who cannot complete the experimental operations.
Experiment report after class	The level system is adopted, the internship report can be submitted in time after class, the experimental data is detailed and reliable, and the data analysis and thinking can be in-depth, excellent (90-100); the internship report can be submitted in time after class, the experimental data is detailed, the data analysis and Thinking, good (80-89); submitting the internship report after class, the experimental data is basically detailed, some data analysis and

	thinking have been carried out, medium (70-79); the after-class internship report is delayed, the experimental data is basically complete, Those who fail to conduct data analysis and thinking will pass (60-69); those who have delayed submitting the internship report after class, lack of experimental data, and fail to conduct data analysis and thinking will fail (<60).

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1 （Assignments） （K1）	Assessment 2 （Software operation on computer） （K2）
Percentage		0.4	0.6
Score percentage of course objective for each assessment method	Course Objective 1 (M1)	1	1

The evaluation criteria of the course objectives can be determined on the basis of assessment method, grading criteria and course objective allocation matrix, as shown in Table 7.

Table 7 Evaluation criteria of the course objectives

Course objectives	**Evaluation criteria**				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
Under the requirements of the experimental instruction book and the guidance of the teacher, understand and master relevant experimental techniques, principles and methods, and experimental skills, be able to use relevant experimental	Be able to reasonably and accurately apply basic professional knowledge such as mechanical principles to analyze experimental phenomena and complete experimental content.	Be able to correctly apply basic professional knowledge such as mechanical principles to analyze experimental phenomena and	Be able to correctly apply basic professional knowledge such as mechanical principles to analyze experimental phenomena and complete experimental content.	Be able to analyze experimental phenomena and complete experimental contents by applying basic professional knowledge such as mechanical principles.	It is not possible to apply basic professional knowledge such as mechanical principles to analyze experimental phenomena and complete experimental content.

equipment and equipment proficiently, and complete the entire experimental process in accordance with the established or actively designed experimental procedures		complete experimental content.			

VII. Recommended textbooks and reference materials

Textbook:

"Lecture Notes on Mechanical Cognition Practice", edited by Xinli Wu and Shanhong Ma, Zhejiang Sci-Tech University Press

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Course administrator：Xinli Wu

Written by: Shanghong Ma   Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 27, 2021

《机械学科导论*》教学大纲

Introduction to Mechanical Engineering

Course name： Introduction to Mechanical Engineering **Course code：** 31902

Course type： Discipline platform course (Compulsory)

Total teaching hours： 16 (Classroom Hours: 16)

Credit： 1

Prerequisites: N/A

Major： Mechanical engineering related majors

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

This course will introduce students to the field of mechanical engineering and the relationships between physics, mathematics, communications, and sciences which inform the study, design, and manufacture of mechanical products and systems. Students will learn how mechanical engineering is broadly defined, what mechanical engineers do, and what technical capabilities they have. We will also review some basic principles from mathematics and physics that you will apply in any discipline of engineering. In addition, we aim to equip students with the following abilities.

II. Course Objectives

Course Objective 1： Know about the significant achievement in mechanical engineering field in China. Understand the social value of mechanical engineering technology and social responsibility of engineers. Develop interest and engineering concept in this major; understand the occupational ethics of engineers.

Course Objective 2： Understand the history, current status and development trends of mechanical engineering in the following fields: robotics, textile equipment, agricultural equipment, modern design methods, manufacturing, engineering material, industrial engineering, mechanics and modern engineering.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Introduction to Mechanical Engineering*

Index points of graduation requirements	**Content**
6.2	Know about the history and cultural background of mechanical engineering, correctly cognize the correlation and interaction between mechanical engineering and objective world. Familiar with guidelines, policies, laws and regulations of social, health and safety in mechanical RD, production and operation.
8.3	Understand the social value of mechanical engineering technology and social responsibility of engineers. Understand and abide by engineer professional ethics and code of practice.

Table 2. The supporting relationship between the course objectives of *Introduction to Mechanical Engineering* and the index points of graduation requirements

Index points of graduation requirements	**6.2**	**8.3**
Course objectives	2	1
Intensity of support	H	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**
1	Unit 1: Robotics	1. Understand the history, cultural background and trend of robotics 2. Know about the significant achievement in the field of robotics in China. Understand the social value of robotics.	2	Lecture	1,2
2	Unit 2: Textile equipment	1. Understand the history, cultural background and trend of Textile equipment 2. Know about the significant achievement in the field of Textile equipment in China. Understand the social value of Textile equipment.	2	Lecture	1,2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
3	Unit 3: Modern design methods	1. Understand the history, cultural background and trend of Modern design methods	2	Lecture	2
4	Unit 4: Agricultural equipment	1. Understand the history, cultural background and trend of agricultural equipment 2. Know about the significant achievement in the field of Agricultural equipment in China. Understand the social value of Agricultural equipment.	2	Lecture	1,2
5	Unit 5: Engineering materials	1.Understand the history, cultural background and trend of Engineering materials	2	Lecture	2
6	Unit 6: Process equipment	1.Understand the history, cultural background and trend of Process equipment	2	Lecture	2
7	Unit 7: Manufacturing	1. Understand the history, cultural background and trend of Manufacturing 2. Know about the significant achievement in the field of manufacturing in China. Understand the social value of manufacturing.	2	Lecture	1,2
8	Unit 8: Mechanics and modern engineering	1.Understand the history, cultural background and trend of Mechanics and modern engineering	2	Lecture	2

V. Teaching method

The course mainly consists of lectures and group discussion. A variety of teaching methods and a flexible range of activities are suggested to provide students with various learning experiences and encourage their initiatives. Make use of modern educational technology with an optimal integration of various teaching media to effectively improve the teaching quality.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 Course objectives and assessment methods

Score category	**Assessment methods**	**Percentage**	**Assessment details**	**Corresponding objectives**
Usual performance	Classroom performance	20%	Attendance and study performance in classroom	1,2
Course report	Report	70%	A report with more than 3000 words, accounting for 50% of total score.	2

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	**Grading criteria**
Classroom performance	According to the condition of completion, there will be four levels: Excellence (90-100, good (75-89, normal (60-74), fail (below 60). Adjust the score depending the class attendance.
Report	According to the quality of the report, there will be four levels: Excellence (90-100, good (75-89, normal (60-74), fail (below 60).

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

<table>
<tr><th colspan="2"></th><th>Assessment 1(Classroom performance)（K1）</th><th>Assessment 2（Report）（K2）</th></tr>
<tr><td colspan="2">Percentage</td><td>0.2</td><td>0.8</td></tr>
<tr><td rowspan="2">Score percentage of course objective for each assessment method</td><td>Objective 1（M1）</td><td>0.3</td><td>0</td></tr>
<tr><td>Objective 2（M2）</td><td>0.7</td><td>1</td></tr>
</table>

VII. Recommended textbooks and reference materials

Textbook：

Textbook is not required.

Reference books：

[1] Jonathan Wickert, Kemper Lewis, “An Introduction to Mechanical Engineering”, CL Engineering, 2012
[2] Robert Rizza, “Introduction to Mechanical Engineering “, Prentice Hall, 2000Online resource:

Teaching group： Hongjun Li, etc.   Course administrator：Hongjun Li

Written by: Hongjun Li   Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 27, 2021

《机械制图 1*》教学大纲

Mechanical Drawing 1

Course name：Mechanical Drawing 1　　　**Course code**：31903

Course type：Basic Course，Compulsory Course

Total teaching hours：48 (Classroom Hours: 48)

Credit：3.0

Major：Mechanical engineering

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

Mechanical drawing is an application oriented course that introduces the preparation, representation and reading of machine drawings. Mechanical drawing, similar to characters and numbers, is one of the indispensable tools used by human for technical communication and is an important technical document in industry for design, manufacture, operation, and maintenance, so it is called as “a common technical language for engineers”. This course teaches students the related national standards in Mechanical Drawing and Technical Drawing as well as the basic engineering knowledge, basic theories of drawing preparation, regulations, up-to-date drawing technologies, etc. What's more, This course teaches some knowledge about the development history of China industry and the influence of Chinese culture in the world by presenting some literatures or media documents to inspire the students' motivation for persuing social responsibility of mechanical engineers. The course is divided into Mechanical Drawing 1 and Mechanical Drawing 2, which are planned to be taught in fall semester and spring semester of freshmen respectively.

Mechanical Drawing 1 includes two sections, which are fundamentals for technical drawing and descriptive geometry. The section of fundamentals for technical drawing covers the basic regulations of the national standards in Mechanical Drawing and Technical Drawing, the skill of instrumental drawing and freehand drawing, the basic ability for drawing and reading projections, and the basic method to mark dimension. In the section of descriptive geometry, the basic principle and method to present solid geometry using orthographic projection and illustrate space geometry problem are introduced.

The main objective of this course is to ensure the students master the basic principles of orthographic projection and its application, establish the ability to illustrate space geometry problem, develop the abilities for spatial and logical thinking and visual imagination, grasp the way to understand and draft engineering drawing in light of orthographic projection and prepare for the following courses.

II. Course Objectives

Course Objective 1: Understand China's basic condition; Master the processes of precise, factualistic serious-minded and responsible personality and scientism.

Course Objective 2: Master the basic regulations of the national standards in Mechanical Drawing and Technical Drawing; Master the skill of instrumental drawing and freehand drawing; Know the basic knowledge and drawing method of axonometric projection; Be able to draft the engineering drawing by appropriate drawing tools according to the complexity of engineering problem.

Course Objective 3: Master the basic principles of orthographic projection and its application, including point, line, plane and solid projection, composite solid view and dimension, common representation method for mechanical part; Establish the ability to illustrate space geometry problem, develop the abilities for spatial and logical thinking and visual imagination, grasp the way to understand and draft engineering drawing.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Mechanical Drawing 1》

Index points of graduation requirements	**Content**
1.1	Master the knowledge of mathematics and natural science and the ability for describing the complex engineering problems in mechanical engineering using appropriate language tools.
5.2	For complex engineering problems in the field of mechanical engineering, select and use appropriate technological means and modern engineering tools to model, predict and simulate.
8.3	Understand the core concept of engineering ethics and the social responsibility of mechanical engineers, and consciously abide by the professional ethics and code of conduct of mechanical engineers in engineering practice.

Table 2. The supporting relationship between the course objectives of 《Mechanical Drawing 1》 and the index points of graduation requirements

Index points of graduation requirements	**8.3**	**5.2**	**1.1**
Course objectives	1	2	3

Intensity of support	L	L	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	Foundations of Engineering Drawing	1. Understand the development history of cartography, as well as the contribution and influence of the development of Chinese cartography on the development of world cartography 2. The rules of mechanical drawings specified by National Drawing Standards. 3. The drawing method and step of ruler gauge plotting; Methods and Master skills of freehand sketching. 4. Understand the geometry condition of arc connection; Abilities to analyze and mark dimensions of plane graphs.	3	Lecture	1,2
2	Projection of Points, lines, and planes	1. Understand projection and its classification; Master the principles of orthographic projections. 2. Understand the projection formed in the first angle of three-view projection system; Master the projection characteristics of points, the relative position of two points, the concept of coincidence points and its visibility. 3. Master the projection characteristics of lines and point on the line, the projection characteristics of three kinds of line, three relative positions of two lines; Understand the projection characteristics of the right angle with one line parallel to the projection plane. 4. Understand the representation of plane; Master the projection characteristics of three kinds of plane; Understand the geometry condition of the point or line on the plane; Master the drawing problem of point or line on the plane. 5. Understand the relative position of line with plane and plane with plane; Understand the parallelism or perpendicular geometry condition of line with plane and plane with plane; Understand the drawing problem of parallelism or perpendicular of line with plane and plane with plane in special cases; Master the drawing problem of intersection or intersecting line between line and plane, plane and plane in special cases. 6. Understand the method of right-angled triangle; Master the method of auxiliary projection plane and its application in solving basic spatial geometry problems such as true	12	Lecture	3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		length and inclining angle of straight line, true shape of plane, relative position of line with plane and plane with plane.			
3	Projection of Solids	1. Understand the generation and classification of solids; Master the projection of the polyhedral solids (Prism and pyramid); Understand the generation of revolution surface and the projection of revolution solid; Master the projection of cylinder, cone and sphere; Understand the projection of torus. 2. Master the drawing problem of the intersection between planes and polyhedral solids; Understand the drawing problem of true section shape. 3. Familiar with the intersection on cylinder, cone and sphere; Master the drawing problem of the intersection between planes and revolution solid. 4. Understand the penetration line; Master the method of using the accumulation to find the penetration line between two revolution solids; Familiar with three special cases of penetration lines.	10	Lecture	3
4	View and configuration of composite solids	1. Understand the generation of three views and their projection characteristics. 2. Understand different methods of forming composite solids; Understand the relative position of adjacent surfaces on the composite solid. 3. Master the method and procedure of drawing views of composite solids. 4. Familiar with the main point of reading views; Master the method and procedure of reading views of composite solids. 5. Understand the requirement of dimensioning composite solids; Familiar with the dimensions of basic solids and common composite solids; Master the method and procedure of dimensioning composite solids. 6. Combining with the analysis and discussion of dimension in engineering examples, the importance of rigorous, excellence and meticulous craftsmanship spirit is emphasized.	9	Lecture	1, 2, 3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
5	Axonometric Projections	1. Understand the generation and classification of axonometric projections; Understand the concept of axonometric axes, axes angle and axial deformation coefficient. 2. Familiar with the drawing method of Isometric projection and Cabinet axonometric projection.	3	Lecture	2
6	Representation for commonly used parts	1. Understand the concept and classification of views; Master the concept and representation of principle views, directional views, oblique views and partial views. 2. Understand the concept and classification of sectional views; Master the concept and representation of full sectional views, half sectional views, local sectional views, rotating sectional views, oblique sectional views, multiple parallel sectional views and composite sectional views. 3. Understand the concept and classification of cuts; Master the representation of cuts. 4. Familiar with the drawing of partial enlargement, simplified and specified representation. 5. Understand the third-angle projection. 6. Combining with the analysis and discussion of dimension in engineering examples, the importance of rigorous, excellence and meticulous craftsmanship spirit is emphasized.	11	Lecture	1, 2, 3

V. Teaching method

1. Case-based teaching and heuristic teaching

Mechanical Drawing is a strong technical course which must rely to combination of theory and practice. Case-based teaching and heuristic teaching methods are applied to foster the ability to think, analyze and solve problems in students and guide and encourage students to obtain knowledge through practice and self-study.

2. Teaching tool

For the theoretical knowledge part of this course, the course should be arranged in multimedia classroom, teaching with blackboard-writing and multimedia, using three-dimensional models or solid model to teach, to make the students learn more views and actual parts, to develop student’s spatial imagination.

3. Exercise course

Exercise course is to help students understand and consolidate the important and difficult part of the course and improve the ability to analyze and solve problems. It is also a way that teacher can evaluate how well students master the contents.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives. The course objectives and the corresponding assessment methods are listed in Table 4.

Table 4 Course objectives and assessment methods

Score category	**Assessment methods**	**Percentage**	**Assessment details**	**Corresponding objectives**
Class attendance	Roll call Class discussion	5%	Call the roll in class randomly. Those absence times are more than one third of the total roll call times will fail to achieve the score. Combined with case analysis, evaluate the participation degree of class discussion.	(1) (3)
Usual homework	Assignment in exercise book	20%	Assign the questions in the exercise book as homework, accounting for 20% of total score.	(2) (3)
Project	Draft A3 or A4 drawing	15%	Assign three projects which are Basic Exercise, Views of Composite Solid, Representation, accounting for 15% of total score.	(2) (3)
Exam	Closed-book exam	60%	Closed-book exam is all about drawing including 20% of point, line, plane projections, 10-15% of basic solid projection, 25% of composite solid view, 10% of dimension and 30-35% of representation method.	(3)

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	**Grading criteria**
Usual performance	Those absence times are more than one third of the total roll call times will fail to achieve the class attendance score. Grade each usual homework and project according to the completion level and correctness. Calculate the weighted mean of the grades.
Final exam	Grade the exam according to the answer and score judgment standard.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1 (Attendence, class discussion) (K1)	Assessment 2 (Exercise book homework) (K2)	Assessment 3 (A3 or A4 drawing) (K3)	Assessment 4 (Final exam) (K4)
Percentage		0.05	0.2	0.15	0.6
Score percentage of course objective for each assessment method	Objective 1 (M1)	0.5	0	0	0
	Objective 2 (M2)	0	0.1	0.3	0
	Objective 3 (M3)	0.5	0.9	0.7	1

VII. Recommended textbooks and reference materials

Textbook

Lin Hu, Engineering Drawing (Chinese-English Bilingual Edition), China Machine Press, 2005

Reference books

1. K.L. Narayana, P. Kannaiah, K. Venkata Reddy, Machine Drawing (Third Edition),New Age International (P) Ltd., Publishers, 2006.

2. Mingxin He, Keqiang Qian, Zumao Xu, Machine Drawing (Sixth Edition), Higher Education Press, 2010.

Online resources

http://jxzhitu.tongji.edu.cn

Teaching group: Xiaoqiang Du　　Course administrator: Xiaoqiang Du

Written by: Xiaoqiang Du　　Reviewed by: Qingchuan He

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 24, 2021

《机械制图 2*》教学大纲

Mechanical Drawing 2

Course name：Mechanical Drawing 2　　　**Course code**：31904

Course type：Basic Course，Compulsory Course

Total teaching hours：40 (Classroom Hours: 40)

Credit：2.5

Prerequisites: Mechanical drawing 1

Major：Mechanical engineering

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

Mechanical drawing is an application oriented course that introduces the preparation, representation and reading of machine drawings. Mechanical drawing, similar to characters and numbers, is one of the indispensable tools used by human for technical communication and is an important technical document in industry for design, manufacture, operation, and maintenance, so it is called as “a common technical language for engineers”. This course teaches students the related national standards in Mechanical Drawing and Technical Drawing as well as the basic engineering knowledge, basic theories of drawing preparation, regulations, up-to-date drawing technologies, etc. What's more, This course teaches some knowledge about the development history of China industry and the influence of Chinese culture in the world by presenting some literatures or media documents to inspire the students' motivation for persuing social responsibility of mechanical engineers. The course is divided into Mechanical Drawing 1 and Mechanical Drawing 2, which are planned to be taught in fall semester and spring semester of freshmen respectively.

Mechanical Drawing 2 includes teaching the fundamental ability to draft and read the detail drawing and assembly drawing of the general machine or assembly, teaching the function, structure, notation and conventional representation, and teaching the operation skill of computer aided drawing. The ability to read the engineering drawing is the most important content in this course.

The main objective of this course is to ensure the students master the conventional representation of standard parts, master the content of part drawing and assembly drawing, understand AutoCAD and be familiar with basic operations about 2D drawing and modification, letter and dimension, master the ability to look up the machine parts handbook and national standards, master the abilities to read and draft the detail drawings and assembly drawings of moderate complexities.

II. Course Objectives

Course Objective 1: Understand China's basic condition; Master the processes of precise, factualistic serious-minded and responsible personality and scientism.

Course Objective 2: Master the rules of mechanical drawings specified by National Drawing; Master the standard representation of standard parts; Master the content of part drawing and assembly drawing; Master the abilities of reading and drawing the part drawings and assembly drawings of moderate complexities; Master the ability to look up the machine parts handbook and national standards.

Course Objective 3: Master the drawing method and step of instrument drawing and freehand sketching; Be able to use computer aided drawing.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Mechanical Drawing 2》

Index points of graduation requirements	**Content**
5.1	Possess the ability to apply the related information technology such as internet tool, database and modern engineering tool to search and analyze the research literature that are required to solve complicated mechanical engineering problems.
5.3	Understand the limitations to solve complex mechanical engineering problems with modern tools.
8.3	Understand the core concept of engineering ethics and the social responsibility of mechanical engineers, and consciously abide by the professional ethics and code of conduct of mechanical engineers in engineering practice.

Table 2. The supporting relationship between the course objectives of 《Mechanical Drawing 2》 and the index points of graduation requirements

Index points of graduation requirements	**8.3**	**5.1**	**5.3**
Course objectives	1	2	3
Intensity of support	L	H	M

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	Commonly used parts and standard parts	1. Master the representations of thread part, detail drawings and assembly drawings of thread fasteners; 2. Understand the forms of gear transmission, the notation of different gear parameters and their calculation; Master the drawing of single gear and meshing gears; 3. Understand the role, model and conventional representations of keys, pins, rolling bearings and springs. 4. Combining with the analysis and discussion of dimension in engineering examples, the importance of rigorous, excellence and meticulous craftsmanship spirit is emphasized.	8	Lecture	1, 2
2	Part drawings	1. Understand the contents and view selections of part drawings; Master the view selections of parts; Understand dimensioning methods, the labeling methods for surface roughness, geometrical tolerances and so on; 2. Understand the manufacturing process of common structures of machine parts; 3. Master reading and drawing the part drawings with general complexity. 4. Combining with the analysis and discussion of dimension in engineering examples, the importance of rigorous, excellence and meticulous craftsmanship spirit is emphasized.	11	Lecture	1, 2
3	Assembly Drawings	1. Understand the contents and representation methods of assembly drawings; Master the standard drawing method and special representation of assembly drawings; Master the view selection methods, part numbers and part lists for assembly drawings; 2. Understand the rationality of the assembly structures; 3. Master reading and drawing the assembly drawings with general complexity; Master the method to draw the parts according to the assembly drawing. 4. Combining with the analysis and discussion of dimension in engineering examples, the importance of rigorous, excellence and meticulous craftsmanship spirit is emphasized.	13	Lecture	1, 2
4	Computer Aided Drawing (AutoCAD)	1. Be familiar with the basic process of AutoCAD drawing; Master the basic operations of 2D drawing and modification; Master the operation of labeling surface roughness, tolerance, dimension and specification; 2. Be familiar with the operation of part drawing and assembly drawing.	8	Lecture and tutorial	1, 3

V. Teaching method

1. Case-based teaching and heuristic teaching

Mechanical Drawing is a strong technical course which must rely to combination of theory and practice. Case-based teaching and heuristic teaching methods are applied to foster the ability to think, analyze and solve problems in students and guide and encourage students to obtain knowledge through practice and self-study.

2. Teaching tool

For the theoretical knowledge part of this course, the course should be arranged in multimedia classroom, teaching with blackboard-writing and multimedia, using three-dimensional models or solid model to teach, to make the students learn more views and actual parts, to develop student's spatial imagination.

3. Exercise course

Exercise course is to help students understand and consolidate the important and difficult part of the course and improve the ability to analyze and solve problems. It is also a way that teacher can evaluate how well students master the contents.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives. The course objectives and the corresponding assessment methods are listed in Table 4.

Table 4 Course objectives and assessment methods

Score category	**Assessment methods**	**Percentage**	**Assessment details**	**Corresponding objectives**
Class attendance	Roll call	5%	Call the roll in class randomly. Those absence times are more than one third of the total roll call times will fail to achieve the score.	(1) (2)
Usual homework	Assignment in exercise book	15%	Assign the questions in the exercise book as homework, accounting for 15% of total score.	(2) (3)
Project	Draft A3 or A4 drawing	15%	Assign three projects which are Thread Fasteners, Part Drawing, Assembly Drawing, accounting for 15% of total score.	(2) (3)

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Computer aided drawing	AutoCAD	15%	Finish one detail drawing using AutoCAD in class, accounting for 15% of total score.	(3)
Exam	Closed-book exam	50%	Closed-book exam consists of filling blanks and drawings including 30% of commonly used parts, 35% of detail drawing and 35% of assembly drawing.	(2)

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria
Usual performance	Those absence times are more than one third of the total roll call times will fail to achieve the class attendance score. Grade each usual homework and project according to the completion level and correctness. Calculate the weighted mean of the grades.
Final exam	Grade the exam according to the answer and score judgment standard.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1 (Attendence, class discussion) (K1)	Assessment 2 (Exercise book homework) (K2)	Assessment 3 (A3 or A4 drawing) (K3)	Assessment 4 (AutoCAD practice) (K4)	Assessment 5 (Final exam) (K5)
Percentage		0.05	0.15	0.15	0.15	0.5
Score percentage of course objective for each assessment method	Objective 1 (M1)	0.5	0	0	0	0
	Objective 2 (M2)	0.5	0.9	0.7	0	1
	Objective 3 (M3)	0	0.1	0.3	1	0

VII. Recommended textbooks and reference materials

Textbook

Lin Hu, Engineering Drawing (Chinese-English Bilingual Edition), China Machine Press, 2005

Reference books

1. K.L. Narayana, P. Kannaiah, K. Venkata Reddy, Machine Drawing (Third Edition),New Age International (P) Ltd., Publishers, 2006.

2. Mingxin He, Keqiang Qian, Zumao Xu, Machine Drawing (Sixth Edition), Higher Education Press, 2010.

Online resources

http://jxzhitu.tongji.edu.cn

Teaching group: Xiaoqiang Du Course administrator: Xiaoqiang Du

Written by: Xiaoqiang Du Reviewed by: Qingchuan He

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 24, 2021

《机械制造基础*》教学大纲

Basic Course for Mechanical Manufacturing

Course Name： Basic Course for Mechanical Manufacturing **Course Code：** 31908

Course type： Specialized course (required）

Total teaching hours： 32 lessons (including lectures：30 lessons, experiment: 2 lessons)

Credits： 2.0

Prerequisite courses： Industrial exercises, Engineering Materials and Heat Treatment

Major： Mechanical Engineering

Department： Department of mechanical design and manufacturing

I. Course Introduction

This course is a fundamental technology course for students majored in Mechanical Engineering. It is a specialized course including the materials casting, forging and welding which is mandatory for students majored in Materials Shaping and Control Engineering. This course is playing a requisite role in cultivating advanced engineers with high competence, wide specialty, logical knowledge structure, and high capability in analyzing and solving the engineering problems. The objective of this course is to introduce the main characteristics and basic principle of common forming processes and the basic ideas in selecting the raw materials and appropriate forming process. Also, this course would provide students the operation of some manufacturing facilities and tools and specific fields of application. Additionally, this course would introduce the structural properties of engineering components and material properties of common metals. This course is important for engineering students to learn advanced academic courses and their future works in mechanical design and manufacturing. At the same time, students can fully understand the history, current situation and development trend of the mechanical manufacturing field, explore the characteristics of novel manufacturing technology-based next generation smart device and equipment, as well as the development prospects and challenges of "made in China 2025", so as to prepare for the cultivation of manufacturing scientists and engineers with high patriotism and professional quality.

II. Course Objectives

Objective 1: By the end of this course, students will systematically master the theories and methods of mechanical manufacturing, the development and evolution of manufacturing technology, understand the importance of core manufacturing technologies in the aspect of national security and economy. It is aimed at cultivating students' national pride and mission, cultivate students to establish the idea of "science and technology is power", correct learning attitude, and establish the ideal and ambition of serving our country.

Objective 2： By the end of this course, undergraduate students are able to understand the basic principle and main characteristics of casting process, metal forming processes, welding process and powder metallurgy and also know the forming process of non-metals, ceramics and composite materials.

Objective 3： By the end of this course, undergraduate students are able to understand the concept of green manufacturing, provide the thorough consideration to the effects of manufacturing processes on the environment, design a reasonable and thoughtful implementation scheme and focus their attentions on the engineering practices and sustainable development.

Objective 4： By the end of this course, undergraduate students are able to appropriately choose the raw materials and manufacturing processes for engineering components after thoroughly considering the influences of manufacturing processes on environment; Students are able to reasonably design the specific material forming process and solve the production issues on the basis of full consideration on economic cost and engineering management.

III. Graduation Requirements Supported by Teaching Objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the teaching objectives of this course and the index points supporting graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Basic Course of Mechanical Manufacturing*

Index points of graduation requirements	Content of the index points of graduation requirements
2.3	Be able to correctly express the solution to complex engineering problems in mechanical engineering, and be able to analyze and evaluate the rationality and feasibility of the solutions by employing the basic principles.
7.2	To understand the concept of green manufacturing and the evaluation on the effects of complicated engineering problems and practices in the filed of mechanical engineering on environmental and sustainable development.

Table 2 The supporting relationship between the course objectives of *Basic Course of Mechanical Manufacturing* and the index points supporting graduation requirements

(Note: the first choice of graduation requirements is 1 to 1, followed by many to 1, not many to many)

Index points of graduation requirements	**2.3**		**7.2**	
Objectives	3	4	1	2

Intensity of support	H	H	L	H
percentage	0.5	0.5	0.3	0.7

IV. Basic Teaching Content and Class Arrangement

Table 3 Relationship between course objectives and teaching content

Chapters	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
1	1. Introduction (1) Manufacturing processes (2) Breaking even analysis (3) Examples and exercises	1. Understand the history and importance of manufacturing processes, improve the students' feelings of patriotism and pride of our country 2. Understand the concept of breaking even analysis	1	Teaching in class	1
2	2. Engineering Materials (1) Engineering properties (2) Ferrous materials (3) Non-ferrous materials (4) Heat treatment of metals	1. Understand the importance of the properties of engineering materials such as strength, hardness, ductility, and toughness. 2. Learn about the fundamentals of structure of engineering materials and how they control their properties. 3. Get the various details of the plain carbon steels and the variables that control their properties. 4. Understand the importance of different alloying elements in promoting the properties in alloy steels 5. Learn different non-ferrous materials form the engineering standpoint. 6. Understand the heat treatment process and learn about the various heat treatment methods and their application. 7.Through video learning and group discussion, we can deepen the important impression in students that the progress of	2	Teaching in class	1、3

Chapters	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
		engineering materials and manufacturing technology telates tightly to the development of our country, and stimulate students' national pride and patriotic enthusiasm.			
3	3. Metal Casting Processes (1) Introduction (2) Patterns (3) Moulding materials (4) Cores	1. Understand the history of metal casting process 2. Design patterns and cores for metal casting process 3. Understand the various moulding materials used in the making of moulds and cores 4. Learn about the casting of bronzes by video, understand the long civilization and profound colorful history and culture of ancient China, and stimulate students' noble aesthetic interest and patriotic feelings.	2	Teaching in class	1、2、3
4	4. Gating Systems for Casting (1) Introduction (2) Gating system design (3) Risering design	1. Understand the importance of the various elements present in a gating system 2. Design the gating system for different castings 3. Appreciates the risering requirements and design them for different castings	1	Teaching in class	1、2、3
5	5. Melting and Casting Quality (1) Melting practice (2) casting cleaning (3) casting defects (4) product design for casting	1. Understand the functioning of cupola furnace for melting cast iron 2. Calculate the charge quantities to be used in cupola for the required final metal composition 3. Identify different types of furnaces used in foundries	1	Teaching in class	1、2、3

Chap ters	Teaching content	Teaching requirement	Lesson	Teaching style	objec tives
6	6. Special Casting Processes (1) Shell moulding (2) Precision investment casting (3) Permanent mould casting (4) Diecasting (5) Vacuum diecasting (6) Low pressure diecasting (7) Centrifugal casting (8) Continuous casting (9) Squeeze casting	1. Understand the shell moulding as a process for higher quality castings with thin surface details 2. Know precision investment casting used for complex shapes 3. Use permanent mould casting for mass production of relatively simple shapes 4. Apply die casting process for complex parts 5. Understand the advantages of using centrifugal casting process 6. Learn the advantages and applications of various other special casting process	2	Teaching in class	1、2、3
7	7. Metal Forming Processes (1) Nature of plastic deformation (2) Rolling (3) Forging (4) Extrusion (5) Wire drawing (6) Rod and dube drawing (7) Swaging (8) Tube making	1. Understand the advantages of utilizing the metal working processes 2. Learn about different rolling processes and applications 3. Utilize different forging processes and applications 4. Understand different extrusion processes and applications	6	Teaching in class	1、2、3
8	8. Sheet Metal Operations (1) Press tool operations (2) Shearing action (3) Shearing operations (4) Drawing (5) Draw die design (6) Spinning (7) Bending (8) Stretch Forming (9) Embossing and Coining (10) Sheet metal die design	1. Understand the different types of sheet metal operations 2. Design sheet metal dies for different applications	4	Teaching in class	1、2、3
9	9. Welding Processes (1) Fabrication methods (2) Gas welding and	1. Understand the varieties of fabrication methods used in manufacturing	3	Teaching in class	1、2、3

Chapters	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
	cutting (3) Gas cutting (4) electric arc welding (5) Resistance welding (6) welding design	2. Utilize gas welding processes for low volume and repair work 3. Select different arc welding processes for large volume manufacture 4. Use resistance welding processes for sheet metal joints 5. Design welded joints to produce defect free weldments			
10	10. Other Welding Processes (1) Thermit welding (2) Electro slag welding (3) Electron beam welding (4) Laser beam welding (5) Forge welding (6) Friction welding (7) Diffusion welding (8) Explosion welding (9) Brazing (10) Braze welding (11) Soldering	1. Understand the different types of welding processes used for special fabrication applications 2. Learn brazing and soldering applications	2	Teaching in class	1、2、3
11	11. Powder Metallurgical (1) Introduction (2) Production of metallic powder (3) Processing methods (4) Advantages (5) Other compacting methods (6) Designing for P/M	1. Understand the basics of powder metallurgy process 2. Learn about various metal powder production methods 3. Know the different steps involved in powder metallurgy part preparation 4. Understand the advantages and limitations of powder metallurgy 5. Learn other developments in the compaction process 6. Design parts for powder metallurgy process	2	Teaching in class	1、2、3
12	12. Plastic Processing (1) Introduction (2) Plastic materials (3) Extrusion of plastics (4) Injection moulding (5) Blow moulding (6) thermoforming	1. Understand the basics and history of plastic materials for engineering applications 2. Learn about different plastic materials and their properties for engineering application	6	Teaching in class	1、2、3

Chapters	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
	(7) Thermosetting materials (8) Plastic product design	3. Know the different extrusion processes used in making plastic parts 4. Understand the injection moulding process and other variants of the same 5. Know the various blow moulding operations used in making plastic parts 6. Learn thermoforming as a method to make low cost plastic parts with simple equipment 7. Understand the moulding methods used for thermosetting materials 8. Design plastic parts taking the process and material requirements into account			

Table 4 Relationship between experiment content and lesson arrangement

Experiement	content	Method/instrument	lesson	Studnets/ Group	Experimental attributes (basic/comprehensive/design/research innovation)	Make a request (do/optional)	Corresponding course objectives
Measurement of residual thermal stress in cast iron	Learn how to use the stress box to measure the residual stress, and understand and verify the residual thermal stress caused by the inconsistent thickness of castings.	1. Stress frame pattern; 2.Molding sand, sand box and molding tools; 3.Melting furnace,pouring tools; 4. molten liquid iron 5. Pincer pliers;	2	30	basic	Compulsory	2

		6. Hand saw; 7.Vernier caliper.					

V. Teaching Method

The teaching mainly relies on the in-class teaching, assisted by practice and homework.

VI. Evaluation Method

The assessment of *Basic Course of Mechanical Manufacturing* is to evaluate the degree of students achieving the teaching objectives of the course, which reflects the degree of students achieving the objectives of ability cultivation. The assessment methods are shown in Table 5 below.

Table 5 Course objectives and assessment methods

Scores	Evaluation parts	percentage	Evaluation details	Related objectives
Usual performance	In-class performance	10%	It mainly assesses students' understanding and mastery of basic knowledge and skills. Evaluate students' answers to questions and their participation in class discussions. Practice effect in class. will count 10% towards the course grade.	1、2、3
	homework	30%	It mainly assesses students' understanding and mastery of each lesson. Calculate the average score of all assignments and count it into the total score by 30%.	1、2、3
Experiment	Experimental report	10%	It mainly assesses the measurement of internal stress of castings. Scores are given on the basis of experiment results and report.	3
Final Exam	Exam result	50%	It mainly assesses the students' understanding an mastery of basic principles and theories of common manufacturing processes and relevant design and analysis methods. The aspects of final exam and corresponding score are shown as follows: 1. Multiple choices or definition of terminologies, 20 for objective 1; 2. True or false or completion questions, 15 for objective 1; 3. Short answer or drawing questions, 30 for objective 3; 4. Calculation questions, 15 for objective 1; 5. Analyzing questions, 20 for objective 1; Final exam will count 50% towards the course grade.	1、2、3

The grading standards of this course for each assessment link of the course are shown in Table 6.

Table 6 The grading standards of this course

<table>
<tr><th>Evaluation parts</th><th colspan="2">Grading standards</th></tr>
<tr><td>Usual performance</td><td colspan="2">According to the situation of answering questions, there are five grades: excellent (90-100), good (80-89), middle (70-79), passed (60-69), failed (below 60 points), on the basis of grades combined with class performance as appropriate to give points.</td></tr>
<tr><td>Experiment</td><td>Experiment（10%）</td><td>According to the completion of the experiment report and result, there are five grades: Excellent (90-100), good (80-89), middle (70-79), passed (60-69), failed (below 60).</td></tr>
<tr><td>Final Exam</td><td colspan="2">According to the completion of the test, according to the scoring rules will be graded.</td></tr>
</table>

The score distribution matrix of assessment methods and course objectives is shown in Table 7.

Table 7 Assessment methods and course target score distribution matrix

		Part 1（in-class performance）（K1）	Part 2（experiment）（K2）	Part 3（exam）（K3）
Percentage		0.40	0.10	0.50
Percentage of the objectives	Objective 1（M1）	0.30	0	0.20
	Objective 2（M2）	0.40	0	0.30
	Objective 3（M3）	0.30	1.0	0.50

VII. Recommended Teaching Materials and Reference Materials

Textbook:

[1] P.N. Rao，Manufacturing Technology: foundry, forming and welding, Volume 1, Edition 3, China Machine Press, 2009

References:

[1] Zhangxiao Zhu, Kefu Yao. Engineering Materials, Edition 5, Beijing, Tsinghua University Press, 2011.

[2] Qiwen Shen. Foundation of Materials Forming Process, Edition 3, Chemical Industry Press, 2003.

[3] Shaowen Yan. Foundation of Materials Forming Process, Edition 2, Tsinghua University Press, 2008.

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Responsibility：Yongfeng Yuan

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Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Modified on May 11th, 2021

《互换性与技术测量*》教学大纲

Interchangeability and Technical Measurement

Course name：Interchangeability and Technical Measurement **Course code**：31910

Course type：Basic discipline-related course (Required elective course)

Total teaching hours：32 (Classroom Hours: 18, Laboratory Hours or Tutorial Hours:14)

Credit：**2.0**

Prerequisites: Machinery design, engineering drawing, mechanics of materials, machinery manufacturing

Major：Mechanical design, manufacturing and automation, Mechatronics engineering, Energy and power engineering

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

This course is a basic discipline-related course, it plays an important role as a bridge between mechanical design and mechanical manufacturing. It is a fundamental subject which is closely related to the development of machinery industry. Especially for mechanical engineers, reasonable interchangeability design is the key to the success of mechanical system design. After study of this course, students can improve their ability of accuracy design for mechanical parts, firmly establish the concept of precision machining, be able to correctly apply relevant national standards or ISO standards to master the principles and methods of accuracy design and measurement, and supplement the rapid development of modern measurement technology. Students can master the basic knowledge of measurement technology and quality assessment through experiments.

Except the basic teaching content, each chapter of this course adds discussions about the demand for engineers with high-tech manufacturing and measurement ability in the socialist modernization construction. Let the students think about this aspect in the course of teaching, and help the students to set up their learning goals at the same time, strengthen the confidence of the construction of the motherland, and strive for the realization of faster, stronger and more precise modern production.

II. Course Objectives

Course Objective 1：Have the ability to accurately describe the development status of machinery manufacturing and technical measurement technology at home and abroad, to find the advantages and disadvantages of current domestic technology through comparisons and to promote national pride and cultivate patriotism. Understand the rigor and scientific spirit required in manufacturing and technical measurement processes, and be able to accurately explain the role of interchangeability design in mechanical design and manufacturing processes.

Course Objective 2: Grasp the generalities, definitions, symbols, and indication on drawings of the dimensional, geometrical tolerance and surface roughness. Grasp the skill to use the Geometrical product specifications in the precision designing of mechanical parts, and lay the technology foundation for the mechanical jobs.

Course Objective 3： Have the ability to design the geometrical precision of products, be able to read, interpret and design the dimensional, geometrical tolerance and roughness in an engineering drawing.

Course Objective 4： Master the skill to use general measuring instruments, to process the measured data, and to evaluate the precision quality of geometrical products.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Interchangeability and Technical Measurement》

Index points of graduation requirements	**Content**
2.2	The feelings of real engineering environment, system engineering exercise practice learning experience, achieve refined to complex practical engineering problems, definition, modeling, analysis and evaluation.

Table 2. The supporting relationship between the course objectives of 《Interchangeability and Technical Measurement》 and the index points of graduation requirements

Index points of graduation requirements	**2.2**
Course objectives	1、2、3、4
Intensity of support	H

IV. Basic course content and teaching arrangement

The teaching arrangement of this course is mainly composed of two parts: theory lectures and measurement experiments. The arrangement for theory lectures is shown in table 3, and experiment arrangement is shown in table 4.

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	Course objectives
1	Unit 1 Introduction 1.1 Interchangeability. 1.2 Standardization. 3. Series of preferred values	1. Understand the concept of interchangeability 2. Know the concept and classification of standards 3. Have the ability to use preferred values when making machinery design 4.Students discuss in groups the typical advanced manufacturing technology at home and abroad, arouse students' patriotism and creative spirit	1	Lecture	1、2
2	Unit 2 Limits and fits of plain workpiece 2.1 Basic terms and definitions 2.2 Standards of limits and fits 2.3 Selection of limits and fits 2.4 General dimension tolerance	1.Understand the basic terms and definitions related with dimension tolerance 2.Know about the related standards 3. Able to give the reasonable accuracy design for mechanical parts	3	Lecture and experiments	2、3
3	Unit 3 Fundamentals of geometrical quantity measurement 3.1 Introduction 3.2 Metrological equipment and measurement methods 3.3 measurement error and data treatment	3. Understand the basic concept of metrology 4. Know the most commonly used metrological equipment and measurement methods 5. Able to process the measurement data 6. Students discuss the current advanced technical measurement technology in groups, and present their understanding of precision measurement and error treatment. Stimulate students' desire for advanced technology and motivation for learning.	2	Lecture and tutorial	1、3、4
4	Unit 4 Geometrical tolerance 4.1 General 4.2 Indication of geometrical tolerance on engineer drawings 4.3 definition of geometrical tolerance 4.4 Tolerance principles 4.5 Assessment and Measurement of geometrical deviations 4.6 Selection of geometrical tolerance	1. Know basic concepts of geometrical tolerance 2. Able to indicate geometrical tolerances in engineering drawings correctly 3. Able to choose geometrical tolerance characteristics and grades correctly 4. Able to assess and measure the geometrical deviations	5	Lecture and experiments	1、2、3、4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	Course objectives
5	Unit 5 Surface roughness 5.1 Basic terms and definitions 5.2 Main evaluation parameters of surface roughness 5.3 Principles for selecting surface roughness parameters 5.4 Graphical symbols and notation 5.5 Indication of surface texture requirements on engineering drawing 5.6 Measurement techniques	1. Understand basic concepts related to the surface roughness 2. Able to indicate the different surface roughness requirement in a certain engineering drawings correctly 3. Able to measure the surface roughness	3	Lecture and experiments	2、3、4
6	Unit 6 Accuracy design of cylindrical involute gear 6.1 General 6.2 Evaluation parameters of cylindrical involute gear 6.3 Accuracy design of cylindrical involute gear	1. Understand the evaluation parameters of cylindrical involute gear 2. Know the related standards of accuracy design of cylindrical involute gear	2	Lecture and experiments	2、3、4
7	Unit 7 Computer-aided measurement (support Course Objective 1） 1. Structure of coordinate measurement machine 2. Procedures of coordinate measurement	1. Know about some most commonly used coordinate measurement machines 2. Know about the most commonly used coordinate measurement software 3.Understand the development status of CMM technology in China and inspire students' patriotic feelings and aspirations to serve the motherland	2	Lecture	1、2

Table 4 Relationship between course objectives and course experiment

Experiment title	Experiment content	Main equipment	Hours	Numbers of group	Property	Mandatory or optional	Course objectives
Measurement experiment for shaft diameter with vertical optimeter	Master the use of vertical optimeter and process the measurement data correctly.	Vertical optimeter	2	4-5	Basic	Mandatory	3,4

Geometrical errors measurement for gear box	Master the use of dial indicator and the measurement method of geometrical errors; Process the measurement data correctly.	Dial indicator	4	3-4	Integrated	Mandatory	3,4
Measurement experiment for surface roughness	Learn to measure the surface roughness of parts with a hand-held surface roughness meter	Hand-held surface roughness meter	2	4-5	Basic	Mandatory	3,4
Measurement experiments of accuracy parameter for cylindrical involute gear	Master the use of tooth thickness caliper, common normal micrometer, gear radial runout measuring instrument; Master the measurement data treatment.	Tooth thickness caliper, common normal micrometer, gear radial runout measuring instrument.	4	3-4	Basic	Mandatory	3,4
Measurement experiment by using machine vision	Master the use of machine vision instrument	Image measuring machine	2	5-6	Basic	Mandatory	1,3,4

V. Teaching method and arrangements of practice teaching

The course mainly consists of lectures, measurement experiments and assignments. All lectures will be given in English. Multimedia teaching method will be chosen to present all contents including lectures and experiments.

The arrangement of practice teaching content is given in Table 5.

Table 5 Arrangements of practice teaching

Measuring objects	Instrument	Teaching hours	Number /group	Property	Compulsory / elective
Diameter of axle	Vertical Optimeter	2	10	Basic	Compulsory
Geometrical errors of block parts	Dialgauge	4	10	Comprehensive	Compulsory
Roughness	Surfagauge	2	10	Basic	Compulsory
Cylindrical gear	gear tooth	4	10	Comprehensive	Compulsory

	micrometer, Gear Tooth caliper, etc.				

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 6 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Assignments and experiments	50%	To assess the level of understanding knowledge taught in class and the experimental operation skills, accounting for 50% of total score	2、3
Exam	Final test	50%	To assess the ability to use course knowledge to give the correct answers in final test paper, accounting for 50% of total score.	1、2、3、4

The grading criteria of this course for each assessment method are presented in Table 7.

Table 7 The grading criteria for each assessment method

Assessment methods	Grading criteria
Assignments	According to the condition of completion, there will be four levels：Excellence (90-100, good (75-89, normal (60-74), fail (below 60). Adjust the score depending the class attendance.
Final test	According to the answer and score judgement standard

The score allocation matrix of assessment methods and course objectives are given in Table 8.

Table 8 Assessment methods and score allocation matrix

		Assessment 1（Assignments, experiments）（K1）	Assessment 2（Final test）（K2）
Percentage		0.4	0.6
Score percentage of course objective for each assessment method	Objective 1（M1）	0	0.2
	Objective 2（M2）	0.4	0.3
	Objective 3（M3）	0.6	0.3

		Assessment 1（Assignments, experiments）（K1）	Assessment 2（Final test）（K2）
	Objective 4（M4）	0	0.2

The evaluation criteria of the course objectives can be determined on the basis of assessment method, grading criteria and course objective allocation matrix, as shown in Table 9.

Table 9 Evaluation criteria of the course objectives

Course objectives	**Evaluation criteria**				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
Course Objective 1：Have the ability to accurately describe the development status of machinery manufacturing and technical measurement technology at home and abroad. Understand the rigor and scientific spirit required in manufacturing and technical measurement processes, and be able to accurately explain the role of interchangeability design in mechanical design and manufacturing processes.	Able to describe the development status of machinery manufacturing and technical measurement technology, and to understand the rigor and scientific spirit required in manufacturing and technical measurement processes **accurately** and **correctly**, and be able to explain the role of interchangeability design in mechanical design and manufacturing processes **accurately** and **correctly**.	Able to describe the development status of machinery manufacturing and technical measurement technology, to understand the rigor and scientific spirit required in manufacturing and technical measurement processes **very correctly**, and be able to explain the role of interchangeability design in mechanical design and manufacturing processes **very correctly**.	Able to **correctly** describe the development status of machinery manufacturing and technical measurement technology, to understand the rigor and scientific spirit required in manufacturing and technical measurement processes, and be able to explain the role of interchangeability design in mechanical design and manufacturing processes **correctly**.	Able to **roughly** describe the development status of machinery manufacturing and technical measurement technology, to understand the rigor and scientific spirit required in manufacturing and technical measurement processes, and be able to explain the role of interchangeability design in mechanical design and manufacturing processes **roughly**.	Not able to describe the development status of machinery manufacturing and technical measurement technology, to understand the rigor and scientific spirit required in manufacturing and technical measurement processes, and be not able to explain the role of interchangeability design in mechanical design and manufacturing processes.

Course objectives	Evaluation criteria				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
Course Objective 2：Grasp the generalities, definitions, symbols, and indication on drawings of the dimensional, geometrical tolerance and surface roughness. Grasp the skill to use the Geometrical product specifications in the precision designing of mechanical parts.	Able to **accurately** and **correctly** understand the definitions, symbols and indicate dimensional, geometrical tolerance and surface roughness on drawings.	Able to **very correctly** understand the definitions, symbols and indicate dimensional, geometrical tolerance and surface roughness on drawings.	Able to **correctly** understand the definitions, symbols and indicate dimensional, geometrical tolerance and surface roughness on drawings.	Able to **roughly** understand the definitions, symbols and indicate dimensional, geometrical tolerance and surface roughness on drawings.	**Not** able to understand the definitions, symbols and indicate dimensional, geometrical tolerance and surface roughness on drawings.
Course Objective 2：Have the ability to design the geometrical precision of products, be able to read, interpret and design the dimensional, geometrical tolerance and roughness in an engineering drawing.	Able to **accurately** and **correctly** design the dimensional, geometrical tolerance and roughness of products.	**Proficiently** design the dimensional, geometrical tolerance and roughness of products.	**Correctly** design the dimensional, geometrical tolerance and roughness of products.	**Roughly** design the dimensional, geometrical tolerance and roughness of products.	**Not** able to design the dimensional, geometrical tolerance and roughness of products.
Course Objective 3：Master the skill to use general measuring instruments, to process the measured data, and to evaluate the precision quality of geometrical products.	**Fully** be able to use general measuring instruments, to process the measured data, and to evaluate the precision quality of geometrical products.	Possess the ability to **proficiently** use general measuring instruments, to process the measured data, and to evaluate the precision quality of geometrical products.	Possess the ability to **correctly** use general measuring instruments, to process the measured data, and to evaluate the precision quality of geometrical products.	Possess the ability to **roughly** use general measuring instruments, to process the measured data, and to evaluate the precision quality of geometrical products.	**Not** able to use general measuring instruments, to process the measured data, and to evaluate the precision quality of geometrical products.s

VII. Recommended textbooks and reference materials

Textbook：

[1] Zhang Yanfu, Fundamental of geometrical tolerance and measurement technology, Beihang University Press, 2015.

Reference books：

[1] Li Beizhi, Interchangeability and Technical Measurement (in Chinese), Huazhong University of

Science and Technology Press, 2017
[2] Hua Guoliang, Precision Measurement Technology (in Chinese), Tsinghua University Press, 2011
[3] Gene R. Cogorno, Geometric dimensioning and tolerancing for mechanical design, McGraw-Hill Education, 2011
[4] Georg Henzold, Geometrical Dimensioning and Tolerancing for Design, Manufacturing and Inspection, Oxford: Butterworth-Heinem- ann. 2011.

Online resource:

[1] https://www.icourse163.org/course/HIT-1002028013

[2] https://www.icourse163.org/course/CHD-1002143006

[3] https://www.icourse163.org/course/NJUST-1206162804

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Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: Mar 21, 2021

《机械制造工艺学*》教学大纲

Mechanical Manufacturing Technology

Course name：Mechanical Manufacturing Technology **Course code**：31915

Course type：Specialized course (Compulsory)

Total teaching hours：48 (Lecture Hours: 45 Laboratory Hours 3)

Credit：3

Prerequisites: Mechanical drawing, Theoretical Mechanics, Mechanics of Materials, Metal Materials & Heat Treatment, Metal Technology, Mechanics Principle, Mechanics Design, Metal Cutting Principle & Machine Tool

Major：Mechanical Design, Manufacturing and its automation

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

Mechanical manufacturing technology is a professional basic course for the major of mechanical design, manufacturing and automation. The course is about the manufacturing process and assembly process of mechanical parts. It aims to equip students with the knowledge of basic theory, skills of manufacturing process.

II. Course Objectives

Course Objective 1：Cultivate the spirit of patriotism, dedication, excellence, meticulousness and pursuit of excellence, inherit the value concept of Chinese craftsmanship, and establish the sense of mission to realize the Chinese dream of the great rejuvenation of the Chinese nation.

Course Objective 2：Master basic theory and basic knowledge of mechanical parts processing and assembly process, including: concept of references, positioning principle, dimension chain, Processing quality, positioning error, grip design, processing procedure, assembly technique, advanced manufacturing technology etc..

Course Objective 3：Have the ability to analyze and develop parts processing procedures and mechanical assembly processes, analyze and design tooling and fixture, analyze and solve machining and assembly quality problems, analyze the rationality of product structure from the point of view of Technology.

Course Objective 4：Have good awareness and basic knowledge on environmental protection, establish the concept of green manufacturing, take full account of environmental factors in the formulation of the process specification.

Course Objective 5： Command the methods of economic analysis, and have the ability to improve the economy of mechanical products by reasonable manufacturing process and fixture design.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Mechanical Manufacturing Technology》

Index points of graduation requirements	Content
3.1	Know about the status and development trend of mechanical engineering. Familiar with new products, new process, new technology and new equipment research, development basic procedure. Have the attitude and consciousness of innovation in solving complex mechanical engineering problem.
6.3	Able to evaluate the impact of solution plan of mechanical engineering problem on society, health, safety, law and cultural influence, and take the responsibility.
7.2	Able to establish the concept of green manufacturing, and to evaluate the effect of engineering practice on the sustainable development of environment and society.
8.2	Understand the socialist core values, to understand the national conditions, to safeguard national interests, has the sense of responsibility to promote national rejuvenation and social progress.
11.1	Master the economic analysis and decision making methods, economic evaluation methods of environmental protection, and technological theory and methods.

Table 2. The supporting relationship between the course objectives of *Mechanical Manufacturing Technology* and the index points of graduation requirements

Index points of graduation requirements	**3.1**	**6.3**	**7.2**	**8.2**	**11.1**
Course objectives	1	2	3	1	4
Intensity of support	H	H	H	M	M

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	Unit 1: Introduction	1. Understand the research object, content and requirement of mechanical manufacturing technology. 2. Understand the development of mechanical manufacturing engineering. 3. Discusses that "manufacturing power" is the foundation of a powerful country, combining current events and history.	2	Lecture	1,2,3,4,5
2	Unit 2: Basic concept of mechanical manufacturing process r	1. Understand the concept and difference of production process and process. 2. Understanding of production planning and production, process characteristics of various types of production. 3. Understand the concept of the workpiece positioning and the locating datum, the principle and method of Positioning. Grasp the restrictions of different positioning elements and positioning methods on the freedom of parts. 4. Understand the concept of assembly benchmark and positioning.	4	Lecture	2,3,4
3	Unit 3: Design of machining process	1. Understand the concept and content of machining process. 2. Master the process arrangement and design method of machining. 3. Master machining process design methods. 4. Understand computer aided process planning. 5. Understand the productivity and economic analysis of the process. 6. Through learning the deeds of "great craftsmen", students' feelings of home country, professional belonging and mission are aroused.	8	Lecture	1,2,3,4,5
4	Unit 4: Analysis and control of machining quality	1. Understand the concept of machining quality and its content. 2. Understanding the main factors affecting the machining accuracy. 3. Master the comprehensive analysis method of machining error. 4. Understand the factors affecting surface quality analysis methods and control methods. 5. Through learning programs such as "national treasure", "national treasure talks" and the deeds of "great country	9	Lecture and experiment	1,2,3,4,5

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		craftsmen", we can cultivate students' craftsmanship spirit and stimulate national pride.			
5	Unit 5: Typical parts processing technology	1. Master the machining technology of shaft parts. 2. Master the machining technology of carriage parts. 3. Know the machining technology of other typical parts.	7	Lecture	2,3,4
6	Unit 6: Basic principles of jig design	1. Know about the content of jig design. 2. Master the workpiece positioning in the jig, clamping methods and related parts of the design, positioning error calculation method. 3. Understand the design method of special jig. 4. Understand the method of computer aided fixture design.	6	Lecture	2, 3,5
7	Unit 7: Typical jig design	1. Understand the function, structure and design requirements of the drill jig. 2. Understand the function, structure and design requirements of the boring jig. 3. Understand the function, structure and design requirements of the milling jig. 4. Understand the function, structure and design requirements of the lathe jig. 5. Taking lithography as an example, the paper illustrates the influence of assembly technology on product quality and stimulates the sense of responsibility of students.	6	Lecture	1,2
8	Unit 8: Fundamentals of machine assembly process	1. Understand the concept and content of machine assembly process. 2. Know the composition of machine assembly dimension chain. 3. Understand the method of ensuring assembly accuracy. 4. Understand the assembly process specification p reparation. 5. Understand assembly automation and computer aided assembly process design.	6	Lecture	1, 2

Table 4 Class hour allocation for experimental teaching content

Experiment	Content outline	Equipment or Experiment environment	Hour	No. of students in each group	Experiment attribute（basic/comprehensive/design/research innovation）	Requirement (compulsory/optional)	Corresponding course objective
statistical analysis of machining error	Understand the connotation and influence of machining quality of parts.	A batch of processed parts, micrometer	2	35	Basic	compulsory	2,5
Understand typical machine tools and fixtures	Know about typical machining tools and fixtures.	Typical machining machine tools and fixtures, production workshop	1	35	Basic	compulsory	2,3,5

V. Teaching method

Mechanical manufacturing technology is a highly practical course, we must adhere to the principle of both theory and Practice. The teacher should combine the project from the actual production to carry on the project teaching. Through the narrative of the teacher, the students can understand how to analyze the causes of the engineering problems, optimize the selection of solutions and solve the problems in solving the practical engineering problems. The heuristic and discussion teaching methods were used to cultivate students' ability to think, analyze and solve problems. Teachers guide and encourage students to acquire knowledge through practice and self-learning, increase the question and answer questions and other teaching sections.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 5 Course objectives and assessment methods

Score category	**Assessment methods**	**Percentage**	**Assessment details**	**Corresponding objectives**
Usual performance	Classroom performance	10%	Assess the level of understanding basic knowledge. Attendance and study performance in classroom	1,2
	Mid-term exam	20%	Open book examination	1

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Experiments	Experiment report	10%	Two experiments: No.1: Statistical analysis of machining error and geometry measurement of cutting tools, No.2 Understand the technical scope of various machine tools	1,2
Final exam	Exam	60%	It mainly assesses students' understanding of the knowledge based on the exam paper. The paper structure and score distribution are as follows: Filling in blank 20%, single choice 20%, right or wrong questions 10%, short answer questions 10% and calculation questions or analysis questions 40%.	1,2

The grading criteria of this course for each assessment method are presented in Table 5.

Table 6 The grading criteria for each assessment method

Assessment methods	Grading criteria
Classroom performance	According to the condition of completion, there will be four levels：Excellence (90-100, good (75-89, normal (60-74), fail (below 60). Adjust the score depending the class attendance.
assignments	According to the quality of the assignment, there will be four levels: Excellence (90-100, good (75-89, normal (60-74), fail (below 60).
Mid-term exam	According to the exam paper grading criteria.
Experiment report	According to the quality of the report, there will be four levels: Excellence (90-100, good (75-89, normal (60-74), fail (below 60).
Exam	According to the exam paper grading criteria.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 7 Assessment methods and score allocation matrix

		Assessment 1 (Classroom performance)（K1）	Assessment 2（Experiment）（K2）	Assessment 3（mid-term Exam）（K2）	Assessment 4（Final Exam）（K2）
Percentage		0.1	0.1	0.2	0.6
Score percentage of course objective for each	Objective 1（M1）	0.4	0.3	0.3	0
	Objective 2（M2）	0.6	0.7	0.2	0.6
	Objective 3（M3）	0	0	0.1	0.1

		Assessment 1 (Classroom performance)（K1）	Assessment 2（Experiment）（K2）	Assessment 3（mid-term Exam）（K2）	Assessment 4（Final Exam）（K2）
assessment method	Objective 4（M4）	0	0	0.2	0.1
	Objective 5（M5）	0	0	0.2	0.2

VII. Recommended textbooks and reference materials

Textbook：

[1] Xiaozhong Ren, Naifei Ren, Hongjun Wang, Fundamentals of manufacturing technology: English-Chinese Bilingual [M]. China Mechanical Press, 2014.

[2] Serope Kalpakjian, Stephen R. Schmid, Manufacturing Engineering and Technology, Pearson Education,2013.

Teaching group： Hongjun Li, etc. Course administrator：Hongjun Li

Written by: Hongjun Li Reviewed by: Jian Zhou

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 27, 2021

《机械系统设计*》教学大纲

Mechanical System Design

Course Chinese Name: Mechanical System Design **Course Code:** 31916

English name of the course: Mechanical System Design

Course category: professional education (compulsory)

Total class hours: 32 class hours (including lecture hours: 32 class hours)

Credits: 2.0

Prerequisite courses: mechanical principle, mechanical design, control engineering foundation

Applicable major: mechanical design and manufacturing and its automation, intelligent manufacturing, etc.

Department: Department of Mechanical Design and Manufacturing

1. Course introduction

Mechanical system design is an elective course in the direction of mechanical engineering that explains the basic components of modern machinery and how these components constitute a complete and coordinated complex system. The mechanical system is the matrix of various mechanical equipment, and the design and manufacture of advanced mechanical systems is an important part of the realization of China's manufacturing strategy. Through the study of the mechanical system design course, students can have a clear basic concept, necessary basic knowledge, more proficient design calculation ability, certain analysis ability and preliminary overall for the composition, layout, and evaluation of the design plan of the mechanical system. Scheme design ability. Through the study of this course, the trained students can use a systematic point of view to understand the rules and characteristics of general mechanical product design from the perspective of the whole machine. Through the study of this course, students will be able to weigh the status of each subsystem in the overall design based on such a knowledge system when designing modern mechanical systems. At the same time, combining the characteristics of the machinery manufacturing industry in the course, facing the main battlefield of China's manufacturing power strategy, introducing excellent mechanical products and related core technology breakthrough cases in the surrounding and major projects, inspiring students' interest in learning, cultivating students' great country craftsman spirit for excellence, and inspiring Students' home and country feelings and mission of serving the country with science and technology.

2. Course objectives

Course objective 1: Combining the role of mechanical system design in realizing the strategy of making China a strong country, by introducing excellent mechanical products and related core technology breakthrough cases in the surrounding and major projects, cultivate students' spirit of great craftsmanship for excellence, and inspire students to serve the country with science and technology. National sentiments and mission.

Course objective 2: Master the basic theories, basic knowledge and basic concepts of mechanical system design. Master the overall scheme of mechanical system, execution system, transmission system, support system, control system, manipulation and safety system, lubrication and cooling system, etc., classification, composition and design principles and methods. And strengthen the overall understanding of mechanical system design, expand the knowledge of mechanical structure and enhance the ability of structural design, master the basic methods and technologies of mechanical product design, develop the habit of comprehensive analysis and comprehensive consideration of problems, and cultivate a good scientific attitude and innovative spirit .

Course objective 3: Have relatively proficient mechanical system design and calculation ability, certain analysis ability and preliminary overall plan design ability, and be able to select suitable materials and processing at the most economical price on the premise of meeting technical and economic requirements Means, design a reasonable mechanical system, and be able to consider social, health, safety, legal, cultural and environmental factors in the design.

Course objective 4: Have the ability to apply 3D modeling and simulation, finite element, engineering numerical calculation and other software for mechanical system modeling, prediction and simulation.

3. Graduation requirements supported by curriculum teaching objectives

The graduation requirements index points supported by this course are shown in Table 1, and the supporting relationship of the course teaching objectives to the index points supporting graduation requirements is shown in Table 2.

Table 1 Graduation requirements index points supported by "Mechanical System Design"

Index points for graduation requirements	Graduation requirement index point content
3.1	Understand the current status and development trends of mechanical engineering, be familiar with the basic process of research and development of new products, new processes, new technologies and new equipment, and have the attitude and awareness of pursuing innovation in solving complex mechanical engineering problems.
3.3	Be able to identify clear design requirements and propose design solutions for complex mechanical engineering problems, and be able to consider social, health, safety, legal, cultural, and environmental factors.
5.2	Be able to select and use appropriate technical means and modern engineering tools to model, predict and simulate complex mechanical engineering problems.

8.2	Understand the core values of socialism, understand national conditions, safeguard national interests, and have a sense of responsibility to promote national rejuvenation and social progress.

Table 2 The supporting relationship of the "Mechanical System Design" course objectives to the index points supporting graduation requirements

Index points of graduation requirements	**3.1**	**3.2**	**5.2**	**8.2**
Course objectives	2	3	4	1
Intensity of support	M	M	M	L

4. Basic teaching content and class time arrangement

The basic teaching content, teaching requirements, class schedule, teaching methods and the relationship with the course objectives of this course are shown in Table 3.

Table 3 The relationship between course objectives and teaching content

chapter	**Teaching content**	**Teaching requirements**	**Class hours**	**teaching methods**	**Course objectives**
1	1 Introduction (1) The position and function of mechanical system design in mechanical engineering science (2) Tasks, basic principles and requirements of mechanical system design (3) Introduction to the mechanical system design method and the development of mechanical design	1. Combining current affairs hotspots to introduce excellent mechanical products around and in major projects to stimulate students' interest in learning, family and country feelings, sense of pride and mission. For example, the introduction of the "Ben Ben" robot cow and the Chinese Mars rover "Tianwen No. 1" by our alumni Wang Xingxing at the 2021 Spring Festival Gala, and comparison with the American Mars rover "Perseverance", etc. 2. Introduce the knowledge system framework of this course; course teaching objectives, supporting graduation requirements, status in the course system of this major, teaching content, assessment methods and score ratio; 3. Understand the position and role of mechanical system design in mechanical engineering science; 4. Master the tasks, basic principles and requirements of mechanical system design; 5. Understand the development of mechanical system design methods and mechanical design.	2	Classroom teaching	1、2
2	2. Overall design of mechanical system (1) Functional principle design of mechanical system	1. Master the requirements, basic processes and methods of the functional principle design of the mechanical system; 2. Master the requirements, basic processes and methods of the overall design of the mechanical system structure.	4	Classroom teaching	2、3、4

chapter	Teaching content	Teaching requirements	Class hours	teaching methods	Course objectives
	(2) Overall design of mechanical system structure	3. Arrange major tasks for mechanical product design.			
3	3. Perform system design (1) Type and composition of execution system (2) The design of the execution system	1. Through the introduction of relevant core technology breakthrough cases, students will be inspired to serve the country with science and technology and their mission. For example, the introduction of Wang Fan, a young teacher from the School of Computer Control, published the school's first AFM cover article, a new high-performance biocompatible artificial muscle based on functional bacterial cellulose and polypyrrole, which will be used as an execution system in software robots and wearable devices. And other fields have been widely used. 2. Understand the type and composition of the execution system; 3. Master the basic requirements, characteristics and design methods of the execution system such as the execution axis. 4. Report and discussion of design requirements and principle schemes for large-scale operations of mechanical product design	6	Classroom teaching	1、2、3、4
4	4. Transmission system design (1) The composition and classification of the transmission system (2) Motion design of transmission system (3) Design principles of inline drive system	1. Understand the composition and classification of the transmission system; 2. Grasp the basic requirements, characteristics and design methods of common transmission systems such as speed change devices, start-stop, and reversing devices; 3. Understand the design principles of the inline drive system. 4. Through the introduction of scientific research projects in which teachers and enterprises cooperate to solve key technical problems of intelligent equipment, cultivate students' professionalism and the spirit of great country craftsmen. Such as Zhejiang Province's major science and technology project "Key technology research and complete equipment industrialization of fully automatic non-contact identification system antenna coil production" and so on. 5. Report and discussion on the overall design plan of mechanical product design large-scale operation design	6	Classroom teaching	1、2、3、4

chapter	Teaching content	Teaching requirements	Class hours	teaching methods	Course objectives
5	5. Support system design (1) Type and composition of support system (2) Static stiffness of supporting system (3) Dynamic characteristics of the supporting system (4) Thermal characteristics of the support system (5) The foundation of the mechanical system	1. Understand the type and composition of the supporting system; 2. Master the basic requirements and design methods of the supporting system; 3. Master the analysis methods and improvement measures of the static stiffness, dynamic characteristics and thermal characteristics of the supporting system; 4. Understand the common basis and characteristics of mechanical systems.	4	Classroom teaching	2、3、4
6	6. Control system design (1) The role, classification and composition of the control system (2) Control motor and position detection device (3) Servo system design	1. Understand the role, classification and composition of the control system; 2. Familiar with the control motor and position detection device; 3. Understand servo system design. 4. Mechanical product design major job design structure design report discussion	4	Classroom teaching	2、3
7	6. 6. Control system and safety system design 7. (1) Control system design 8. (2) Safety system design	1. Understand the role, classification and composition of the control system and safety system; 2. Master the basic requirements, characteristics and design methods of common operating systems and safety systems. 3. Design defense report for major mechanical product design operations	4	Classroom teaching	2、3、4
8	9. Lubrication system and cooling system (1) Lubricating material (2) Supply method of lubricating oil (grease) (3) Thin oil centralized lubrication system 9. (4) Dry oil lubrication system 10. (5) Cooling system	1. The role, classification and composition of lubrication system and cooling system; 2. Grasp the characteristics and supply methods of common lubricating materials; 3. Master the basic requirements, characteristics and design methods of thin oil and dry oil lubrication systems; 4. Understand the basic requirements and design methods of the cooling system.	2	Classroom teaching	2、3

5, teaching methods

The teaching method is mainly based on classroom lectures and discussions, supplemented by homework and design.

6, assessment method

The assessment of the "Mechanical System Design" course is to evaluate the degree to which students have reached the teaching goals of the course, reflecting the degree of achievement of the students' ability training goals. The evaluation method is shown in Table 4.

Table 4 Course objectives and assessment methods

Grade composition	Assessment/evaluation link	Points	Assessment/Evaluation Rules	corresponding teaching objectives
Usual grades	Normal attendance and homework	20	Attendance accounts for 5%; homework assesses students’ understanding and mastery of the principles, selection, and preliminary methodologies of mechanical system components. Each assignment is graded on a hundred-point scale. The average grade of each assignment is calculated as 15% of the total grade of the course.	1、2、3
	Mechanical product design	30%	The main assessment is for students to refine the design requirements for specific needs, conduct assessment and evaluation in terms of scheme design, three-dimensional modeling and simulation, preparation of design instructions, production of report PPT and defense.	1、2、3、4
Final exam	Final exam paper results	50%	Mainly assess students' mastery of basic knowledge of mechanical system design and related design and analysis methods.	1、2、3

The grading standards for each assessment link of the "Mechanical System Design" course are shown in Table 5.

Table 5 Evaluation Criteria for Course Evaluation Methods

<table>
<tr><th>Assessment/evaluation link</th><th colspan="2">Grading</th></tr>
<tr><td>Usual homework</td><td colspan="2">According to the completion of the homework, it is divided into four grades: excellent (90-100), good (75-89), medium (60-74), and failing (below 60 points). Based on the grade, combined with the usual classroom performance Minute.</td></tr>
<tr><td>Mechanical product design</td><td>Mechanical product design is</td><td>Design requirements (10 points): Refine the background and design requirements of the design.</td></tr>
</table>

	mainly evaluated from the aspects of design requirements, design schemes, three-dimensional models and simulations, design instructions, report PPT and defense.	Design plan (30 points): Use the black box method to complete the functional principle design and evaluation, and complete the overall plan design.
		3D model and simulation (20 points): The correctness of the 3D model and simulation.
		Design specification (20 points): completeness, organization and format specification of the content of the specification
		Report PPT and reply (20 points): the completeness, orderliness and beauty of the PPT, clear narration and answer to questions during the reply.
Final exam	The final exam adopts a 100-point system and is graded according to the standard answers and grading rules drawn up by the person in charge of the course.	

Refer to Table 6 for the evaluation method and the score distribution matrix of the course objectives

Table 6 Assessment Method and Course Target Score Distribution Matrix

		Assessment 1 (Attendance, usual homework) (K1)	Assessment 2 (Instructions, drawings, etc.) (K2)	Assessment 3 (Final exam) (K3)
The proportion of assessment methods in the total score		0.20	0.30	0.50
The proportion of course objectives in each assessment	Course Objective 1 (L1)	0.60	0.30	0.10
	Course Objective 2 (M2)	0.30	0.20	0.50
	Course Objective 3 (M3)	0.10	0.6	0.30
	Course Objective 4 (M4)	0	1.0	0

According to the "Mechanical System Design" assessment method, grading standard and course target distribution matrix, the evaluation standard of the course teaching target can be determined as shown in Table 7.

Table 7 Evaluation Criteria for Curriculum Objectives

Course objectives	**evaluation standard**				
	Average course goal achievement 0.9-1	**Average course goal achievement 0.8-0.89**	**Average course goal achievement 0.7-0.79**	**Average course goal achievement 0.6-0.69**	**Average course goal achievement 0-0.6**
	excellent	**good**	**medium**	**Pass**	**failed**
Combining the role of mechanical system design in realizing the	It has a strong spirit of great	It has a strong spirit of great	It has a certain spirit of	Basically, it has the spirit of	Only have an understanding of the great

Course objectives	evaluation standard				
	Average course goal achievement 0.9-1	Average course goal achievement 0.8-0.89	Average course goal achievement 0.7-0.79	Average course goal achievement 0.6-0.69	Average course goal achievement 0-0.6
	excellent	good	medium	Pass	failed
strategy of China's manufacturing power, by introducing excellent mechanical products and related core technology breakthrough cases in the surrounding and major projects, cultivate students' spirit of great country craftsmanship for excellence, and inspire students' home country feelings and mission of serving the country through science and technology Take charge.	craftsmanship for excellence and a sense and mission of serving the country with science and technology.	craftsmanship of excellence and a sense of family and country and mission to serve the country with science and technology.	great country craftsman who strives for perfection and the feelings and mission of serving the country with science and technology.	great craftsmanship of excellence and the feelings and mission of serving the country with science and technology.	craftsman spirit of the great country and the national sentiment and mission of serving the country with science and technology.
Master the basic theories, basic knowledge and basic concepts of mechanical system design. Master the overall scheme of mechanical system, execution system, transmission system, support system, control system, manipulation and safety system, lubrication and cooling system, etc., classification, composition and design principles and methods. And strengthen the overall understanding of mechanical system design, expand the knowledge of mechanical structure and enhance the ability of structural design, master the basic methods and technologies of mechanical product design, develop the habit of comprehensive	Able to correctly understand and master the basic theory of mechanical system design and the overall scheme of mechanical system and the role, classification, composition and design principles and methods of each subsystem; have an overall understanding of mechanical systems and the ability to comprehensively analyze	Able to more correctly understand and master the basic theory of mechanical system design and the overall scheme of mechanical system and the role, classification, composition and design principles and methods of each subsystem; have a good overall understanding of mechanical systems and the ability	Able to understand and to a certain extent master the basic theory of mechanical system design and the overall scheme of mechanical system and the role, classification, composition and design principles and methods of each subsystem; understand the integrity of the	Basically understand and master the basic theory of mechanical system design and the overall scheme of mechanical system and the role, classification, composition and design principles and methods of each subsystem; basic understanding of the integrity of mechanical system, basic ability to	Insufficient understanding and mastery of the basic theory of mechanical system design and the overall scheme of mechanical system and the role, classification, composition and design principles and methods of each subsystem; lack of understanding of the integrity of the mechanical system, weak ability to comprehensively analyze problems;

Course objectives	evaluation standard				
	Average course goal achievement 0.9-1	Average course goal achieveme nt 0.8-0.89	Average course goal achieveme nt 0.7-0.79	Average course goal achieveme nt 0.6-0.69	Average course goal achievement 0-0.6
	excellent	good	medium	Pass	failed
analysis and comprehensive consideration of problems, and cultivate a good scientific attitude and innovative spirit .	problems; have a scientific attitude and innovation spirit.	to comprehens ively analyze problems; Have a good scientific attitude and innovative spirit.	mechanica l system, and have a certain ability to comprehen sively analyze problems; A certain scientific attitude and innovative spirit.	comprehen sively analyze problems; basic scientific Attitude and innovative spirit.	scientific attitude and Lack of innovative spirit.
Possess relatively proficient mechanical system design and calculation ability, certain analysis ability and preliminary overall plan design ability, able to select suitable materials, processing methods and reasonable design at the most economical price on the premise of meeting technical and economic requirements Mechanical system, and can consider social, health, safety, legal, cultural and environmental factors in the design.	Possess mechanical system design calculation, analysis ability and preliminary overall plan design ability; can design a reasonable mechanical system, and consider social, health, safety, legal, cultural and environment al factors in the design.	Possess good mechanical system design calculation, analysis ability and preliminary overall plan design ability, can better design a reasonable mechanical system, and take social, health, safety, legal, cultural and environmen tal factors into consideratio n in the design .	Possess a certain degree of mechanica l system design calculation , analysis ability and preliminar y overall plan design ability, and consider social, health, safety, legal, cultural and environme ntal factors to a certain extent in the design.	Basically possess mechanical system design calculation , analysis ability and preliminar y overall plan design ability, and basically consider social, health, safety, legal, cultural and environme ntal factors in the design.	Mechanical system design calculation, analysis ability and preliminary overall plan design ability are insufficient, and social, health, safety, legal, cultural and environmental factors are not considered enough in the design.

Course objectives	evaluation standard				
	Average course goal achievement 0.9-1	Average course goal achievement 0.8-0.89	Average course goal achievement 0.7-0.79	Average course goal achievement 0.6-0.69	Average course goal achievement 0-0.6
	excellent	**good**	**medium**	**Pass**	**failed**
It has the ability to apply 3D modeling and simulation, finite element, engineering numerical calculation and other software for mechanical system modeling, prediction and simulation.	It has the ability to apply 3D modeling and simulation, finite element, engineering numerical calculation and other software for mechanical system modeling, prediction and simulation.	It can better apply 3D modeling and simulation, finite element, engineering numerical calculation and other software for mechanical system modeling, prediction and simulation.	Possess certain ability to apply 3D modeling and simulation, finite element, engineering numerical calculation and other software for mechanical system modeling, prediction and simulation.	Basically have the ability to apply 3D modeling and simulation, finite element, engineering numerical calculation and other software for mechanical system modeling, prediction and simulation.	The application of 3D modeling and simulation, finite element, engineering numerical calculation and other software for mechanical system modeling, prediction and simulation is insufficient.

7. Recommended textbooks and reference materials

Reference book:

[1] Zhu Longgen, editor in chief: "Mechanical System Design" (Second Edition), Machinery Industry Press, 2001.

[2] Zhao Han, editor-in-chief: "Mechanical System Design", Higher Education Press, 2005.

Internet resources:

[1] http://jpkc.hfut.edu.cn/2007/jxxtsj/articles/216.htm

[2] http://me.seu.edu.cn/course/mechdesign/

Course teaching team: Zhao Deming, Wang Bingxu, etc. **Course leader:** Pan Jun

Writer: Zhao Deming **Reviewer:** Pan Jun

Approval: Teaching Committee of School of Machinery and Automatic Control

Revision time: May 20, 2021

《机床数控技术*》教学大纲

Machine Tool CNC Technology

Course name：Machine Tool CNC Technology **Course code**：31918

Course type：Specialized course (Elective course)

Total teaching hours：32 (Classroom Hours: 28, Laboratory Hours:4)

Credit：2

Prerequisites: Automatic control theory, Motor and Transmission control, Manufacturing technology

Major：Mechanical design, manufacturing and automation, Mechatronics engineering

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

CNC controllers, working as a brain for manufacturing automation, are high value-added products accounting for over 30% of the price of machine tools. CNC technology is generally considered as a measure of the level of manufacturing technology of a nation, and is currently led by major advanced countries. CNC technology, which cannot be developed with one single technology but needs to integrate computer technology, hardware technology, machining technology, and so on, is often referred to as “The Flower of Industrial Technology”, and requires a strategy long-term support, mostly on a government level.

Despite its significant role, textbooks on CNC controllers are quite rare worldwide, with a few published in the 1970s and some later. However, the earlier ones mostly deal with conventional technologies, while the later ones deal with fragmental contents, mostly focusing on part programming and machine operation. This book used in this course is written by several authors in collaboration who have long experience in CNC development, education and research, and is designed as a highly focused textbook to provide knowledge on the principles and development technologies of CNC controllers. Therefore, this book can be used as a main textbook for courses related to CNC in such departments as mechanical engineering, precision engineering and control engineering, and as a guide for those working on CNC development in industry. For students majoring in mechanical engineering, the basic knowledge of CNC technology should be mastered to meet the needs of scientific and technological development. The CNC technology has an important impact on all aspects of the national economy and people's lives.

II. Course Objectives

Course Objective 1：Craftmanship is a precious quality condensed in production practice, which allows people to feel the glory of labor and the charm of spirit from the craftsmen of great countries. Incorporating the spirit of craftsmanship into the whole process of talent training makes each "artisan story" inspire young people and even more people to pursue excellence.

Course Objective 2：Understand part program, main CNC system functions, hardware interpolator, software interpolator.

Course Objective 3：Familiar with Acc/Dec control after interpolation, Acc/Dec control before interpolation, look ahead and PID control system.

Course Objective 4：Gradually develop the ability to write the part program.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by this course

Index points of graduation requirements	Content
3.3	Be able to identify clear design requirements and propose design solutions for complex engineering problems in the field of mechanical engineering, and be able to consider social, health, safety, legal, cultural and environmental factors.

5.2	Be able to select and use appropriate technical means and modern engineering tools for modeling, forecasting and simulation of complex engineering problems in the field of mechanical engineering.
8.2	Understand the core values of socialism, understand the national conditions, safeguard national interests, and have a sense of responsibility to promote the revival of the clan and social progress.

Table 2. The supporting relationship between the course objectives of this course and the index points of graduation requirements

Index points of graduation requirements	**8.2**	**3.3**	**5.2**
Course objectives	1	2	3、4
Intensity of support	H	M	M

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	<u>1. Introduction to NC Systems</u> 1.1 Introduction 1.2 The History of NC and NC Machine Tools 1.3 CNC Driving System Components 1.4 CNC Control Loop 1.5 The Components of the CNC	1. Understand the development history of CNC technology, and the contribution and influence of the development history of Chinese CNC technology to the development of global CNC technology, and	4	Lecture	1、2、3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	system 1.6 Summary	inherit the value concept of the craftsmanship of the Chinese nation. 2. Understand the basis concept of NC 3. Know about CNC control loop and NCK 4. Familiar with MMI, NCK and PLC functions			
2	2. Interpreter 2.1 Introduction 2.2 Part Program 2.3 Main CNC System Functions 2.4 Summary	1. Know about the program structure, main programs and sub-programs 2. Know about the main CNC system function 3. Able to write simple part program	6	Lecture	2、4
3	3. Interpolator 3.1 Introduction 3.2 Hardware Interpolator 3.3 Software Interpolator 3.4 Fine Interpolation 3.5 Summary	1. Understand that the interpolator plays the role of generator of axis movement data 2. Know about the hardware interpolator and the software interpolator 3. Familiar with the fine	5	Lecture	2、3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		interpolation			
4	4. Acceleration and Deceleration 4.1 Introduction 4.2 Acc/Dec Control After Interpolation 4.3 Acc/Dec Control Before Inter-polation 4.4 Look Ahead 4.5 Summary	1. Understand Acc/Dec control methods 2. Know about that the Acc/Dec control before interpolation is suitable for high-speed and high-accuracy machining. 3. Familiar with the look-ahead algorithm	5	Lecture	2、3
5	5. PID Control System 5.1 Introduction 5.2 The Servo Controller 5.3 Servo Control for Positioning 5.4 Position Control 5.5 Summary	1. Understand the servo controller 2. Know about the PID controller, PID gain tuning and feedforward control 3. Familiar with the following error 4. Combining examples, emphasizing the craftsmanship of rigor and excellence	4	Lecture	1、3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
6	6.1 Numerical Control Kernel 6.1 Introduction 6.2 Architecture of ACDAI-type NCK 6.3 Architecture of an ADCBI-type NCK 6.4 Summary	1. Familiar with the implementation of the interpolator, the rough interpolator, the Acc/Dec controller, etc. 2. Familiar with the implementation of the look-ahead module, the Acc/Dec controller, etc. 3. Take the road of becoming talents with skills and serving the country with skills, and vigorously promote the spirit of craftsmanship.	4	Lecture	1、3
7	7. Simulation experiment 7.1 Part Program for CNC lathe 7.2 Part Program for CNC Milling Machine	Master the essentials of part program and the programming steps.	4	Experiment	1、4

V. Teaching method

The course mainly lectures, supplemented by classroom discussion, in class experiments and homework.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives, reflecting the achievement degree of students' ability training objectives. The assessment methods are shown in Table 4.

Table 4 Course objectives and assessment methods

Score category	**Assessment methods**	**Percentage**	**Assessment details**	**Corresponding objectives**
Usual performance	Class question	20%	It mainly assesses students' understanding and mastery of basic knowledge and skills. Evaluate students' participation in answering questions, class discussion and participation in class discussion. Account for 20% of total score.	1、2、3
	Experiment	20%	It mainly assesses students' mastery of part program. Account for 20% of total score.	2、3、4
Final report	Report	60%	It mainly tests the students' mastery of interpreter, interpolator, acceleration and deceleration, PID control system and numerical control kernel. Account for 60% of total score.	1、2

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	**Grading criteria**
Class question	According to the condition of completion, there will be four levels：Excellence (90-100), good (75-89), normal (60-74), fail (below 60). Adjust the score depending the class attendance.
Experiment	According to the experiment performance and reports, there will be five levels: Excellence (90-100), good (80-89), normal (70-79), pass (60-69), fail (below 60).

Report	According to the completion of the report, score according to the rules.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1 (Class question) (K1)	Assessment 2 (Experiment) (K2)	Assessment 3 (Report) (K3)
The proportion of assessment methods in the total score		0.2	0.2	0.6
Score percentage of course objective for each assessment method	Objective 1 (M1)	0.5	0	0
	Objective 2 (M2)	0.25	0.2	0.6
	Objective 3 (M3)	0.25	0.2	0.2
	Objective 4 (M4)	0	0.6	0.2

VII. Recommended textbooks and reference materials

Textbook：

Since lecture notes will be delivered to students, textbook is not required. However, students are encouraged to read the following reference books:

Reference books：

[1] Du Guochen. “The machine tool CNC technology”, China Machine Press, 2017.

[2] Li Haolin, and Fang Jian. “Numerical control of machine tools”, China Machine Press, 2020.

[3] Chen Junlong. “Numerical control and numerically controlled machine tool”, Zhejiang University Press, 2015.

Teaching group：Xu Du　　　　Course administrator：Xu Du

Written by: Xu Du　　　　Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 31, 2021

《机械优化设计*》教学大纲

Optimization of mechanical design

Course name： Optimization of mechanical design **Course code：** 31919

Course type： Specialized course (Optional course)

Total teaching hours： 32 (Classroom Hours: 26, Laboratory Hours: 6)

Credit： 2

Prerequisites: Advanced mathematics, Mechanical Design, Mechanical Principle

Major: Mechanical Design manufacture and Automation, Mechatronics engineering

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

With the development of high-scientific technologies, mechanical design are playing significantly important role in enhancing comprehensive strength for all countries. As we known, a mechanical engineer always meets some problems on mechanical design and how to get the optimized mechanical products needs the combination of basic knowledge on mechanical design and optimization methods. This will raise the efficiency of designed process and save the date and expense for manufacturing the products. Therefore, understanding theories of optimization of mechanical design is significantly important for mechanical engineers in solving practical problems on mechanical design. “Optimization of Mechanical Design” is a basic-optional major course for undergraduate students from Mechanical design manufacturing and automation and mechatronics engineering. Through studying the course, students should understand the importance of optimization of mechanical design to raise the strength of research and development for high-scientific technologies and have the sense of scientific and contribution spirits. Students will know theories of optimization of mechanical design and how to use the corresponding optimized methods to solve the problems of mechanical design.

Students will learn basic concept of optimization, mathematical foundation for optimization methods, one-dimensional search method, unconstrained optimization method, constrained optimization method, linear programming and how to use Matlab to make codes for solving different optimization problems. For above optimization methods, students should understand their theories and know how to get the optimized solutions. Several examples and homework on optimization problems of mechanical design will be provided for further understanding of their optimization theories. A final examination on handwriting and making codes will carried out to check the level of students’ understanding on this course.

II. Course Objectives

Course Objective 1: Understand the importance of optimization of mechanical design to mechanical, aerospace, oceanic and other industries in China and cultivate scientific spirit to make contribution to enlarging comprehensive strength of China.

Course Objective 2: Understand theories of different optimization methods, their characteristics and how to select suitable optimization methods for corresponding optimization problems. In addition, be familiar with establishing mathematic models of optimization problems and obtaining corresponding optimized solutions.

Course Objective 3: Have the ability to analyze optimization problems of mechanical design and use optimization methods to get optimized solutions.

Course Objective 4: Master software on Matlab well and develop the programming ability for building mathematic models and obtaining optimization solutions

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Optimization of mechanical design*

Index points of graduation requirements	**Content**
1.3	To grasp deeply professional knowledge of analysis, design, manufacturing and control in the mechanical engineering to solve complicated projects on mechanical engineering
2.1	To apply basic principles of mathematics, natural science and engineering science to making more accurate recognition and expression of complicated problems on mechanical engineering
3.1	To understand the present situation of mechanical engineering and its development trend， be familiar with the basic technological process of research and development on new products, new process, new technology and new equipment，and possess innovative awareness in solving complex mechanical engineering project.
5.2	To make modeling and simulation on complex mechanical engineering problems by selecting and using appropriate technology and modern engineering tools， and understand the limitations of related tools in the process of practice.
12.2	To have correct understanding of lifelong learning and capability of keeping learning and adapting to social evolution.

Table 2. The supporting relationship between the course objectives and the index points of graduation requirements

Index points of graduation requirements	**1.3**	**2.1**	**3.1**	**5.2**	**12.2**

Course objectives	1、2	3	2、3、4	2、3	3、4
Intensity of support	H	H	H	H	H

IV. Basic course content and teaching arrangement

The Basic course content and teaching arrangement is shown in following Table3.

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**
1	Chapter 1: Introduction 1.1 Concept of optimization 1.2 Methodology of optimization 1.3 Histories of optimization 1.4 Mathematical models of optimization problems	1. Understand the concept of optimization 2. Know the methodology of optimization 3. Know histories of optimization 4. Master mathematical models of optimization problems 5. Discuss the application of optimization of mechanical design in practical industrial manufacture and motivate the sense of pride and mission for students.	2	Lecture	1、4
2	Chapter 2 Mathematical foundation for optimization problems 2.1 Multivariate function 2.2 Taylor’s series 2.3 Extremum conditions of unconstrained and constrained problems	1. Understand concept of multivariate function 2. Know expansion of Taylor’s series 3. Know the extremum conditions of unconstrained and constrained problems	2	Lecture	1、2、4
3	Chapter 3 One-dimensional search method 3.1 Introduction of one-dimensional search method 3.2 Theory of one-dimensional search method 3.3 Test method of one-dimensional search method 3.4 Interpolation method of one-dimensional search method	7. Understand the theory of one-dimensional search method 8. Able to use one-dimensional search method to solve optimization problems	4	Lecture and tutorial	1、2、3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
4	Chapter 4 Unconstrained optimization method 4.1 Introduction 4.2 Steepest descent method 4.3 Newton's method 4.4 Conjugate direction method 4.5 Coordinate rotation method 4.6 Powell's method	1. Understand the concept of unconstrained optimization method 2. Know theories of different unconstrained optimization methods 3. Able to use different unconstrained optimization methods to solve optimization problems 4. By giving examples of design in "Neck jamming" technique, cultivate the sense of patriotic spirit and contribution for students	6	Lecture and tutorial	1、2、3
5	Chapter 5 Constrained optimization method 5.1 Introduction of constrained optimization method 5.2 Random direction method 5.3 Complex method 5.4 Feasible direction method 5.5 Penalty function method 5.6 Linear approximation method	1. Understand the concept of constrained optimization method 2. Know theories of different constrained optimization methods 3. Able to use different constrained optimization methods to solve optimization problems	6	Lecture and tutorial	1、2、3
6	Chapter 6 Linear programming 6.1 Introduction of linear programming 6.2 Transformation of basic feasible solutions 6.3 Simplex method 6.4 Modification of simplex method	1. Understand the concept of linear programming problems 2. Know theories of different optimization methods on solving linear programming problems 3. Able to use above methods to solve linear programming problems	6	Lecture and tutorial	1、2、3
7	Chapter 7 Matlab and its application 7.1 The introduction and application of Matlab 7.2 Solving problems by using one-dimension search method 7.3 Solving problems by using Newton's method 7.4 Solving practical engineering problems	1. Know how to use Matlab and make codes 2. Know how to make codes on building mathematic model and obtaining optimized solution 3. Able to use Matlab to solve optimization problems of mechanical design 4. By using Matlab to solving the design of missiles, rockets and robots, make students understand the meaning of learning optimization of	6	Laboratory courses (Matlab practice)	2、3、4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		mechanical design to enhancing comprehensive strength of all fields in China.			

V. Teaching method

The course mainly consists of lectures, practice on computer and assignments. In the process of the teaching, multimedia courseware will be used appropriately. Teaching means include classroom teaching, instance analysis and programming. The students must attend experiment lessons together. In view of mastering the optimization methods and studying for the purpose of application, Visual Basic or Visual C++ is used for one dimensional searching methods and Matlab for constrained optimization methods

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives as shown in Table 4.

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Attendance and answer questions	20%	To check the attendance and cases of answering questions, accounting for 20% of total score	1、2、3、4
Conventional assignments	Assignments	20%	To check the level of students mastering the knowledge and cultivate students' ability in studying independently, accounting for 20% of total score	1、2、3、4
Final examination	Examination paper and coding	60%	To assess the ability to master the knowledge of this course, accounting for 60% of total score.	1、2、3

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Evaluation criteria

Usual performance	According to the condition of attendance and performance during the courses, there will be four levels：Excellence (90-100), good (75-89), normal (60-74), fail (below 60).
Conventional assignments	According to the condition of completion in assignments, including times and quality of finishing homework, there will be four levels：Excellence (90-100), good (75-89), normal (60-74), fail (below 60).
Final examination	The final examination will be conducted in a 100-point principle, according to the answer and score judgement standard

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（Performance）（K1）	Assessment 2（Assignments）（K2）	Assessment 3（Software operation on computer）（K3）
Percentage		0.2	0.2	0.6
Score percentage of course objective for each assessment method	Objective 1（M1）	0.3	0.3	0.2
	Objective 2（M2）	0.3	0.3	0.3
	Objective 3（M3）	0.2	0.4	0.3
	Objective 4（M4）	0.2	0	0.2

The evaluation criteria of the course objectives can be determined on the basis of assessment method, grading criteria and course objective allocation matrix, as shown in Table 7.

Table 7 Evaluation criteria of the course objectives

Course objectives	**Evaluation criteria**				
	Course objectives achievement, average value 90-100	**Course objectives achievement, average value 80-89**	**Course objectives achievement, average value 70-79**	**Course objectives achievement, average value 60-69**	**Course objectives achievement, average value 0-59**
	Excellent	**Good**	**Middle**	**Pass**	**Fail**
Course Objective 1：Understand theories of different optimization methods，their characteristics and how to select suitable optimization	Able to **proficiently** understand theories of different optimization methods and know how to solve optimization problems by	Able to **very correctly** understand theories of different optimization methods and know how to solve optimization problems by	Able to **correctly** understand theories of different optimization methods and know how to solve optimization problems by	Able to **roughly** understand theories of different optimization methods and know how to solve optimization problems by	**Not** able to understand theories of different optimization methods and know how to solve optimization problems by corresponding

Course objectives	Evaluation criteria				
	Course objectives achievement, average value 90-100	Course objectives achievement, average value 80-89	Course objectives achievement, average value 70-79	Course objectives achievement, average value 60-69	Course objectives achievement, average value 0-59
	Excellent	**Good**	**Middle**	**Pass**	**Fail**
methods for corresponding optimization problems	corresponding optimization methods	corresponding optimization methods	corresponding optimization methods	corresponding optimization methods	optimization methods
Course Objective 2：Familiar with establishing mathematic models of optimization problems and obtaining corresponding optimized solutions	**Proficiently** master how to build mathematic models for optimization problems and obtain optimized solutions	**Very correctly** master how to build mathematic models for optimization problems and obtain optimized solutions	**Correctly** master how to build mathematic models for optimization problems and obtain optimized solutions	**Roughly** master how to build mathematic models for optimization problems and obtain optimized solutions	**Not** able to master how to build mathematic models for optimization problems and obtain optimized solutions
Course Objective 3：Have the ability to analyze optimization problems of mechanical design and use optimization methods to get the best solutions.	**Proficiently** know how to analyze optimization problems of mechanical design and use optimization methods to get the best solutions	**Very correctly** know how to analyze optimization problems of mechanical design and use optimization methods to get the best solutions.	**Correctly** know how to analyze optimization problems of mechanical design and use optimization methods to get the best solutions.	**Roughly** know how to analyze optimization problems of mechanical design and use optimization methods to get the best solutions.	**Not** able to know how to analyze optimization problems of mechanical design and use optimization methods to get the best solutions.
Course Objective 4：Master software on Matlab well and develop the programming ability for building mathematic models and obtaining optimization solutions	**Proficiently** use Matlab to solving optimization problems of practical mechanical design	**Very correctly** use Matlab to solving optimization problems of practical mechanical design	**Correctly** use Matlab to solving optimization problems of practical mechanical design	**Roughly** use Matlab to solving optimization problems of practical mechanical design	**Not** able to use Matlab to solving optimization problems of practical mechanical design

VII. Recommended textbooks and reference materials

Textbook：

[1] Jing Min Sun and Ying Chun Liang, Optimization of Mechanical Design, China Machine Press, ISBN: 9787111566434, 2017.

Reference books:

[1] Xiao Zhong Deng and Zhi Chao Zhu, Optimization of Mechanical Design, ISBN: 9787568007627, Huazhong University of Science and Technology Press, 2015.

[2] Yan Fang Li and Fang Tian, Optimization of Mechanical Design, ISBN: 9787111584797, China Machine Press, 2018.

Online resource:

[1] http:// www.jxcad.com.cn/

[2] http:// www.simwe.com/

[3]https://ocw.mit.edu/courses/institute-for-data-systems-and-society/ids-338j-multidisciplinary-system-design-optimization-spring-2010/lecture-notes/

Teaching group: Guang Zhang Course administrator: Guang Zhang

Written by: Guang Zhang Reviewed by: Zhe Lin

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May. 01, 2021

《机械可靠性设计*》教学大纲

Mechanical Reliability Design

Course name：Mechanical Reliability Design **Course code**：31920

Course type：Major-related course (Optional)

Total teaching hours：32

Credit：2

Prerequisites: Probability Theory、Mechanics of Materials、Machine Design

Major：Mechanical design, manufacturing and automation, Mechatronics engineering, Energy and power engineering

Department: Mechanical Design & Manufacture

I. Course Introduction

The method on the mechanical reliability design is one of the modern mechanical design methods. It is a higher level of design method that the enterprises pay more and more attention. The enterprise who can manufacture the high reliability of products can survive and develop in further. The engineers who want o product higher reliability products must have the knowledge and skills about reliability design. The goal of this course is to train the students to have the concepts about the mechanical reliability design (e.g. parts, component, unite, system, sub-assemble parts), master the principles and methods. Not only this course is based on the Probability Theory、Mechanics of Materials、Machine Design, but also can further improve the ability of machine design for the students and engineers.

Made in China explores the incredible progress of Chinese industry over the last century, focused primarily on the period following the 1978 Chinese Economic Reform, better known as 'Reform and Opening-Up'. From the elementary stages of manufacturing to the innovative specialisation of today's various industries, this book charts China's development on the course to becoming one of the world's highest performing industrial powers. To promote the spirit of craftsmanship and foster a culture of craftsmanship, some case analysis are introduced in this course by using documentaries selected from 《The Pillars of a Great Power》and Craftsmen of the Nation》to illustrate why need to do and how to do reliability design.

II. Course Objectives

Course Objective 1：With reference to various global campaigns in which China has been involved, there is an underlying thread that tells of the nation's competitive growth alongside various foreign powers, which has ultimately given rise to a localised and powerful Chinese industry. Whilst recognising the multiple foreign companies that challenged China during her industrial revolution, this course gives a voice to the domestic manufacturing corporations that have truly bolstered China's industrial success to this day, and also promote the spirit of craftsmanship and foster a culture of craftsmanship.

Course Objective 2: Know the general principle and method of calculating the reliability design in reliability design, the method for deducing formula of reliability calculation of mechanical parts under the stress and the intensity distribution.

Course Objective 3: Be able to build the reliability model of a complex mechanical system by using the foundation knowledge on the reliability calculation and analysis method of parallel system, hybrid system, reserves system. Be able to do reliability prediction and reliability allocation for mechanical system. Be able to do reliability design of bolts, springs, gears, shafts, bearings and other mechanical parts with the requirements of loading and construction dimension. Be able to conduct failure mode, effect and criticality analysis for mechanical system.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Mechanical Reliability Design》

Index points of graduation requirements	Content
1.3	Know the required professional knowledge of principle and method in mechanical design to solve complex design problems in mechanical engineering.
2.1	Be able to address complex mechanical engineering problems by applying mathematics, basic principle of natural science and engineering

Table 2. The supporting relationship between the course objectives of《Mechanical Reliability Design》 and the index points of graduation requirements

Index points of graduation requirements	**1.3**	**2.1**	**1.3**	**2.1**
Course objectives	1	1	2, 3	2, 3
Intensity of support	L	L	M	M

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	Overview of Reliability Design	1. Overview of design and development of reliability Design, and some case analysis are introduced in this course by using documentaries selected from 《The Pillars of a Great Power》and Craftsmen of the Nation》 to illustrate why need to do and how to do reliability design. 2. Master the definition and characteristics of reliability, the basic concepts related to reliability;	2	Lecture	1,2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		3. Be familiar with the characteristics, content, methods and design criteria in mechanical reliability design.			
2	The mathematical basis of reliability	1. Understand random events and probability. 2. Grasp the classification and numerical characteristics of random variables. 3. Master the commonly used probability application of discrete and continuous random variables. 4. Understand the method of parameter estimation and hypothesis test.	6	Lecture	2
3	System reliability design	1.Understand the basic concepts of system reliability and system; understand the basic reliability and mission reliability model. 2.Master method of solving complex system series model, parallel model, hybrid model, reliability model and. 3.Understand the expected purpose, procedures of reliability design; master the prediction method for unit reliability and system reliability. 4. Well know the principle and method of reliability allocation.	6	Lecture	2,3
4	The principle of reliability design and reliability calculation	1. Know well the stress - strength interference theory and interference mode. 2. Can general expression of reliability calculation. 3. Know well the calculation method of reliability under the known stress and strength distribution, such as normal distribution, lognormal distribution. 4. Know well the calculation method of failure distribution and cycle life of the provisions of parts under known of stress amplitude level. 5. Master the known intensity distribution and the maximum stress amplitude in the calculation of parts under specified life reliability 6. Understand the safety coefficient of reliability 7. Understand the difference between different reliability design methods. 8. To promote the spirit of craftsmanship and foster a culture of craftsmanship, some case analysis are introduced in this course by using documentaries selected from 《The Pillars of a Great Power》and Craftsmen of the Nation》to illustrate why need to do and how to do reliability design.	8	Lecture	1,2,3
5	Reliability design of machine parts	1.Know the static strength, tensile bolt fatigue strength; master the static reliability design method and process steps. 2.Be familiar with the static strength reliability design method and steps for spring. 3.Be familiar with gear surface, the tooth root bending fatigue strength reliability design method and steps. 4.Be familiar with shaft static strength, fatigue	4	Lecture	1,2,3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		strength reliability design method and steps, 5.Be familiar with the relationship between rolling bearing life and reliability under the dynamic loading.			
6	Failure mode, effects analysis and fault tree analysis	1.Understanding of fault classification and fault rate 2.Understand the concept, characteristics, and application program in failure mode, effect and criticality analysis. 3.Master the way of setting up fault tree, qualitative analysis and quantitative calculation.	4	Lecture	1,2,3
7	Reliability test and PHM	1.Be familiar with reliability test. 2.Known the method of prognostics health management (PHM). 3. Some case analysis are introduced in this course by using documentaries selected to promote the spirit of craftsmanship and foster a culture of craftsmanship.	2	Lecture	1,2,3

V. Teaching method

1. Case-based teaching and heuristic teaching

Mechanical Reliability Design is a strong technical course which must rely to combination of theory and practice. Case-based teaching and heuristic teaching methods are used to foster the ability to think, analyze and solve problems in students and guide and encourage students to obtain knowledge through practice and self-study.

2. Teaching tool

The course are arranged in multimedia classroom teaching with blackboard-writing and multimedia.

3. Case study

Case study is used to help students understand and consolidate the important and difficult part of the course and improve the ability to analyze and solve problems. It is also a way that teacher can evaluate how well students master the contents.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives. The course objectives and the corresponding assessment methods are listed in Table 4.

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
classroom performance	Roll call	20%	Have a good attendance, listen carefully and actively interact with the teachers	1
Exercise	Assignment in exercise book	30%	Five times, not limited to the exercise in book. There is a certain degree of difficulty, including analysis, design and calculation.	1, 2

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Final examinations	Closed-book exam	60%	It is a closed-book exam. The contents are all about the 7 topics. There is a certain degree of difficulty, including analysis, design and calculation.	1, 2

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria
Usual performance	Those absence times are more than one third of the total roll call times will fail to achieve the class attendance score. Grade each usual homework and project according to the completion level and correctness. Calculate the weighted mean of the grades.
Final exam	Grade the exam according to the answer and score judgment standard.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（Usual performance）（K1）	Assessment 2（Final exam）（K2）
Percentage		0.5	0.5
Score percentage of course objective for each assessment method	Objective 1（M1）	0.2	0.4
	Objective 2（M2）	0.8	0.6

The evaluation criteria of the course objectives can be determined on the basis of assessment method, grading criteria and course objective allocation matrix, as shown in Table 7.

Table 7 Evaluation criteria of the course objectives

Course objectives	**Evaluation criteria**				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
1. Know the general principle and method of calculating the reliability design in reliability design, the method for	Understand the general principle and method of calculating the reliability design in reliability	Comprehend the general principle and method of calculating the reliability design in reliability	Apprehend the general principle and method of calculating the reliability design in reliability	Know the general principle and method of calculating the reliability design in reliability design, the method for deducing formula of	Do not know the general principle and method of calculating the reliability design in reliability design, the method for deducing

Course objectives	Evaluation criteria				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
deducing formula of reliability calculation of mechanical parts under the stress and the intensity distribution.	design, the method for deducing formula of reliability calculation of mechanical parts under the stress and the intensity distribution.	design, the method for deducing formula of reliability calculation of mechanical parts under the stress and the intensity distribution.	design, the method for deducing formula of reliability calculation of mechanical parts under the stress and the intensity distribution.	reliability calculation of mechanical parts under the stress and the intensity distribution.	formula of reliability calculation of mechanical parts under the stress and the intensity distribution.
2. Be able to build the reliability model of a complex mechanical system by using the foundation knowledge on the reliability calculation and analysis method. Be able to do reliability prediction and reliability allocation for mechanical system. Be able to do reliability design of bolts, springs, gears, shafts, bearings and other mechanical parts with the requirements of loading and construction dimension. Be able to conduct failure mode, effect and criticality analysis for mechanical system.	Can build the reliability model and reliability allocation of a complex mechanical system, do reliability design of bolts, springs, gears, shafts, bearings and other mechanical parts , conduct failure mode, effect and criticality analysis for mechanical system.	Be able to build the reliability model and reliability allocation of a complex mechanical system, to do reliability design of bolts, springs, gears, shafts, bearings and other mechanical parts , to conduct failure mode, effect and criticality analysis for mechanical system.	Understand how to build the reliability model and reliability allocation of a complex mechanical system, do reliability design of bolts, springs, gears, shafts, bearings and other mechanical parts , conduct failure mode, effect and criticality analysis for mechanical system.	Know how to build the reliability model and reliability allocation of a complex mechanical system, do reliability design of bolts, springs, gears, shafts, bearings and other mechanical parts , conduct failure mode, effect and criticality analysis for mechanical	Do not know how to build the reliability model and reliability allocation of a complex mechanical system, do reliability design of bolts, springs, gears, shafts, bearings and other mechanical parts , conduct failure mode, effect and criticality analysis for mechanical

VII. Recommended textbooks and reference materials

1. Bernd Bertsche, et al：Reliability in Automotive and Mechanical Engineering，Spring，2008.

2. Gary S. Wasserman: Reliability Verification, Testing, and Analysis in Engineering Design, Marcel Dekker, Inc, 2003;
3. 刘惟信编著：《机械可靠性设计》，机械工业出版社，1996 年出版.

Teaching group: Qingchuan HE　　Course administrator: Qingchuan HE

Written by: Qingchuan HE　　Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: Apr 30, 2021

《机器人技术及应用*》教学大纲

Robot Technology and Applications

Course name： Robot Technology and Applications **Course code：** 31923

Course type： Profession education course (Elective)

Total teaching hours： 32 (Classroom Hours: 28, Experiment Hours: 4)

Credit： 2.0

Prerequisites: Advanced Mathematics, Mechanical drawing, Theoretical Mechanics, Principles of Machinery,

Major： Mechanical design, manufacturing and automation

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

This course is a professional platform course for undergraduates majoring in mechanical engineering. The purpose of this course is to make student understand the research and development status and basic principles of robot technology, understand and preliminarily master the structural design method and control method of robot, understand the theoretical and technical difficulties in robot technology and the main research direction of robotics at present, so as to cultivate student's interest in mechanical engineering. Robotics is a multidisciplinary interdisciplinary frontier discipline, which involves mechanics, electronics, kinematics, dynamics, control theory, sensor detection, computer technology and ergonomics. It is also a course combining theory with application.

II. Course Objectives

Course Objective 1： Guide students to correctly view the gaps and development prospects in the field of science and technology at home and abroad through systematic learning of the knowledge system of the robot technology; establish a correct world view, outlook on life and values; establish a truth-seeking and pragmatic research spirit, an innovative spirit of innovation; promote patriotism, and serve the ideals and aspirations of the motherland.

Course Objective 2： Master the technical points and basic theoretical knowledge of robot mechanism design, motion analysis, control and use. Master the basic theory and knowledge of mechanism and mechanical dynamics, including basic structure of robot, overall and mechanical structure, mechanism analysis, motion analysis, dynamics analysis, Jacobian matrix, trajectory planning and control, visual sensing, etc.

Course Objective 3: Have abilities to analyze the forward and inverse kinematics of general robots. Master the technical parameters of robots, the establishment of mechanism and linkage coordinate systems, as well as abilities of kinematics and dynamics analysis with the help of existing robots in the laboratory.

Course Objective 4: Have abilities to understand the basic concepts and methods of mathematics and mechanics in robot operation. Have abilities to use the basic theory and professional knowledge to carry out innovative design, habits of comprehensive analysis and consideration of problems, and abilities to analyze, judge and make decisions on things. Have a scientific attitude, innovative consciousness and team spirit.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Robot Technology》

Index points of graduation requirements	**Content**
1.3	Have the ability to deduce the mathematical model to the engineering model of complex engineering problems in the field of mechanical engineering.
2.3	Be able to correctly describe the solution of a complex engineering problem in mechanical engineering, and analyze the rationality of the scheme by using the basic principles.
3.1	Understand the current situation and development trend of the frontier of mechanical engineering, familiar with the basic process of research and development of new products, new processes, new technologies and new equipment, and have the attitude and consciousness of pursuing innovation in solving complex engineering problems in the field of mechanical engineering.
8.2	Understand the core values of socialism and national conditions; safeguard national interests; have a sense of responsibility to promote national rejuvenation and social progress.

Table 2. The supporting relationship between the course objectives of《Robot Technology》and the index points of graduation requirements

Index points of graduation requirements	1.3	2.3	3.1	8.2
Course objectives	2	3	4	1
Intensity of support	M	L	M	L

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	1. Introduction (1) Basic concepts, development history and classification of robots (2) Application of robot technology	1. Introduce the knowledge system framework of this course, teaching objectives, graduation requirements, position in the curriculum system of the major, teaching content, assessment methods and score ratio; 2. Understand the basic concept, history and classification of robots; 3. Understand the application of robot technology. 4. Guide students to correctly view the gap and development prospects of robots at home and abroad; promote patriotism and cultivate students to establish a scientific and technological power of the country.	2	Lecture	1,4
2	2. Overall and structure design of robot (1) Basic composition and technical parameters of robot (2) Overall design of robot (3) Design of robot mechanical system (4) Design of robot transmission parts (5) Design of robot walking mechanism (6) Design of robot body, arm, wrist, and hand	1. Understand the basic composition and technical parameters of robot; 2. Master the overall design of the robot and the design of each part. 3. Establish the spirit of seeking truth and being pragmatic, and the spirit of innovation by learning the overall design and composition of the robot.	4	Lecture	1,2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
3	3. Robot kinematics (1) Pose description of rigid body (2) Coordinate transformation (3) Homogeneous coordinates and homogeneous transformation (4) Common coordinate systems and transformation equation of robot (5) Euler transformation and RPY transformation (6) Links parameters of robot and its D-H coordinate transformation (7) Kinematics equations of robot (8) Inverse kinematics of robot	1. Master the method of description of the robot's position and orientation; 2. Master the robot kinematics analysis method; 3. Master D-H method; 4. Master the inverse kinematics of robot.	6	Lecture	2,3,4
4	4. Differential motion and Jacobian matrix (1) Definition of Jacobian matrix (2) Construction of Jacobian matrix (3) Inverse Jacobian matrix and singularity (4) Force Jacobian	1. Master the definition of Jacobian matrix; 2. Master Jacobian matrix modeling method; 3. Master the definition and analysis method of robot singularity; 4. Master the definition and analysis of force Jacobian matrix.	4	Lecture	2,3,4
5	5. Robot dynamics (1) Newton-Euler equation of motion (2) Lagrange dynamics (3) Joint space and operation space dynamics	1. Master the Newton-Euler method of dynamic analysis; 2. Understand the Lagrange method; 3. Master the dynamic modeling method of joint space and operation space.	4	Lecture	2,3,4
6	6. Robot trajectory planning (1) Basic concepts of robot planning (2) Joint space method (3) Rectangular coordinate space method	1. Understand the basic concepts of robot planning; 2. Master the joint space method; 3. Master the rectangular coordinate space method.	4	Lecture	2,4
7	7. Robot control (1) Concept and structure of robot control system (2) Concept and principle of independent joint control, speed control and force control (3) Teaching control method	1. Understand the concept and structure of robot control system; 2. Understand the concept and principle of independent joint control, speed control and force control; 3. Understand the teaching control method.	2	Lecture	2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
8	8. Robot sensing and vision technology (1) Sensor classification (2) Characteristics and functions of internal sensors and external sensors (3) Basic principles of vision system (4) Image generation model and primary processing technology	1. Understand the sensor classification; 2. Understand the characteristics and functions of internal sensors and external sensors; 3. Understand the basic principle of vision system; 4. Understand image generation model and primary processing technology.	2	Lecture	2
9	9. Robot experiment (1) Kinematics experiment (2) Dynamics experiment	1. Master analysis methods of robot kinematics; 2. Master analysis methods of robot dynamics. 3. Cultivate students' research character: perseverance in adversity, arduous exploration; promote the spirit of craftsman.	4	Experiment	1,2,3

V. Teaching method

The course mainly lectures, supplemented by classroom discussion, in class experiments and homework.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives, reflecting the achievement degree of students' ability training objectives. The assessment methods are shown in Table 4.

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	In class questions	10%	It mainly assesses students' understanding and mastery of basic knowledge and skills. Evaluate students' participation in answering questions, class discussion and participation in class discussion. 10% of the average score is included in the total score of the course.	1、2、3、4
	routine homework	20%	It mainly tests the students' understanding and mastery of knowledge in each class. Calculate the average score of all assignments, and then calculate 30% into the total score.	1、2、3、4

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
	Experiment	10%	It mainly assesses students' mastery of robot kinematics simulation and dynamics simulation	1、2、3、4
Final report	Report score	60%	It mainly tests the students' mastery of robot mechanical design, kinematics and dynamics analysis, trajectory planning and control, as well as their proficiency in robot application, the ability to analyze problems through various technical means, and the ability to express in writing. The format and framework of the paper are 10 points, the mastery of knowledge is 60 points, and the ability to analyze problems is 30 points. 60% of the report score are included in the total course score	1、2、3、4

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Standard for evaluation
In class questions	According to the condition of question answer, there will be five levels：Excellence (90-100), good (80-89), normal (70-79), pass (60-69), fail (below 60). Adjust the score depending on the class attendance.
Routine homework	According to the condition of homework, there will be five levels: Excellence (90-100), good (80-89), normal (70-79), pass (60-69), fail (below 60).
Experiment	According to the experiment performance and reports, there will be five levels: Excellence (90-100), good (80-89), normal (70-79), pass (60-69), fail (below 60).
Final report	According to the completion of the report, score according to the rules.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（In class questions）（K1）	Assessment 2（Routine homework）（K2）	Assessment 3（Experiment）（K3）	Assessment 4（Final report）（K4）
The proportion of assessment methods in the total score		0.10	0.20	0.1	0.60
Score percentage of course	Objective 1（M1）	0.2	0.1	0.2	0.3
	Objective 2（M2）	0.3	0.3	0.4	0.2

		Assessment 1（In class questions）（K1）	Assessment 2（Routine homework）（K2）	Assessment 3（Experiment）（K3）	Assessment 4（Final report）（K4）
objective for each assessment method	Objective 3（M3）	0.2	0.3	0.4	0.2
	Objective 4（M4）	0.3	0.3	0	0.3

The evaluation criteria of the course objectives can be determined on the basis of assessment method, grading criteria and course objective allocation matrix, as shown in Table 7.

Table 7 Evaluation criteria of the course objectives

Course objectives	**Evaluation criteria**				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
Guide students to correctly view the gaps and development prospects in the field of science and technology at home and abroad through systematic learning of the knowledge system of the robot technology; establish a correct world view, outlook on life and values; establish a truth-seeking and pragmatic research spirit, an innovative spirit of innovation; promote patriotism, and serve the ideals and aspirations of the motherland.	Have excellent robot kinematics and dynamics analysis ability, independent thinking ability; can accurately find and reasonably analyze the gap and development prospects in the field of science and technology at home and abroad; fully establish a truth-seeking spirit; promote patriotism, and serve and ambitions of the motherland.	Have better robot kinematics and dynamics analysis ability, independent thinking ability; can accurately find and reasonably analyze the gap and development prospects in the field of science and technology at home and abroad; can establish a truth-seeking spirit; promote patriotism, and serve and ambitions of the motherland.	Have certain robot kinematics and dynamics analysis ability, independent thinking ability; find and analyze the gap and development prospects in the field of science and technology at home and abroad; establish a truth-seeking spirit; promote patriotism, and serve and ambitions of the motherland.	Have the basic robot kinematics and dynamics analysis ability, independent thinking ability; can accurately find and analyze the gap and development prospects in the field of science and technology at home and abroad.	Do not have the robot kinematics and dynamics analysis ability, independent thinking ability; can accurately find and analyze the gap and development prospects in the field of science and technology at home and abroad.

Course objectives	Evaluation criteria				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
Master the technical points and basic theoretical knowledge of robot mechanism design, motion analysis, control and use. Master the basic theory and knowledge of mechanism and mechanical dynamics, including basic structure of robot, overall and mechanical structure, mechanism analysis, motion analysis, dynamics analysis, Jacobian matrix, trajectory planning and control, visual sensing, etc.	Very well master the technical points and basic theoretical knowledge of robot mechanism design, motion analysis, control and use. Master the basic theory and knowledge of mechanism and mechanical dynamics, including basic structure of robot, overall and mechanical structure, mechanism analysis, motion analysis, dynamics analysis, Jacobian matrix, trajectory planning and control, visual sensing, etc.	Well master the technical points and basic theoretical knowledge of robot mechanism design, motion analysis, control and use. Master the basic theory and knowledge of mechanism and mechanical dynamics, including basic structure of robot, overall and mechanical structure, mechanism analysis, motion analysis, dynamics analysis, Jacobian matrix, trajectory planning and control, visual sensing, etc.	Master the technical points and basic theoretical knowledge of robot mechanism design, motion analysis, control and use. Master the basic theory and knowledge of mechanism and mechanical dynamics, including basic structure of robot, overall and mechanical structure, mechanism analysis, motion analysis, dynamics analysis, Jacobian matrix, trajectory planning and control, visual sensing, etc.	Roughly master the technical points and basic theoretical knowledge of robot mechanism design, motion analysis, control and use. Master the basic theory and knowledge of mechanism and mechanical dynamics, including basic structure of robot, overall and mechanical structure, mechanism analysis, motion analysis, dynamics analysis, Jacobian matrix, trajectory planning and control, visual sensing, etc.	Fail to master the technical points and basic theoretical knowledge of robot mechanism design, motion analysis, control and use. Master the basic theory and knowledge of mechanism and mechanical dynamics, including basic structure of robot, overall and mechanical structure, mechanism analysis, motion analysis, dynamics analysis, Jacobian matrix, trajectory planning and control, visual sensing, etc.
Have abilities to analyze the forward and inverse kinematics of general robots, master the technical	Have excellent abilities to analyze the forward and inverse kinematics of general	Have good abilities to analyze the forward and inverse kinematics of general robots, good	Have abilities to analyze the forward and inverse kinematics of general robots, master the technical	Basically have abilities to analyze the forward and inverse kinematics of general robots, basically master	Fail to have abilities to analyze the forward and inverse kinematics of general robots, failed to master

Course objectives	Evaluation criteria				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
parameters of robots, the establishment of mechanism and linkage coordinate system, and have abilities of kinematics and dynamics analysis with the help of existing robots in the laboratory.	robots, excellent master the technical parameters of robots, the establishment of mechanism and linkage coordinate system, and have excellent abilities of kinematics and dynamics analysis with the help of existing robots in the laboratory.	master the technical parameters of robots, the establishment of mechanism and linkage coordinate system, and have good abilities of kinematics and dynamics analysis with the help of existing robots in the laboratory.	parameters of robots, the establishment of mechanism and linkage coordinate system, and have abilities of kinematics and dynamics analysis with the help of existing robots in the laboratory.	the technical parameters of robots, the establishment of mechanism and linkage coordinate system, and basically have abilities of kinematics and dynamics analysis with the help of existing robots in the laboratory.	the technical parameters of robots, the establishment of mechanism and linkage coordinate system, and fail to have abilities of kinematics and dynamics analysis with the help of existing robots in the laboratory.
Have abilities to understand the basic concepts and methods of mathematics and mechanics in robot operation; Have the ability to use the basic theory and professional knowledge to carry out innovative design; Have habits of comprehensive analysis and comprehensive consideration of problems; Have abilities to analyze, judge and make decisions on things; Have a	Have excellent abilities to understand the basic concepts and methods of mathematics and mechanics in robot operation; Have the excellent ability to use the basic theory and professional knowledge to carry out innovative design; Have excellent habits of comprehensive analysis and comprehensiv	Have good abilities to understand the basic concepts and methods of mathematics and mechanics in robot operation; Have the good ability to use the basic theory and professional knowledge to carry out innovative design; Have good habits of comprehensive analysis and comprehensive	Have abilities to understand the basic concepts and methods of mathematics and mechanics in robot operation; Have the ability to use the basic theory and professional knowledge to carry out innovative design; Have habits of comprehensive analysis and comprehensive consideration of problems; Have abilities	Basically have abilities to understand the basic concepts and methods of mathematics and mechanics in robot operation; Basically have the ability to use the basic theory and professional knowledge to carry out innovative design; Basically have habits of comprehensive analysis and comprehensive consideration of problems; Basically have abilities to analyze, judge and make decisions on	Do not have abilities to understand the basic concepts and methods of mathematics and mechanics in robot operation; Do not have the ability to use the basic theory and professional knowledge to carry out innovative design; Do not have habits of comprehensive analysis and comprehensive consideration of problems; Do not have abilities to analyze, judge

Course objectives	Evaluation criteria				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
scientific attitude, innovative consciousness and team spirit.	e consideration of problems; Have excellent abilities to analyze, judge and make decisions on things; Have a excellent scientific attitude, innovative consciousness and team spirit.	consideration of problems; Have good abilities to analyze, judge and make decisions on things; Have a good scientific attitude, innovative consciousness and team spirit.	to analyze, judge and make decisions on things; Have a scientific attitude, innovative consciousness and team spirit.	things; Basically have a scientific attitude, innovative consciousness and team spirit.	and make decisions on things; Do not have a scientific attitude, innovative consciousness and team spirit.

VII. Recommended textbooks and reference materials

Textbook：

Introduction to robotics mechanics and control, John Craig, China Machine Press, 2018

Reference books：

Tsai, L.W. (1999) Robot Analysis: The Mechanics of Serial and Parallel Robots. John Wiley & Sons, New York.

Edited by Zhu Shiqiang, Wang Xuanyin. Robot Technology and its Application, 2nd Edition, Zhejiang University Press, 2018.

Teaching group： Fan Wang　　Course administrator：Fan Wang

Written by: Fan Wang　　Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 22, 2021

《材料力学实验*》教学大纲

Materials Mechanics Experiment

Course Name: Experiments for Mechanics of Materials **Course Code** :31925
Course Type: professional education (compulsory)
Total teaching hours :16 hours
Credit :0.5
Prerequisite Course: Mechanics of Materials
Major: Mechanical design and manufacture and automation, energy and power engineering
Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

《Materials Mechanics Experiment》 is an important part of the material mechanics course system and an important practical teaching link. This course mainly includes metal material tensile experiment, metal material torsion experiment, basic strain electrical measurement method, bending normal stress test experiment of uniform cross-section beam (1/4 bridge, half bridge and full bridge), the main bending and torsion combined deformation. The main direction of stress test experiment, strain gage pasting and welding experiment, the test experiment of equal-strength beam, etc. Its purpose is to enable students to master the mechanical properties and measurement methods of solid materials under various loads, verify the theory and calculation formulas of material mechanics, and use what they have learned to design experiments. Cultivate students' scientific and rigorous work attitude and the spirit of cooperation and mutual assistance in the experiment.

II. Course Objectives

Course Objective 1: The experiment is grouped and teamwork, Mind and Hand is encouraged. Through experiments, students will cultivate a scientific and rigorous work attitude and a pragmatic spirit of seeking truth from facts.

Course objective 2: Understand some basic concepts in material mechanics experiment, master the basic principles, properties and test methods, be able to correctly deal with data, analyze the phenomena and reasons in the experiment. Experiments can be designed and verified by the resistance strain measurement method.

III. Graduation Requirements Supported by Curriculum Teaching Objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by ***Materials Mechanics Experiment***

Index points of graduation requirements	**Content**
4.1	Master the test and experimental methods of complex mechanical systems, including force, deformation, motion, heat, etc., master the relevant basic principles.
9.3	Possess certain organizational and management skills, can reasonably formulate work plans, assign tasks according to the knowledge and ability characteristics of team members, and coordinate to complete work tasks.

Table 2 The Support Relationship between the Teaching Objectives of ***Material Mechanics Experiment*** and the Index Points of Supporting Graduation Requirements

Index points of graduation requirements	**4.1**	**9.3**
Curse objectives	2	1
Intensity of support	H	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Serial number	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching methods**	**Corresponding Teaching objectives**

Serial number	Course content	Teaching requirements	Teaching hours	Teaching methods	Corresponding Teaching objectives
1	1. Tensile testing of metallic terials (1) .Determination of Strength and Plastic Properties of mild Steel during Tension: Lower Yield Strength σ_{eL}、Tensile strength σ_m、Elongation A 、reduction of area Z (2).Determine the strength performance index of gray cast iron when it is stretched: tensile strength σ_b. (3). Compare the mechanical properties and failure modes of low carbon steel and gray cast iron during stretching.	1.Observe and explain the stretching phenomenon of metal materials; judge the plasticity and brittleness of metal materials; 2.Learn to test the yield strength of low carbon steel σ_{eL}, tensile strength σ_m elongation A, section shrinkage Z and the tensile strength of cast iron σ_b; and draw the tensile curves of the two materials. 3. Be able to collect, process, calculate and analyze data. 4. In the experiment, students' scientific and rigorous working attitude and cooperative spirit are cultivated.	2	Experiment	1，2
2	2 Torsion experiment of metal materials (1) Determination of the strength performance indicators of metal materials during torsion: the yield strength under torsion τ_{eL} and torsion strength τ_m of low carbon steel; the torsion strength τ_b of gray cast iron. (2) Draw the fracture diagrams of low-carbon steel and gray cast iron, and compare the torsion failure modes of low-carbon steel and gray cast iron.	1. Observe and explain the torsion phenomenon of metal materials; judge the characteristics of plasticity and brittleness of metal materials; 2. Learn to test the torsional yield strength τ_{eL} and torsional strength τ_m of low carbon steel and the torsional strength τ_b of cast iron; and draw the torsion curve diagrams of the two materials. 3. Be able to collect, process, calculate and analyze data. 4. In the experiment, students' scientific and rigorous working attitude and cooperative spirit are cultivated.	2	Experiment	1，2

Serial number	Course content	Teaching requirements	Teaching hours	Teaching methods	Corresponding Teaching objectives
3	3 The basics of resistance strain measurement method and the use of strain gauges (1) Learn the principle of resistance strain measurement method (2) Learn the principle of strain gauge (3) Learn the use of strain gauges	1. Learn the basics of resistance strain measurement method and the principle of strain bridge; 2. Learn the principle and use of strain gauges. 3. Master the three wiring methods of strain gauges in the bridge; 4. In the experiment, students' scientific and rigorous working attitude and cooperative spirit are cultivated.	2	Experiment	1，2
4	4 Test of normal stress in bending of rectangular section beam (1/4 bridge) (1) Be familiar with the basic principles of resistance strain measurement method and the use of static resistance strain gauges. (2) Measure the normal stress distribution on the cross section of a rectangular cross-section beam during pure bending and transverse force bending. (3) Skilled 1/4 bridge.	1. Conduct force analysis on rectangular cross-section beams; grasp the feelings of pure bending and transverse bending of rectangular cross-section beams. 2. Learn to use theoretical formulas to calculate the bending moment and normal stress on the cross section of a rectangular cross-section beam in pure bending and transverse bending; 3. Master the method of 1/4 bridge connection, use strain gauge to collect strain data; calculate experimental stress. And calculate the error with the theoretical value. 4. In the experiment, students' scientific and rigorous working attitude and cooperative spirit are cultivated.	2	Experiment	1，2
5	5.Test of bending normal stress of rectangular section beam (half bridge and full bridge) (1) Be familiar with the basic principles of resistance strain measurement method and the use	1. Familiar with the use of resistance strain gauges, master the half-bridge and full-bridge wiring methods to measure strain values. 2. The experimental stress will	2	Experiment	1，2

Serial number	Course content	Teaching requirements	Teaching hours	Teaching methods	Corresponding Teaching objectives
	of static resistance strain gauges. (2) Measure the normal stress distribution on the cross section of a rectangular cross-section beam during pure bending and transverse force bending. (3) Proficiency in half-bridge and full-bridge.	be calculated based on the experimental strain value. And calculate the error with the theoretical value. 3. Cultivate students' scientific and rigorous work attitude and improve the ability of teamwork. 4. training team work together.			
6	6 Determination of the principal direction of the principal stress in the combination of bending and torsion (1).Use resistance strain gauges to determine the magnitude and direction of the principal stress at a point in the plane stress state; (2).Understand the application of strain analysis theory under plane stress in experiments; (3).Further familiarize with resistance strain gauge measuring bridge circuit and static multi-point strain measuring method.	1. Learn the force analysis and theoretical calculation of a point in the combined state of bending and torsion. 2. Learn to use resistance strain gauges to determine the magnitude and main direction of the principal stress at a point in a plane stress state; 3. In the experiment, students' scientific and rigorous working attitude and cooperative spirit are cultivated.	2	Experiment	1，2
7	7 Strain gauge pasting and welding experiment (1) Preliminary mastery of the pasting technology of strain gauges; (2) Learn the general method of patch quality inspection.	1. Learn the strain gauge paste technology; 2. Learn to check the quality of strain gauge paste process; 3. Practice the pasting technique of strain gauge and wire welding technique. 4.In the experiment, students' scientific and rigorous working attitude and cooperative spirit are cultivated.	2	Experiment	1、2

Serial number	Course content	Teaching requirements	Teaching hours	Teaching methods	Corresponding Teaching objectives
8	8.Test experiment of equal strength beam (1) Question: What is an equal-strength beam? Use mathematical methods to prove the definition of equal-strength beams. (2). Question: How to find the elastic modulus E of a beam of equal strength? (3). Question: The definition and formula of Poisson's ratio μ. (4).Use electrical measurement to find E and μ, and verify the equal-strength beam. Design patch scheme and bridge design. (5). According to E and μ, determine the material and grade of the equal strength beam. (6) Measure the weight P of the weight to be measured by electrical measurement.	1. Questions inspire students to think. 2. Encourage group discussion, design plans, continuous improvement and in-depth. 3.Plan analysis and determination, and select the appropriate bridge. 4.In the experiment, students' scientific and rigorous working attitude and cooperative spirit are cultivated.	2	Experiment	1、2

V. Teaching method

1. Online class preview and review. Let students be prepared and expand.

2. Classroom experiment explanation and demonstration, supplemented by inspiration and discussion. Student group experiments, everyone uses their hands and brains to solve problems cooperatively.

VI. Assessment

The course assessment of ***Material Mechanics Experimen***tis to evaluate the degree of students' achievement of the course teaching goal and to reflect the degree of achievement of the students' ability training goal. The specific assessment methods, proportion and corresponding teaching objectives of the course are shown in Table 4 below.

Table 4 Course objectives and assessment methods

Score carегory	Assessment methods	percentage	Assessment details	Corresponding objectives
Usual grades	Preview	5%	It mainly assesses students' learning attitude and understanding and mastering degree of basic knowledge of material mechanics experiment.	1
	Operation	35%	The main assessment of the students' attitude towards the experiment and the grasp of the basic operation of the experiment.	1
Reporting achievements	Report	60%	It mainly assesses students' experimental data processing and analysis abilities, as well as in-depth thinking on the design of experimental schemes.	2

The grading criteria of each examination link in the course of Material Mechanics Experiment are as follows: Table 5.

Table 5 Rating Criteria for Assessment Methods

Assessment methods	Grading criteria
Usual grades	A five-level system is adopted combined with attendance, preview and operation on a comprehensive considerations.
Experimental report score	A five-level system is adopted, and scores are based on the reference answers and scoring rules in the experimental report.

The distribution matrix of the assessment method and the course objective of ***Material Mechanics Experiment***is given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1(Usual grades**) K1**	**Assessment 2(**Experimental report score**) K2**
Percentage		0.4	0.8
Score percentage of course objective for each assessment method	Objective 1(M1)	1	0
	Objective 2(M2)	0	1

VII. Recommended textbooks and reference materials

(I) Textbooks:

Wei Yimin et al. Experiments on Mechanics of Materials (Bilingual Edition). Wuhan: Huazhong Science and Technology Press, 2019.

(2) Reference books:

[1] Deng Zongbai. Material mechanics experiment and training. Beijing: Higher Education Press, 2014.

[2] Yang Xupu. Engineering Mechanics Experiment. Beijing: China Railway Publishing House, 2018.

[3] Liu Hongwen. Experimental Study on Mechanics of Materials. Beijing: Higher Education Press, 2017.

[4] Shu Delin, Ed. Mechanical properties of engineering materials. Beijing: China Machine Press, 2017.

[5] Gu Bin, Ed. Experimental guidance and basic training of material mechanics; Beijing: Beijing Institute of Technology Press, 2016

[6] GB/T 228.1-2010. Metallic materials tensile test part 1: room temperature test method.

[7] GB/T 10128-2007. Room temperature torsion test method for metallic materials.

[8] GB/T 13992-2010 Metal Pasted Resistance Strain Gauge.

(III) Network resources :(the website of the course or links to major network resources)

材料力学实验* (chaoxing.com)

Teaching group:Wei Yimin, Li Jianmin,Chen huanguo, Zhou Xun, Le Zhongping

Course administrator: Wei Yimin

Written by: Le Chung Ping Reviewed by: Jianmin Li

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 21, 2021

《机械基础实验 1*》教学大纲

Experiments on Basic Machinery 1

Course Name： Experiments on Basic Machinery 1   **Course code：** 31926

Course Type： Basic Course (Compulsory)

Total Teaching Hours： 16

Course Credit： 0.5

Prerequisites: Principle of mechanical parts

Major： Mechanical design, manufacturing and automation, Mechatronics engineering, Energy and power engineering

Department: Mechanical basis experimental teaching demonstration center

I. Course Introduction

Experiments on Basic Machinery 1 is a professional basic course experiment supporting mechanical principles, verifying and deepening the understanding and consolidating the theoretical knowledge learned, and improving students' practical ability, comprehensive quality, and design innovation ability. It is an important practical link for students majoring in mechanical and near-machine majors.

This course mainly includes three types of experiments: the first is a basic experiment (including validation and cognitive experiment), which is a verification experiment of theoretical knowledge in the classroom, including typical mechanical cognition experiments, mapping and analysis experiments of mechanism motion diagrams, measurement experiments of involute spur gear parameters, and mechanism motion parameters measurement experiments; The second is the comprehensive experiment, which is the ductility experiment of classroom theoretical knowledge, including the dynamic balance experiment of rotary members, unit operation and flywheel adjustment experiment. The third kind of experiment is the comprehensive innovative experiment, including the creative design simulation experiment of mechanism motion scheme.

The teaching purpose of this course is to enable students to master the basic laws and research methods of mechanical principles such as mechanism motion diagrams, mechanism kinematics and dynamics, and characteristics of commonly used mechanisms, so that students can initially learn to apply mechanical principles and methods to analyze and solve engineering Practical problems and lay the foundation for follow-up related courses.

Besides the basic teaching content, the course combines the explanation of the professional quality, professional ethics of the mechanical equipment design and manufacturing talents in the socialist modernization construction. During the experiment, students are guided to form a careful and rigorous attitude to the experiment operation, help students to establish their learning goals, further establish professional awareness and confidence, and set up the goal of striving for the modernization of the motherland as a qualified engineer in the future.

II. Course Objectives

Course objective 1: To understand the gap of technology and talents at home and abroad in the field of mechanical design and manufacturing, and to be aware of the "craftsman spirit" is of great importance to the development of China's machinery industry. Students should establish a serious, rigorous, hardworking, studious and diligent professional quality to better serve China's goal of accelerating the development of advanced manufacturing industry, and building an advanced manufacturing power, establish good study habits and attitude, and make contributions to the better construction of the motherland.

Course objective 2: Under the requirements of the experimental instruction book and the guidance of the teacher, understand and master relevant experimental measurement techniques, principles and methods, and experimental skills, be able to proficiently use related experimental equipment and equipment, and complete the entire experimental process in accordance with the established or actively designed experimental procedures. And use experimental equipment to collect raw data.

III. Graduation requirements supported by course objectives

The graduation requirements index points supported by this course are shown in Table 1, and the supporting relationship of the course teaching objectives to the index points supporting graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by "Experiments on Basic Machinery 1"

Index points of graduation requirements	**Content**
4-2	Able to comprehensively apply the scientific principles learned, design experiments according to research needs, conduct experiments according to reasonable steps and obtain data.

Table 2. The supporting relationship between the course objectives of "Experiments on Basic Machinery 1"and the index points of graduation requirements

Index points of graduation requirements	**4-2**
Course objectives	1
Intensity of support	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Number	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	1 Typical mechanical cognition (1) To understand the structure and operation principle of each part of rapier loom through the virtual cognition software of textile equipment (2) To get the working principle of weft insertion mechanism or beating mechanism	1. Recognize the function of weft insertion mechanism or beating mechanism in rapier loom. 2. Draw the movement diagram of weft insertion mechanism or beating up mechanism, and expound the adjustment method of rapier head stroke to adapt to different door width or explain the influence of different conjugate cams on the motion parameters of reed. 3. Understand the important position of textile machinery in the national economy, and the development of our school from the former silk Institute of technology to now, stimulate students' enthusiasm for loving our school and devoting themselves to the development of China's machinery industry.	2	Experiment	1
2	2 Mapping and analysis of mechanism motion diagrams (1) Drawing method of mechanism motion diagram (2) Analysis of the structure of the mechanism and the split of the rod group	1. Draw the movement diagrams of four kinds of mechanisms: jaw crusher, eccentric slide valve pump, cross slide coupling and sewing machine cloth feeding mechanism. 2. Analyze and verify the degree of freedom of the organization to determine whether there is a definite movement. 3. Conduct structural analysis of the organization.	2	Experiment	1
3	3 Determination of the parameters of involute spur gears (1) How to use surveying and mapping tools (2) Measurement of the length of the common normal (3) Calculation method of gear parameters	1. Grasp the relationship between the geometric parameters of the gear. 2. Master the method of measuring gears with simple measuring tools. 3. To understand the preciseness of measurement work, guide students to discuss "craftsman spirit", stimulate students' sense of mission and thinking of doing things seriously.	2	Experiment	1

Number	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
4	4 Dynamic balance of rotating components (1) The concept of dynamic balance (2) Design calculation of allowable uneven quality (3) The use of hard support dynamic balancing machine	1. Consolidate the concept of dynamic balance of rotating components. 2. Grasp the principle and operation method of the hard-supported dynamic balancing machine, and understand the principle of the sensor on the dynamic balancing machine. 3. The test piece is balanced on the hard-supported dynamic balancing machine to achieve the required balance accuracy.	2	Experiment	1
5	5 Determination of mechanism motion parameters (1) Build crank slider, crank guide rod and flat-bottomed cam mechanism on the test bench (2) Measure the displacement, speed and acceleration curve of the kinematics of the mechanism	1. Master the measurement methods of the displacement, speed and acceleration of the crank slider, crank guide rod and flat-bottomed cam mechanism. 2. Understand the working principles of various sensors such as gratings and angular displacement sensors.	2	Experiment	1
6	6 Unit operation and flywheel adjustment (1) The principle of the flywheel regulating the smooth operation of the unit (2) Load adjustment and flywheel disassembly (3) Measurement of the uneven rate of unit speed (4) Design of flywheel	1. Understand the reasons for the speed fluctuations of the unit during stable operation, and understand the principle of flywheel speed regulation. 2. Understand the movement law of the unit during starting and stopping. 3. Observe the unevenness of the speed of the unit under different load conditions with and without a flywheel. 4. Use the experimental data to calculate the equivalent moment of inertia of the flywheel, and design the flywheel reasonably.	2	Experiment	1
7	7 Simulation experiment of creative design of mechanism movement scheme (1) Selection and connection of mechanism components (2) Selection and connection of mechanism motion pair	1. Deepen students' understanding of the principles of organization, especially the concept of clubs. 2. Use several different rod groups to splice different plane mechanisms. 3. According to the design mechanism plan, draw the mechanism movement diagram, carry on the mechanism structure analysis and	4	Experiment	1

Number	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	(3) Analysis of pole group	innovation. 4. Through group discussion on the idea of institutional innovation, guide students to be diligent in research, willing to work and brave in innovation, and stimulate the enthusiasm of students to serve China and accelerate the development of advanced manufacturing industry.			

V. Teaching method

Explore and improve teaching methods, advocate heuristic, discussion, and research teaching, avoid emphasizing experimental results and process, and highlight the cultivation of students' engineering ability and innovative consciousness.

Course teaching is mainly in-class, and the specific content is as follows.

In-class teaching: experiment

In teaching methods, traditional teaching and modern teaching methods are combined. In addition to live demonstrations of experimental equipment in the classroom, the use of broadcast courseware enables students to have a deeper understanding of experimental principles. For the comprehensive design experiment, introduce a variety of new teaching methods such as "referring to formal", "heuristic", "discussion", "problem inquiry", etc., so that students can gradually form a combination of independent, cooperative, and research methods The learning method effectively improves students’ learning enthusiasm and learning quality.

VI. Assessment

"Experiments on Basic Machinery 1" course assessment is to evaluate the degree to which students have reached the teaching goals of the course, reflecting the degree of achievement of students' ability training goals. The specific assessment methods, proportions and corresponding teaching objectives of the courses are shown in Table 4.

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives

Usual grades	Classroom performanc e	40%	It mainly assesses students' ability to clarify experimental tasks and complete experiments in teamwork. The usual results are comprehensively given according to the attendance rate, participation, experimental results, participation in discussions, and experimental arrangement of students in classroom experiments.	1
Report grades	Experiment report after class	60%	It mainly assesses students' ability to understand the principles of experimental theory, the ability to analyze experimental data, and the ability to think about experiments. The results of the experimental report are comprehensively given based on the timeliness of the experimental report submitted by students after class, experimental data, data analysis and thinking, etc.	1

The grading standards for each assessment link of the "Experiments on Basic Machinery 1" course are shown in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria
Classroom performance	Adopting a hierarchical system, according to the experiment process, the selection of experimental components, the construction and debugging of the experimental platform, points are given as appropriate. Can complete the experimental operation quickly and accurately and meet the experimental requirements, excellent (90-100); can complete the experimental operation quickly and meet the experimental requirements, good (80-89); can basically complete the experimental operation and experimental requirements after guidance , Moderate (70-79); Pass (60-69) for those who can complete the basic operation and experimental requirements after instruction; fail (<60) for those who cannot complete the experimental operations.
Experiment report after class	Adopting a hierarchical system, able to submit experimental reports in time after class, detailed and reliable experimental data, capable of in-depth data analysis and thinking, excellent (90-100); able to submit experimental reports in time after class, detailed experimental data, data analysis and Thinking, good (80-89); submitting the experiment report after class, the experimental data is basically detailed, and some data analysis and thinking have been carried out, medium (70-79); there are delays in the submission of the experiment report after class, and the experimental data is basically complete. Those who have not conducted data analysis and thinking will pass (60-69); those who have delayed submitting the experiment report after class, lack of experimental data, and have not conducted data analysis and thinking will fail (<60).

Refer to Table 6 for the score distribution matrix of "Experiments on Basic Machinery 1" course assessment methods and course objectives.

Table 6 Assessment methods and score allocation matrix

	Assessment 1 (usually) K1	**Assessment 2 (report) K2**

The proportion of assessment methods in the total score		0.4	0.6
The proportion of course objectives in each assessment	Course Objective 1 (M1)	0.2	0
	Course Objective 2 (M2)	0.8	1

According to the course assessment method, grading standard and course objective distribution matrix of "Experiments on Basic Machinery 1", the evaluation standard of the achievement of course teaching objectives can be determined as shown in Table 7.

Table 7 Evaluation criteria of the course objectives

Course objectives	**Evaluation criteria**				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
To understand the gap of technology and talents at home and abroad in the field of mechanical design and manufacturing, and to be aware of the "craftsman spirit" is of great importance to the development of China's machinery industry. Students should establish a serious, rigorous, hardworking, studious and diligent professional quality to better serve China's goal of accelerating the	Have a deep understanding of the important role of "craftsman spirit" in the development of China's machinery industry, the key role of establishing the habits of being serious, rigorous, hardworking, studious and diligent in cultivating professional quality, and have excellent learning habits and	Have a better understanding of the important role of "craftsman spirit" in the development of China's machinery industry, and the key role of establishing the habit of being serious, rigorous, hardworking, studious and	Recognize the important role of "craftsman spirit" in the development of China's machinery industry, the key role of establishing the habits of being serious, rigorous, hardworking, studious and diligent in cultivating professional	Basically realize the important role of "craftsman spirit" in the development of China's machinery industry, the key role of establishing the habits of being serious, rigorous, hardworking, studious and diligent in cultivating	Don’t realize the important role of "craftsman spirit" in the development of China's machinery industry, the key role of establishing the habits of being serious, rigorous, hardworking, studious and

development of advanced manufacturing industry, and building an advanced manufacturing power, establish good study habits and attitude, and make contributions to the better construction of the motherland.	handling situations.	diligent in the cultivation of professiona l quality, and have a better learning habit and degree of handling affairs.	quality, and have good learning habits and handling situations.	professiona l quality, and have basic learning habits and handling situations.	diligent in cultivating profession al quality, and have no learning habits and handling situations.
Under the requirements of the experimental instruction book and the guidance of the teacher, understand and master relevant experimental measurement techniques, principles and methods, and experimental skills, be able to use relevant experimental equipment proficiently, complete all experimental processes in accordance with established or actively designed experimental procedures, and use experimental instruments Equipment for raw data collection	Be able to reasonably and accurately apply basic professional knowledge such as mechanical principles to analyze experimental phenomena and complete experimental content.	Be able to correctly apply basic professiona l knowledge such as mechanical principles to analyze experiment al phenomena and complete experiment al content.	Be able to correctly apply basic professional knowledge such as mechanical principles to analyze experiment al phenomena and complete experiment al content.	Be able to apply basic professiona l knowledge such as mechanical principles to analyze experiment al phenomena and complete experiment al content.	It is not possible to apply basic profession al knowledge such as mechanical principles to analyze experiment al phenomen a and complete experiment al content.

VII. Recommended textbooks and reference materials

Textbooks：

[1] Zhichao Zhu.The machine design foundation experiment course[M]. Science Press, 2012.02

References:

[1] Huan Sun, Zuomo Chen, Wenjie Ge. Theory of Machines and Mechanisms[M]. Higher Education Press, 2013.05

[2] Harbin Institute of Technology. Theoretical Mechanics[M]. Harbin Institute of Technology Press,2016.

Network Resources:

[1]Chinese University mooc, Harbin Institute of Technology Mechanical Basic Realistic Teaching (Mechanical Principles) Course:

https://www.icourse163.org/learn/HIT-1002331007?tid=1002447010#/learn/announce

Written by: Shanhong Ma   Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 31, 2021

《机械设计课程设计 A*》教学大纲

Curriculum Design of Mechanical Design A

Course name：Curriculum Design of Mechanical Design A **Course code：**31929

Course type：Basic discipline-related course (Practice compulsory)

Total teaching hours：40

Credit：2

Prerequisites: Metalworking Practice, Material Mechanics, Mechanical Drawing, Principles of Machinery, Mechanical Design

Major：Mechanical design, manufacturing and automation

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

Mechanical design course design is the first comprehensive design training for students majoring in mechanical design, manufacturing and automation, and the last important teaching step of the course. The course integrates the design knowledge learned in the course of mechanical design, and takes the two-stage reducer as an example to train students in design, so as to cultivate students' ability of independent design. Combined with the practical characteristics of the course, the design cases of major national technical fields are introduced to cultivate students' craftsmanship spirit of striving for perfection and inspire students' patriotism of serving the country through science and technology.

II. Course Objectives

Course Objective 1： To understand the technical status quo in the field of mechanical design at home and abroad, to cultivate students' craftsman spirit of striving for perfection, and to inspire students' national feelings of serving the country with science and technology.

Course Objective 2： To cultivate students' ability to combine theory with practice, and to analyze and solve practical engineering problems with the theory they have learned.

Course Objective 3：Learn the general methods of mechanical design, understand and master common mechanical parts, mechanical transmission or simple machinery design process and methods.

Course Objective 4：Basic skills training such as: calculation, drawing, use of design manual standards, specifications and empirical data, empirical estimation and processing of data.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Curriculum Design of Mechanical Design A*

Index points of graduation requirements	Content
3.2	Complete the teaching of course practice, course design, experiment, science and technology training, production practice and graduation design, and be able to apply the basic principles and technical means of natural science and engineering science to the design of mechanical engineering system, complex units and process flow for specific needs.
3.3	Able to identify clear design requirements and propose design solutions to complex engineering problems in the field of mechanical engineering, taking into account social, health, safety, legal, cultural and environmental factors.
8.2	Understand the core socialist values, understand the national conditions, safeguard national interests, and have a sense of responsibility to promote national rejuvenation and social progress.
10.1	Able to express solutions, processes and results to complex engineering problems in the field of mechanical engineering through written reports and oral presentations, and able to understand the queries and suggestions of industry peers and the public.

Table 2. The supporting relationship between the course objectives and the index points of graduation requirements

Index points of graduation requirements	**3.2**	**3.3**	**8.2**	**10.1**
Course objectives	2	3	1	4
Intensity of support	H	M	L	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	1 Design preparation (1) Design specification (2) Design instruction	1. Define the design task 2. Master the design process 3. Introduce the technical shortage of precision reducer in our country,	2	Lecture、practice	1，2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		which leads to the robot products being controlled by people. Encourage students to rise to the challenge, study hard, and strive to solve the bottleneck problem.			
2	2. Overall design of transmission device (1) Transmission scheme (2) Motor selection (3) Motion and dynamic parameters of transmission device	1. Determine the total transmission ratio 2. Distribution of transmission ratios at all levels 3. Calculate the rotation speed, power and torque of each shaft	6	Lecture、practice	2,3,4
3	3. Design and calculation of transmission parts (1) Design and calculation of gear transmission (2) Belt transmission design and calculation	1. Master the design and calculation method of various transmission parts 2. Master the analysis and calculation method of the force on each transmission part 3. The harm of gear failure is introduced with examples to cultivate students' craftsman spirit of excellence	10	Lecture、practice	1，2,3,4
4	4. Assembly drawing design (1) Assembly sketch of reducer (2) Calculation and simulation of shafting components (3) Design of enclosure accessories	1. Preliminary drawing of reducer assembly sketch 2. Master the design and calculation method of shafting components and the simulation check method of shafting 3. Complete the assembly working diagram 4. Through a case study of high-speed railway bearings, this paper introduces the technological breakthroughs made in the field of bearings in China, which can deepen students' understanding of the importance of mechanical design and cultivate their national pride	10	Lecture、practice	1,2,3,4
5	5. Part working drawing design (1) Drawing of gear parts (2) Shaft parts drawing (3) Drawing of reducer casing parts	1. Complete the working drawing of large gear parts 2. Completed the work drawing of shaft parts 3. Complete the drawing of reducer casing parts	6	Lecture、practice	3,4
6	6 Design Instructions (1) Calculation instruction of course design (2) Preparation for	1. Collate and write the calculation instruction of course design 2. Complete the defense of curriculum design summary	8	Lecture、practice	2,3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	defense				

V. Teaching method

The teaching method adopts classroom teaching, supplemented by the course design instruction book, focusing on students' practical design.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Drawing score	Drawing	50%	Including four drawings (general assembly drawing, gear, shaft and shell parts drawing)	1、2、3、4
Report score	Report	20%	A design document	4
Defense score	Defense	30%	The answer questions mainly focus on the knowledge of mechanical design and course design	1、2、3、4

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Standard for evaluation
Drawing score	Adopt the hundred-mark system and give points according to the drawing. The drawings are clear, the parameters are correct, the drawing is standard, the accuracy rate is above 95%, no plagiarism (90-100);The drawings are clear, the parameters are basically correct, the drawing is relatively standard, no obvious mistakes, no plagiarism (80-89);There are obvious drawings, errors in parameters, irregularities in drawing, and no plagiarism (70-79);There are obvious mistakes in the drawing and the drawing is not standard. The teacher corrects and completes it with correct attitude after pointing out (60-69).Failure to comply with design requirements, failure to complete in time, or plagiarism (<60)
Report score	Adopt the hundred-mark system, report content is complete, accuracy rate is above 95%;Write correctly and keep complete and clear calculation process, no plagiarism; Detailed and thorough analysis of problems in the design process (90-100);Complete report with accuracy rate of 80% to 95%;Write correctly and keep complete and clear calculation process, without plagiarism (80-89);The content of the report is basically complete, and the accuracy rate is 60% to 80%, and the writing is correct (70-79);The content of the report is incomplete, and the instructor points out that it is supplemented later

	(60-69);The content of the report is incomplete, and the instructor pointed out that the supplement is still incomplete (<60).
Defense score	Adopt the hundred-mark system, according to the defense situation to give points. Fluent in oral defense, able to answer teachers' questions quickly and correctly, clear in thinking and good in expression (90-100);The defense is fluent, the answers to the teacher's questions are basically correct, and the presentation is good (80-89);Some questions asked by teachers are not clear and generally expressed (70-79);Unable to answer teacher's questions clearly, but able to supplement after teacher's prompt (60-69);Confused thinking, unable to answer questions effectively (<60).

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（In class questions）（K1）	Assessment 2（Routine homework）（K2）	Assessment 3（Major assignments）（K3）
Percentage		0.5	0.2	0.3
Score percentage of course objective for each assessment method	Objective 1（M1）	0.1	0	0.1
	Objective 2（M2）	0.1	0	0.3
	Objective 3（M3）	0.4	0	0.3
	Objective 4（M4）	0.4	1	0.3

VII. Recommended textbooks and reference materials

Textbook：

He Bo. Course design for machinery design, Northwestern Polytechnical University Press, 2017.

Reference books：

Li Yuan, et al. Course Design of Mechanical Design, Metallurgical Industry Press, 2019.

Teaching group： Wei Ye, Junhua Tong   Course administrator：Wei Ye

Written by: Wei Ye   Reviewed by: Junhua Tong

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 4, 2021

《金属切削原理与机床*》教学大纲

Theory of Metal Cutting and Machine Tools

Course name：Theory of Metal Cutting and Machine Tools　　**Course code**：31932

Course type：Specialized course (Compulsory)

Total teaching hours：32 (Lecture Hours: 28 Laboratory Hours or Tutorial Hours 4)

Credit：2

Prerequisites: Mechanical drawing, Engineering material and heat treatment, fundamentals of mechanical manufacturing

Major：Mechanical Design, Manufacturing and its automation

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

This course introduces the principle of metal cutting and machine tools. Machining is an essential process of semi-finishing and often finishing by which desired shape and dimensions are produced by removing extra material from the preformed blanks in the form of chips with the help of cutting tools moved past the work surfaces in machine tools.　In addition, we aim to equip students with the following abilities.

II. Course Objectives

Course Objective 1：Cultivate the spirit of patriotism, dedication, excellence, meticulousness and pursuit of excellence, inherit the value concept of Chinese craftsmanship, and establish the sense of mission to realize the Chinese dream of the great rejuvenation of the Chinese nation.

Course Objective 2：Understand basic laws of the cutting process and its application; know about the lathe, the grinder and milling machine and the main work they can do, their composition, structure characteristics, transmission system analysis and lathe tools, grinding wheel, the type, structure, milling cutter geometric parameters and the selection, of cutting force calculation method, etc.

Course objective 3: understand the complexity of the impact of mechanical manufacturing process on society, health, safety, law and culture, fully consider the impact of society, health, safety, law and culture when formulating mechanical manufacturing process regulations, and bear corresponding responsibilities.

Course objective 4: master and comprehensively apply the relevant knowledge and skills learned in this course and the prerequisite courses, correctly and reasonably select the tool material, cutting part geometric angle, cutting parameters and cutting fluid according to the processing object and specific conditions, and be able to consider its impact on environmental protection and sustainable development. Basically have the selection and design ability of common cutting tools and the selection and design ability of common machine tools.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Theory of Metal Cutting and Machine Tools*

Index points of graduation requirements	**Content**
4.1	Master the testing and experimental methods of complex mechanical systems, including the testing methods and means of force, deformation, motion and heat, and master the relevant basic principles.
7.1	Understand the impact of implementation and operation of mechanical engineering on ecological environment.
7.2	Set up green manufacturing concept, correctly evaluate the impact of complex mechanical engineering problems on environment and social sustainability.
8.2	Understand the socialist core values, to understand the national conditions, to safeguard national interests, has the sense of responsibility to promote national rejuvenation and social progress.

Table 2. The supporting relationship between the course objectives and the index points of graduation requirements

Index points of graduation requirements	**4.1**	**7.1**	**7.2**	**8.2**
Course objectives	2	3	4	1
Intensity of support	H	H	M	M

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	Unit 1 Basic knowledge of metal cutting	1. Understand the cutting motions and machining variables, Geometry of cutting tools and undeformed chip dimensions 2. Introduce the contribution of Chinese scholars，encourage students to work hard and enhance their sense of proudness.	6	Lecture and experiment	1、2
2	Unit 2 Cutting tool materials	1. Understand the requirement of tool materials, the types of tool material and their selection.	2	Lecture	2
3	Unit 3 Basic theory of the metal cutting process	1. Understand the chip formation in the metal cutting process, cutting forces and cutting power , cutting heat and cutting temperature, tool wear and tool life	6	Lecture and experiment	2
4	Unit 4 Applications of basic theory in the cutting process	1. Understand how to control of chips, the concept of machinability, types of cutting fluids. Proper choice of tool geometric parameters and cutting variables	4	Lecture	2、3
5	Unit 5 Introduction to Machine Tools and Cutting Tools	1. Understand the classification and model of machine tools, methods of surface generating and kinematic analysis of machine tools 2. Introduce the progress of machine tools in China，understand the achievement.	2	Lecture	1、2
6	Unit 6 Lathes and lathe cutters	1. Understand the basic contents of turning, constructional features of a center lathe (CA6140) and Lathe cutters	2	Lecture	2、3
7	Unit 7 Grinding wheels and grinding machines	1. Understand the abrasives of grinding wheels and the types of grinding machines	2	Lecture	2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
8	Unit 8 Gear cutting machines and cutting tools	1. Understand the gear forming and generating methods.	2	Lecture	2
9	Unit 9 Hole making machine tools and cutting tools	1. Understand the different hole making methods, and the corresponding machine tools. 2. Through learning the deeds of "great craftsmen", students' feelings of home country, professional belonging and mission are aroused.	2	Lecture	2、3
10	Unit 10 Milling machines and milling cutters	1. Understand the typical milling machines and milling cutters, the difference between up milling and down milling	2	Lecture	1、2、3

Table 4 Class hour allocation for experimental teaching content

Experiment	Content outline	Equipment or Experiment environment	Hour	No. of students in each group	Experiment attribute（basic/comprehensive/design/research innovation）	Requirement (compulsory/optional)	Corresponding course objective
Cutting tool angle measurement	Measure the five angles in a lathe cutter	protractor	2	30	Basic	compulsory	2,3
Cutting force measurement	Measure the three cutting force components	Lathe, force measurement system	2	30	Basic	compulsory	2,3

V. Teaching method

The course mainly consists of lectures and assignment. A variety of teaching methods and a flexible range of activities are suggested to provide students with various learning experiences and encourage their initiatives. Make use of modern educational technology with an optimal integration of various teaching media to effectively improve the teaching quality.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Classroom performance	10%	Assess the level of understanding basic knowledge. Attendance and study performance in classroom	1,2
	Mid-term exam	20%	Open book examination	1
Experiments	Experiment report	10%	Two experiments: cutting force measurement And geometry measurement of cutting tools	1,2
Final exam	Exam	60%	It mainly assesses students' understanding of the knowledge based on the exam paper. The paper structure and score distribution are as follows: Filling in blank 20%, single choice 20%, right or wrong questions 10%, short answer questions 20% and calculation questions or analysis questions 30%.	1,2

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria
Classroom performance	According to the condition of completion, there will be four levels：Excellence (90-100, good (75-89, normal (60-74), fail (below 60). Adjust the score depending the class attendance.
Mid-term exam	According to the exam paper grading criteria.
Experiment report	According to the quality of the report, there will be four levels: Excellence (90-100, good (75-89, normal (60-74), fail (below 60).
Exam	According to the exam paper grading criteria.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

	Assessment 1(Usual performance)（K1）	Assessment 2（Experiment）（K2）	Assessment 3（Exam）（K2）

		Assessment 1(Usual performance)（K1）	Assessment 2（Experiment）（K2）	Assessment 3（Exam）（K2）
Percentage		0.3	0.1	0.6
Score percentage of course objective for each assessment method	Objective 1（M1）	0.1	0	0
	Objective 2（M2）	0.6	0.6	0.6
	Objective 2（M2）	0.3	0.4	0.4

VII. Recommended textbooks and reference materials

Textbook：

[1] Xiaozhong Ren, Naifei Ren, Hongjun Wang, Fundamentals of manufacturing technology: English-Chinese Bilingual [M]. China Mechanical Press, 2014.

[2] Serope Kalpakjian, Stephen R. Schmid, Manufacturing Engineering and Technology, Pearson Education,2013.

Teaching group： Hongjun Li, etc. Course administrator：Hongjun Li

Written by: Hongjun Li Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 27, 2021

《机械设计*》教学大纲

Mechanical Design

Course name：Mechanical Design **Course code**：31934

Course type：Basic discipline-related course (Compulsory)

Total teaching hours：48 (Classroom Hours: 48)

Credit：3

Prerequisites: Mechanical drawing, Principles of Machinery, Basic Course for Mechanical Manufacturing, Material Mechanics,

Major：Mechanical design, manufacturing and automation

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

The nature of mechanical design course is a design course with the design of general size universal parts as the core, and it is also a technical basic course to discuss their basic design theory and method. By discussing some parts design theories and methods, students can master relevant design rules and technical measures, so as to have the ability to design other universal parts and some special parts. Through teaching of the course, students learn to the integrated use of relevant knowledge and skills learned in the courses, the teaching practice of mechanical technicians of basic training, gradually improve their theoretical level and ideation, especially improve the questions, the ability to analyze and solve problems, for a smooth transition to the professional courses of study and professional product and equipment design to lay a broad and solid foundation. In the teaching process, typical cases are introduced to compare the status quo of important technologies at home and abroad, so as to cultivate students' sense of responsibility and national pride.

II. Course Objectives

Course Objective 1：To understand the important role of mechanical design in the realization of manufacturing power strategy, strengthen students' sense of responsibility through the comparison of current Chinese and foreign technology cases, stimulate students' spirit of rising to the challenge, and stimulate national pride.

Course Objective 2： Master the design principle, method and general rules of general mechanical design of parts, and have the ability to design general mechanical parts and simple mechanical devices.

Course Objective 3：Applied abilities of standards, specifications, manuals, atlas and relevant technical materials.

Course Objective 4： Establishing right concept of design philosophy, and understand the current relevant technical economic policy of country.

Course Objective 5： Knowledge of the latest development in machinery design.

Course Objective 6： Understand the complexity of the social, health, safety, legal, and cultural impacts of the mechanical design process, and take account and responsibility for the social, health, safety, legal, and cultural impacts in determining the design proposal.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Mechanical Design*

Index points of graduation requirements	**Content**
1.4	Be able to apply design, manufacturing, control and other related knowledge and mathematical models to the comparison and synthesis of complex engineering problem solutions in the field of mechanical engineering.
2.2	Be able to correctly identify the diversity of solutions to complex engineering problems and seek solutions to complex engineering problems in mechanical engineering and their alternatives through literature research.
3.1	Understand the current situation and development trend of the frontier of mechanical engineering, familiar with the basic process of research and development of new products, new processes, new technologies and new equipment, and have the attitude and consciousness of pursuing innovation in solving complex engineering problems in the field of mechanical engineering.
6.2	Understand the relevant historical and cultural background of mechanical engineering, can correctly understand the relationship and mutual influence between mechanical engineering and the objective world, familiar with the principles, policies and regulations of the research and development, production and operation of mechanical engineering in social, health, safety and other aspects.
6.3	Be able to evaluate the social, health, safety, legal, and cultural impact of mechanical engineering practices and solutions to complex engineering problems in the field of mechanical engineering and to understand the responsibilities.

8.2	Understand the core socialist values, understand the national conditions, safeguard national interests, and have a sense of responsibility to promote national rejuvenation and social progress.

Table 2. The supporting relationship between the course objectives and the index points of graduation requirements

Index points of graduation requirements	**1.4**	**2.2**	**3.1**	**6.2**	**6.3**	**8.2**
Course objectives	2	3	4	5	6	1
Intensity of support	H	H	M	H	H	L

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**
1	1. Introduction 1.1 The Role of Machinery Design 1.2 Machinery and Components 1.3 Overview of Machinery Design 1.4 A General Procedure of Machinery Design 1.5 Contents and Tasks of the Course	1. Introduce the knowledge system framework of this course; teaching objectives, graduation requirements, position in the curriculum system of the major, teaching content, assessment methods and score ratio; 2. The function of the machine, the classification of parts, and the relationship between parts and the machine; 3. List the advanced products of China in the field of mechanical design, such as space rover, Jiaolong, Antarctic vehicle, etc., to arouse the students' national pride; 4. Master the main contents and principles of mechanical design.	1	Lecture	1，4,5，6
2	2. Principles of Machinery Design 2.1 Fundamental Requirements for Machinery Design 2.2 Failure Models of Mechanical Components 2.3 Design Requirements for Mechanical Components 2.4 General Criteria for Component Design	1. Master the design method of mechanical parts; 2. Master the design steps of mechanical parts; 3. Master the selection principle of mechanical parts and materials.	2	Lecture	4,5，6

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
3	3. Failure Theories And Material Strengths 3.1 Theories of Failure 3.2 Bulk Strengths of the Machine Components 3.3 Surface Strengths of the Machine Components	1. Master several laws of stress change and the strength calculation method of unidirectional stress change; 2. Master the strength checking method of bidirectional variable stress.	3	Lecture	2,6
4	4. Friction, Wear And Lubrication 4.1 Friction 4.2 Wear 4.3 Lubrication 4.4 Machinery Condition Monitoring	1. Master the classification and mechanism of friction and wear, lubricants and lubrication methods; 2. Master the formation principle of fluid dynamic pressure oil film and static pressure oil film, and understand the elastic fluid dynamic pressure lubrication. The outstanding achievements of Chinese scholars in the field of elastohydrodynamic lubrication are introduced to deepen students' understanding of the importance of lubrication and cultivate their national pride.	2	Lecture	1，3,5
5	5. Design of Threaded Fasteners and Joints 5.1 Type and application of thread connection 5.2 Type and standard of threaded coupling 5.3 The theory and method of thread connection design and strength calculation 5.4 Force analysis of bolt group connection 5.5 Screw drive performance (efficiency, self-locking, etc.) 5.6 Design and calculation method of main parts (screw and nut) for screw type selection	1. Master the type and application of thread connection, master the theory and method of thread connection design and strength calculation; 2. Master the force analysis of bolt set connection; 3. Master the design and calculation method of main parts; 4. Introduces the typical cases of bolt connection failure, so as to cultivate students' craftsman spirit of excellence.	6	Lecture	1，2,3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
6	6. Design Of Keys, Splines and Pins 6.1 Key Joints 6.2 Spline Joines 6.3 Pin Joints	1. Master the main types, application characteristics and selection methods of key connection; 2. Master the strength checking calculation of each type of key connection; 3. Understand the types, characteristics and applications of keyless joints and pin joints	2	Lecture	2,3，4
7	7. Design of Riveted, Welded and Bonded Joints 7.1 Riveted Joints 7.2 Welded Joints 7.3 Bonded Joints	1. Understand the type, structure and application of riveting joints, stress condition, failure mode and design calculation of riveting joints; 2. Understand the type, structure, application occasions and design key points of adhesive joints; 3. Understand the type and application of interference connection	2	Lecture	2,3，4
8	8. Transmission of Belts 8.1 Principal Geometric Relationships in Belt Drives 8.2 Applications and Work Characteristics of Belt Drives 8.3 V-Belt Drive Design	1. Master the type, characteristics and application of belt drive; 2. Master the structure and standards of V-belt; 3. Master the design method of V-belt transmission	3	Lecture	2,3，4
9	9. Transmission of Chains 9.1 Characteristics and Application of Chain Drives 9.2 Types of Chain Drives 9.3 Moving Characteristics of Chain Drives 9.4 Appended Dynamic Loads of Chain Drives 9.5 Fouce Analysis of Chain Drives 9.6 Design of Chain Drives 9.7 Roller Chain Sprockets 9.8 Lubrication, Arrangement and Tensioning of Chain Drives	1. Master the working principle, characteristics and application of chain drive; 2. Master the design method of roller chain; 3. Master the arrangement, tensioning and lubrication of chain drive	3	Lecture	2,3，4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
10	10. Design of Gears 10.1 Introduction 10.2 Gear Failures and Design Criteria 10.3 Gear Materials 10.4 Design of Spur Gears 10.5 Allowable Stresses and Design Parameters 10.6 Design of Helical Gears 10.7 Design of Straight Bevel Gears 10.8 Gear Blank Design 10.9 Efficiency and Lubrication In Gear Sets 10.10 Brief Introduction of Other Types of Gearing	1. Master the failure forms, design criteria and material selection of gear transmission; 2. Master the force analysis of gear; 3. Master the strength calculation and design method of standard straight and helical gear transmission; 4. Master the strength calculation of displacement gear transmission	6	Lecture	2,3，4
11	11. Design of Worm Gearing 11.1 Types and Characteristics of Worm Gearing 11.2 Principal Parameters and Geometrical Calculations of Worm Gearing 11.3 Causes of Worm Gear Failure and Principle of Design 11.4 Strength Calculations of Worm Gearing 11.5 Efficiency, Lubrication and Thermal Capacity of Worm Gearing	1. Master the type, application and parameter calculation and selection method of worm drive; 2. Master the design and checking method of worm drive; 3. Master the structural design and material selection of worm drive	3	Lecture	2,3，4
12	12. Sliding Bearings 12.1 Types of Sliding Bearing 12.2 Bearing Materials 12.3 Constructions of Sliding Bearings 12.4 Design of Boundary –Lubricated Bearings 12.5 Design of Full –Film Hydrodynamic Lubrication Bearings	1. Master the characteristics, structure and application of sliding bearing; 2. Master the design principle and method of sliding bearing	3	Lecture	2，3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	12.6 Hydrostatic Bearings				
13	13. Rolling -Contact Bearing 13.1 Types of Rolling –Contact Bearings and The Representing Code 13.2 Fouces and Failures 13.3 Selection of Rolling –Contact Bearings 13.4 Mounting of Bearings 13.5 Practical Considerations in The Application of Bearings	1. Master rolling bearing code and type selection; 2. Master rolling bearing selection and life checking calculation; 3.Master bearing device design	6	Lecture	2，3
14	14. Couplings and Clutches 14.1 Types and Structural Properties of Couplings 14.2 Rigid Couplings 14.3 Flexible Couplings 14.4 Selection of Couplings 14.5 Types of Clutches 14.6 Jaw Clutches 14.7 Disc Clutches 14.8 Self –Acting Clutches	1. Master the type, characteristics and application of coupling and clutch; 2. Master the selection and calculation methods of coupling and clutch	3	Lecture	2，3
15	15. Shafts 15.1 Types and Materials of Shafts 15.2 The Procedure of Shaft Design 15.3 Considerations for shaft geometry 15.4 The Strength of Shafts 15.5 Shaft Design Examples	1. Master the type, material and classification of axes; 2. Master the positioning method of parts on the shaft and the structural design method of the shaft; 3. Master the strength calculation and checking methods of various axes	3	Lecture	2,3，4

V. Teaching method

The course mainly consists of lectures, practice and assignments.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 Course objectives and assessment methods

Score category	**Assessment methods**	**Percentage**	**Assessment details**	**Corresponding objectives**
Usual performance	In class questions	5%	To assess the level of understanding knowledge taught in class, accounting for 5% of total score.	1、4、5、6
	routine homework	15%	To assess the level of review, understanding and command for each lesson, accounting for 15% of total score.	2、3、4
	Major assignments	20%	To assess the abilities of grasping the method, procedures and calculation of machine design, abilities of using standards, specifications, manuals, atlas and relevant technical materials, accounting for 20% of total score.	2、3、4、5、6
Exam	Exam score	60%	To assess students' mastery of basic knowledge of mechanical parts design and relevant design and analysis methods, accounting for 60% of total score.	1、2、3

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	**Standard for evaluation**
In class questions	According to the condition of question answer, there will be five levels：Excellence (90-100), good (80-89), normal (70-79), pass (60-69), fail (below 60). Adjust the score depending on the class attendance.
Routine homework	According to the condition of homework, there will be five levels：finish 90% of the homework with high correct rate (90-100), finish 80%-90% of the homework with good correct rate (80-89), finish 70%-80% of the homework with acceptable correct rate (70-79), finish 60%-70% of the homework with acceptable correct rate (60-69), finish less than 60% of the homework with lower correct rate (below 60).
Major assignments	According to the condition of completion, there will be five levels：submit standard drawings and reports without errors (90-100), submit standard drawings and reports with some errors (80-89), submit standard drawings and reports with a lot of errors (70-79), drawings and reports are not standard and have a lot of errors (60-69), do not submit drawings and reports, or there are serious errors (below 60).
Exam	According to the answer and score judgement standard

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（In class questions）（K1）	Assessment 2（Routine homework）（K2）	Assessment 3（Major assignments）（K3）	Assessment 4（Exam）（K4）
Percentage		0.05	0.15	0.2	0.6
Score percentage of course objective for each assessment method	Objective 1（M1）	0.2	0	0	0.1
	Objective 2（M2）	0	0.4	0.2	0.4
	Objective 3（M3）	0	0.4	0.2	0.5
	Objective 4（M4）	0.2	0.2	0.2	0
	Objective 5（M5）	0.3	0	0.2	0
	Objective 6（M6）	0.3	0	0.2	0

VII. Recommended textbooks and reference materials

Textbook：

Yang Mingzhong. Machinery Design, Wuhan University of Technology Press, 2011.

Reference books：

Pu Lianggui, Ji Minggang. Design of Machinery, 8nd Edition, Higher Education Press, 2008.

Teaching group： Wei Ye, Junhua Tong　　Course administrator：Wei Ye

Written by: Wei Ye　　Reviewed by: Junhua Tong

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 4, 2021

《理论力学*》教学大纲

Theoretical Mechanics

Course Name：Theoretical Mechanics　　**Course code：31936**

Course Type：Basic Course，Compulsory Course

Total Teaching Hours：Classroom Hours: 48hs; Laboratory Hours or Tutorial Hours: 0h

Course Credit：3

Prerequisites: Advanced mathematics A, Advanced Physics B

Major：Major related with Mechanical, Robot

Department: Department of Mechanical Design and Manufacturing

I Course Introduction

This course is a basic and compulsory course for every major in mechanical discipline; it's the basis of other 'Mechanic courses' and it can be used in practice directly. By the study of this course, the students should get the following abilities.

The students should expertly know the basic concepts, theories and methods for analyzing the motions in practice, and know how to perform dynamic analysis to rigid bodies with planar motion or with compound motions; masterly know the principle of momentum, principle of moment of momentum and the principle of work and energy, etc.; know how to perform dynamic analysis to a system; know the principle of virtual work and know how to analyze with the method of 'Analyzing Mechanics'; know the concept of impact, analyze and calculate the simple impact problems.

The students should get the following abilities: (a)to possess the ability to transfer a real problem to a mechanic model related with a particle, a particle system, a rigid body or a rigid body system, and the ability to build a math model according to the mechanic principles. (b)through the logic thinking process of inferring, analyzing and judging, obtain the ability to perform the qualitative analysis to the static, kinematic and dynamic of the mechanic model.(c)Calculating ability: the ability to perform the quantitative instant analysis and process analysis to the static, kinematic and dynamic of the mechanic model. (d)Self-learning ability: the ability to read and learn the books of Theoretical Mechanics and other related books.

After the introduction about several typical real examples, e. g., the constraints in real world and how are they considered in mechanics, famous scientists in mechanics such as Qian Xueseng, Qian Weichang and Qian Xilun as well as their huge contribution to the motherland China. The students should understand how the mechanic discipline developed as the need of the real application, and how the real application promoted the development of the mechanic discipline, and should understand the position of Theoretical Mechanics in mechanic discipline as well as in real practice, and train and improve the students' ability in mechanics and science, and also know the importance to study mechanics well and activate them to study well and make a contribution to the motherland China.

II Course Objectives

Objective 1: To know the relationships between the real world and the principles of mechanics, and know how peopled know the principle of the nature, and know the applications of mechanics as well as how scientists in mechanics promote the progress of the science and technology, and let the students know the importance of rigorous and honest attitude, and affect their understanding to the course. (graduation requirement 8-3)

Objective 2: To know the basic concepts, theories and methods for analyzing the motions in practice, and know how to perform dynamic analysis to rigid bodies with planar motion or with compound motions. (graduation requirement 1-3)

Objective 3: To know the principle of momentum, principle of moment of momentum and the principle of work and energy, etc.; know how to perform dynamic analysis to a system; know the principle of virtual work; know the concept of impact, analyze and calculate the simple impact problems. (graduation requirement 1-3)

Objective 4: To possess the ability to transfer a real problem to a mechanic model related with a particle, a particle system, a rigid body or a rigid body system, and the ability to build a math model according to the mechanic principles. To obtain the ability to perform the qualitative analysis to the static, kinematic and dynamic of the mechanic model through the logic thinking process of inferring, analyzing, and judging. (graduation requirement 2-1)

III Graduation Requirements supported by the Teaching Objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Theoretical Mechanics*

Index points of graduation requirements	Content
1.3	To obtain the ability to develop engineering models for complex engineering problems from mathematical models in the field of mechanical engineering
2.1	To be able to identify and judge the key links and parameters of complex engineering problems in complex mechanical engineering according to the basic principles of scientific knowledge.
8.3	To understand the core concept of engineering ethics and the social responsibility of mechanical engineers, and consciously abide the professional ethics and code of conduct of mechanical engineers in engineering practice.

Table 2. The supporting relationship between the course objectives of *Theoretical Mechanics* and the index points of graduation requirements

Index points of graduation requirements	**1.3**	**2.1**	**8.3**
Course objectives	2, 3	4	1

Intensity of support	H	H	L

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**
1-2	Introduction	• To introduce the relationship between the real world and the mechanics. • To introduce the famous scientists as well as their contribution to the motherland China.	1	lecture	1
3	Equilibrium of a Particle : (1) conditions; (2)FBD; (3)Force systems	• To introduce the concept of the free-body diagram for a particle. • To show how to solve particle equilibrium problems using the equations of equilibrium.	1	lecture	2,3
4	Force System Resultants (1)moment; (2)couple moment; (3)resultant	• To discuss the concept of the moment of a force and show how to calculate it in two and three dimensions. • To provide a method for finding the moment of a force about a specified axis. • To define the moment of a couple. • To present methods for determining the resultants of nonconcurrent force systems. • To indicate how to reduce a simple distributed loading to a resultant force having a specified location.	2	lecture	2,3
5	Equilibrium of a Rigid Body: (1)conditions (2)equations	• To develop the equations of equilibrium for a rigid body. • To introduce the concept of the free-body diagram for a rigid body. • To show how to solve rigid-body equilibrium problems using the equations of equilibrium.	2	lecture	2,3
6	Structural Analysis: (1) method of joint (2)method of section	• To show how to determine the forces in the members of a truss using the method of joints and the method of sections. • To analyze the forces acting on the members of frames and machines composed of pin-connected members. To introduce the truss-lift created by China, and related factories, such as Sanyi, Zhonglian..	2	lecture	2,3
7	Friction: (1)dry friction; (2) rolling resistance	• To introduce the concept of dry friction and show how to analyze the equilibrium of rigid bodies subjected to this force. • To present specific applications of frictional force analysis on wedges, screws, belts, and bearings. • To investigate the concept of rolling resistance. • To introduce the CRH train (the resistance) to the students to show the ability to create.	2	lecture	2,3
8	Virtual Work: (1)definition (2)priciple	• To introduce the principle of virtual work and show how it applies to finding the equilibrium configuration of a system of pin-connected members. • To establish the potential-energy function and use the potential energy method to investigate the type of equilibrium or stability of a rigid body or system of pin-connected members.	2	lecture	2,3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
9	Kinematics of a Particle: (1)curvilinear motion (2)relative motion	• To present an analysis of dependent motion of two particles. • To examine the principles of relative motion of two particles using translating axes.	3	lecture	2,3
10	Kinetics of a Particle: Force and Acceleration: (1)motion equation (2) Different CS	• To state Newton's Second Law of Motion and to define mass and weight. • To analyze the accelerated motion of a particle using the equation of motion with different coordinate systems. • To investigate central-force motion and apply it to problems in space mechanics.	3	lecture	2,3
11	Kinetics of a Particle: Work and Energy: (1)principle for a particle (2)principle for a system of particles	• To develop the principle of work and energy and apply it to solve problems that involve force, velocity, and displacement. • To study problems that involve power and efficiency. • To introduce the concept of a conservative force and apply the theorem of conservation of energy to solve kinetic problems.	3	lecture	2,3
12	Kinetics of a Particle: Impulse and Momentum: (1)principle for a particle (2)principle for a system of particles	•To develop the principle of linear impulse and momentum for a particle and apply it to solve problems that involve force, velocity, and time. • To study the conservation of linear momentum for particles. • To analyze the mechanics of impact. • To introduce the concept of angular impulse and momentum. • To solve problems involving steady fluid streams and propulsion with variable mass.	3	lecture	2,3,4
13	Planar Kinematics of a Rigid Body: (1)translation (2)rotation (3)general plane motion	• To classify the various types of rigid-body planar motion. • To investigate rigid-body translation and angular motion about a fixed axis. • To study planar motion using an absolute motion analysis. • To provide a relative motion analysis of velocity and acceleration using a translating frame of reference. • To show how to find the instantaneous center of zero velocity and determine the velocity of a point on a body using this method. • To provide a relative-motion analysis of velocity and acceleration using a rotating frame of reference.	3	lecture	2,3
14	Planar Kinetics of a Rigid Body: Force and Acceleration: (1)mass inertia (2)equations	• To introduce the methods used to determine the mass moment of inertia of a body. • To develop the planar kinetic equations of motion for a symmetric rigid body. • To discuss applications of these equations to bodies undergoing translation, rotation about a fixed axis, and general plane motion.	3	lecture	2,3,4
15	Planar Kinetics of a Rigid Body: Work and Energy (1)kinematic energy (2) principle	• To develop formulations for the kinetic energy of a body, and define the various ways a force and couple do work. • To apply the principle of work and energy to solve rigid–body planar kinetic problems that involve force, velocity, and displacement. • To show how the conservation of energy can be used to solve rigid–body planar kinetic problems.	3	lecture	2,3,4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
16	Planar Kinetics of a Rigid Body: Impulse and Momentum (1)momentum and angular momentum (2) conservation	• To develop formulations for the linear and angular momentum of a body. • To apply the principles of linear and angular impulse and momentum to solve rigid-body planar kinetic problems that involve force, velocity, and time. • To discuss application of the conservation of momentum. • To analyze the mechanics of eccentric impact.	3	lecture	3,4
17	Three-Dimensional Kinematics of a Rigid Body (1) fixed motion (2) general plane motion	To introduce the history of the heliocentric theory and geocentric theory To analyze the kinematics of a body subjected to rotation about a fixed point and general plane motion. • To provide a relative-motion analysis of a rigid body using translating and rotating axes.	3	lecture	1,2,3,4
18	Three-Dimensional Kinetics of a Rigid Body (1) angular momentum (2) kinetic energy	To study the motion of solar system and analyze the heliocentric theory and geocentric theory. To introduce the methods for finding the moments of inertia and products of inertia of a body about various axes. • To show how to apply the principles of work and energy and linear and angular momentum to a rigid body having three-dimensional motion. • To develop and apply the equations of motion in three dimensions. • To study gyroscopic and torque-free motion.	3	lecture	1,2,3,4

V Teaching Methods

The teaching of this course should mainly focus on the teacher's teaching, and partly on the self-learning of the students. During the teaching, the inspiring, discussing and concentrating methods should be adopted, to build an interesting, achieve and interactive atmosphere of the course, encourage the students, lead them to think separately, strength the ability to solve the engineering problem and the ability to practice.

VI Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Assignments	10%	Homework would be assigned every week. Taking 10% to the final score.	1, 2, 3,4

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
	Attendance	10%	Group discussion 5%, Answering the questions 5%.	
	In-class exam	30%	There are 3 in-class exams, each account for 10% to the final score.	
Exam	Close-book exam	50%	The full mark is 100 for the final exam, but it only takes 50% to the final score.	1, 2, 3,4

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods		Grading criteria
Usual performance	Assignments	According to the condition of completion, there will be four levels: Excellence (90-100), good (80-89), middle (70-79), pass(60-69), fail (below 60). Adjust the score depending the class attendance.
	In-class exam	According to the answer and score judgement standard. There are 3 in-class exams, each account for 10% to the final score.
	attendance	Group discussion 5%, Answering the questions 5%.
exam	Final exam	The full mark is 100 for the final exam, and it only takes 50% to the final score.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（Usual performance） （K1）	Assessment 2 （exam）（K2）
Percentage		0.5	0.5
Score percentage of course objective for	Objective 1（M1）	0.1	0
	Objective 2（M1）	0.4	0.2

		Assessment 1（Usual performance）（K1）	Assessment 2（exam）（K2）
each assessment method	Objective 3（M2）	0.2	0.3
	Objective 4（M3）	0.3	0.5

VII Recommended Textbooks and References

R.C. Hebbeler 《Engineering Mechanics——Statics》（12^{th} edition）

R.C. Hebbeler 《Engineering Mechanics——Dynamics》（12^{th} edition）

Internet resources

[1] http://gc.nuaa.edu.cn/lllx

[2] http://lxjd.nuaa.edu.cn

[3] http://www.tsinghua.edu.cn/docsn/lxx/mainpage/zhuye.htm

[4] http://tm.sjtu.edu.cn/kc/kc1.asp

[5] http://cstam.org.cn

Teaching group： Yimin Wei, ,Yaxin Yu, Yi Liu Course administrator：Yimin Wei

Written by: Yimin Wei Reviewed by: Jianmin Li

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 17, 2021

《制图测绘*》教学大纲

Mechanical Surveying and Mapping

Course name：Mechanical Surveying and Mapping **Course code**：31937

Course type：Basic Course，Compulsory Course

Total teaching hours：20

Credit：1.0

Prerequisites: Mechanical drawing 1, Mechanical drawing 2

Major：Mechanical engineering

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

In practice, the procedure that is composed of measuring the machine or equipment, producing schematic drawings and then producing the assembly drawings is called a mapping process. It is a basic skill for engineers to be able to map the machinery parts. This course is a comprehensive practical course which is arranged after Mechanical Drawing 1 & 2. In this course, students can apply their learned basic theory, knowledge and skill to the practical mapping work. Therefore their capabilities of analysis, graphic description, spatial imagery and engineering drawing representation can be improved. What's more, This course teaches some knowledge about the development history of China industry and the influence of Chinese culture in the world by presenting some literatures or media documents to inspire the students' motivation for persuing social responsibility of mechanical engineers.

II. Course Objectives

Course Objective 1: Understand China's basic condition; Master the processes of precise, factualistic serious-minded and responsible personality and scientism.

Course Objective 2: Comprehensively utilize the common mapping tools; Develop the ability to freehand sketch; Enhance the standardization awareness; Initially establish the awareness of engineering, standard, quality, responsibility and safety; Possess the team-work spirit.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Mechanical Surveying and Mapping》

Index points of graduation requirements	Content
8.3	Understand the core concept of engineering ethics and the social responsibility of mechanical engineers, and consciously abide by the professional ethics and code of conduct of mechanical engineers in engineering practice.
9.3	Possess the ability to organize and manage the engineering activity, lay an appropriate working plan, allocate tasks according to the knowledge and capability of each member and coordinate the members to finish the task.

Table 2. The supporting relationship between the course objectives of 《Mechanical Surveying and Mapping》 and the index points of graduation requirements

Index points of graduation requirements	**8.3**	**9.3**
Course objectives	1	2
Intensity of support	L	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	Introduction to Mechanical Mapping	1. Master the method and process of mechanical mapping. 2. Know about the working principle, composition and assembly relation of the gear pump; Make feasible disassemble scheme and disassemble the gear pump. 3. Finish the assembly diagram and principle diagraph of the gear pump. 4. Combining with the analysis and discussion of dimension in engineering examples, the importance of rigorous, excellence and meticulous craftsmanship spirit is emphasized.	Half day	Lecture and tutorial	1, 2
2	Part Mapping	1. Know about the correct usage of ruler, double calipers, vernier caliper; Be familiar with the general method and process of part mapping and the related matters need attention; Master the mapping and design method and process of the standard structures of the thread and gears. 2. Master the method to determine and select the surface roughness and geometric tolerance. 3. Measure and draw the sketches of the pump	3 days	Lecture and tutorial	1, 2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		body, cover, pinion shaft, driven gear shaft, packing cover and gland nut, including the dimension and specifications; Finish the part drawings of the pump body and pinion shaft. 4. Combining with the analysis and discussion of dimension in engineering examples, the importance of rigorous, excellence and meticulous craftsmanship spirit is emphasized.			
3	Assembly Mapping	1. Master the methods of view selection, dimension mark, part index mark, drawing item list and filling title block in the assembly drawing. 2. Determine the representation of the gear pump assembly drawing and finish the drawing. 3. Combining with the analysis and discussion of dimension in engineering examples, the importance of rigorous, excellence and meticulous craftsmanship spirit is emphasized.	1.5 day	Lecture and tutorial	1, 2

V. Teaching method

1. Before the beginning of the course, borrow the models and mapping tools for the course and divide the students into several groups.

2. Explain the working principle of the gear pump with the aid of multimedia materials.

3. Emphasize the mapping and design method and process of the standard structures of the thread and gears; Explain in detail the method to determine and select the surface roughness and geometric tolerance.

4. The instruction should be combined with the student's independent thinking; The teacher must regularly inspect and guide the students to check their task completion in time.

5. The course can be finished in one week or integrated with Mechanical Drawing 2.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives. The course objectives and the corresponding assessment methods are listed in Table 4.

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Survey and mapping process	50%	To assess the progress of each student's task and the communication with the team member and teacher, accounting for 50% of total score. Combined with case analysis, evaluate the participation degree of class discussion.	(1) (2)

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Drawing	Quality of drawing	50%	To assess the quality of the detail drawings and assembly drawing, accounting for 20% of total score.	(2)

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria
Usual performance	According to the condition of completion, there will be five levels：Excellent (90-100), good (80-89), normal (70-79), pass (60-69), fail (below 60). Adjust the score per the class attendance.
Drawing	According to the correctness and quality of the drawings, there will be five levels：Excellent (90-100), good (80-89), normal (70-79), pass (60-69), fail (below 60).

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1 (Usual performance) (K1)	Assessment 2 (Drawing) (K2)
Percentage		0.5	0.5
Score percentage of course objective for each assessment method	Objective 1（M1）	0.5	0.0
	Objective 2（M2）	0.5	1.0

VII. Recommended textbooks and reference materials

Textbook

Lin Hu, Engineering Drawing (Chinese-English Bilingual Edition), China Machine Press, 2005

Reference books

1. K.L. Narayana, P. Kannaiah, K. Venkata Reddy, Machine Drawing (Third Edition),New Age International (P) Ltd., Publishers, 2006.

2. Mingxin He, Keqiang Qian, Zumao Xu, Machine Drawing (Sixth Edition), Higher Education Press, 2010.

Online resources

http://jxzhitu.tongji.edu.cn

Teaching group: Xiaoqiang Du Course administrator: Xiaoqiang Du

Written by: Xiaoqiang Du Reviewed by: Qingchuan He

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 24, 2021

《有限元技术与应用*》教学大纲

Finite Element Technology and Application

Course name：Finite Element Technology and Application **Course code**：31942

Course type：Specialized course (Required elective course)

Total teaching hours：32 (Classroom Hours: 16, Laboratory Hours or Tutorial Hours:16)

Credit：2

Prerequisites: Advanced mathematics, linear algebra, mechanics of materials

Major：Mechanical design, manufacturing and automation, Mechatronics engineering, Energy and power engineering

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

As engineers we often encounter problems too large or too difficult to solve in a conventional manner; therefore, we resort to using the computer to do the hard work for us. This is a first course in Finite Element Analysis (FEA), intended to introduce the student to the algorithms and techniques an engineer might employ in solving these difficult problems. While FEA takes its name from the characteristic “finite elements” we typically visualize in the solution of problems. It is more generally a numerical technique for solving classes of ordinary and partial differential equations. We will develop FEA equations and solutions to problems in one-dimension and extend the concepts to two and three dimensions.

Students will have hand-on exercises utilizing the commercial FEA software ANSYS; however, the objective of this class is not to become an expert in ANSYS, but rather to learn the basics of using a commercial FEA code and the validation exercises an analyst would typically employ to ensure the accuracy of their results. This requires a fundamental understanding of the shortcomings of certain element formulations and element integration techniques. The lab tutorial will cover static, modal, and Eigen value solutions that incorporate several types of line and continuum style elements, as well as techniques in global and local meshing.

II. Course Objectives

Course Objective 1：Understand the application of FE method in mega projects of China, such as high-speed train, big airplane and nuclear power station. Enhance students' self-confidence and national pride, cultivate their patriotism.

Course Objective 2：Understand the basic theory of elastic stress; application of minimum potential energy method in finite element analysis. Familiar with the basic operation procedure, functions of main menu, model building and the help system. Have the ability to analyze the static and simple vibration problems

Course Objective 3: Develop the ability to improve the skills in the use of software, based on the help system, combining with online resources, and gradually have the ability to solve complicated engineering problems.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Finite Element Technology and Application》

Index points of graduation requirements	**Content**
5.2	For complex engineering problems in the field of mechanical engineering, select and use appropriate technological means and modern engineering tools to model, predict and simulate.
5.3	Understand the limitations to solve complex mechanical engineering problems with modern tools.
8.1	With correct values, accurate understanding the relationship between individual and society, understanding and identification of China's national conditions.

Table 2. The supporting relationship between the course objectives of 《Finite Element Technology and Application》 and the index points of graduation requirements

Index points of graduation requirements	**5.2**	**5.3**	**8.1**
Course objectives	2	3	1
Intensity of support	H	H	L

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	1.Introduction to Finite Element Analysis 1.1 What is FEA 1.2 FEM Application 1.3 Analysis Procedure 1.4.Ansys overview	1. Understand the concept of FEA 2. Command the analysis procedure of FEA 3. familiar with the Ansys software interfaces 4. Through the application of FE in High speed train, Nuclear power station and three gorges dam, increase student's, enhance their self-confidence and proudness.	2	Lecture	1、2、
2	2. Bar and Beam Elements 2.1. Axial Bar Element 2.2. Beam Element 2.3. Finite Element Calculation Procedure 2.4. Frame and Truss.	1.Understand the characteristics of bar and beam elements 2.Know about the FE formulations for bar and beam elements 3. Able to solve frame and truss practical problems	10	Lecture and tutorial	2、3
3	3. Two Dimensional Analysis 3.1.Plane stress Analysis 3.2.Plane strain analysis 3.3.Axisymmetric Analysis	9. Understand the conditions to apply 2D plane analysis 10. Able to simplify 3D solid model to plane analysis and solve practical problems	6	Lecture and tutorial	2、3
4	4. Shell Elements 4.1.3D shell Elements 4.2. Axisymetric shell Elements	1. Know about the derivation procedure for shell FE formulation 2. Able to use axisymmetric and 3D elements to solve practical problems 3. Demonstrate how FE used in C919 big plane analysis, foreign FEA software is used, there is no Chinese FEA software, encourage students to know the gap between developed countries, and work hard to make contribution if possible.	6	Lecture and tutorial	1、2、3
5	5. Three Dimensional Analysis 5.1.Introduction to 3D analysis 5.2.Elements	4. Understand the different shapes of 3D solid elements and their pros and cons 5. Able to use 3D solid elements to solve practical problems	4	Lecture and tutorial	2、3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
6	6. Dynamic Analysis 6.1.Equations of Motion 6.2.Frequency Response Analysis 6.3.Modal Analysis 6.4.Transient Response Analysis	3. Understand the difference between static and dynamic analysis 4. Able to carry out modal analysis in Ansys 5. Introducing the Humen bridge accident, cultivate students the spirit of exploration.	4	Lecture and tutorial	1、2、3

Table 4 Class hour allocation for experimental teaching content

Experiment	Content outline	Equipment or Experiment environment	Hour	No. of students in each group	Experiment attribute（basic/comprehensive/design/research innovation）	Requirement (compulsory/optional)	Corresponding course objective
2D Plane truss	Application of 2D bar element, simple boundary condition, familiar with analysis procedure	Ansys V.15 or above	2	35	Basic	compulsory	3、4、5
Bicycle Space Frame	Application of beam element, simple boundary condition	Ansys V.15 or above	2	35	Basic	compulsory	3、4、5
Plane Stress Bracket	Application of 2d plane element, simple boundary condition	Ansys V.15 or above	2	35	Basic	compulsory	3、4、5
Deflection of a Simply Supported Plate with a Central Point Load	Application of shell element, simple boundary condition	Ansys V.15 or above	2	35	Basic	compulsory	3、4、5
Solid Model Creation	Application of 3D solid element, simple boundary condition	Ansys V.15 or above	2	35	Basic	compulsory	3、4、5
Modal	Vibration analysis	Ansys V.15 or	2	35	Basic	compuls	3、4、5

Analysis of a Cantilever Beam		above				ory	
Comprehensive Problems	Selection of elements, application of BC and loads	Ansys V.15 or above	4	35	Comprehensive	compulsory	3、4、5

V. Teaching method

The course mainly consists of lectures, practice on computer and assignments.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 Course objectives and assessment methods

Score category	**Assessment methods**	**Percentage**	**Assessment details**	**Corresponding objectives**
Usual performance	Assignments	50%	To assess the level of understanding knowledge taught in class, accounting for 50% of total score	1、2
Exam	Software operation on computer	50%	To assess the ability to use Ansys solving practical problems, accounting for 50% of total score.	2、3

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	**Grading criteria**
Assignments	According to the condition of completion, there will be four levels：Excellence (90-100, good (75-89, normal (60-74), fail (below 60). Adjust the score depending the class attendance.
Software operation on computer	According to the answer and score judgement standard

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

	Assessment 1（Assignments）（K1）	Assessment 2（Software operation on computer）（K2）

<table>
<tr><th colspan="2"></th><th>Assessment 1
（Assignments）（K1）</th><th>Assessment 2
（Software operation on computer）（K2）</th></tr>
<tr><td colspan="2">Percentage</td><td>0.2</td><td>0.8</td></tr>
<tr><td rowspan="3">Score percentage of course objective for each assessment method</td><td>Objective 1
（M1）</td><td>0.1</td><td>0</td></tr>
<tr><td>Objective 2
（M2）</td><td>0.7</td><td>0.9</td></tr>
<tr><td>Objective 3
（M3）</td><td>0.2</td><td>0.1</td></tr>
</table>

VII. Recommended textbooks and reference materials

Textbook：

Since lecture notes will be delivered to students, textbook is not required. However students are encouraged to read the following reference books:

Reference books：

[1] Tirupathi R. Chandrupatla, A.D. Belegundu. “Introduction to Finite Elements in Engineering”, Prentice Hall, 2002

[2] Y. Nakasone and S. Yoshimoto, “ Engineering Analysis with ANSYS Software “, Elsevier Butterworth-Heinemann, 2006

[3] M.Asghar Bhatti. “Fundamental Finite Element Analysis and Applications.” Wiley, 2005. ISBN 0-471-64808-6

[4] J.N. Reedy. “An Introduction to the Finite Element Method.” McGraw-Hill Science/Engineering/Math, ISBN 0-072-46685-5.

Online resource:

[1] http://www.ansys.com

Teaching group： Hongjun Li, Yimin Wei, Xun Zhou   Course administrator：Hongjun Li

Written by: Hongjun Li   Reviewed by: Jianmin Li

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 27, 2021

《三维建模与仿真技术*》教学大纲

3D Modeling and Simulation Technology

Course Name： 3D Modeling and Simulation Technology Course Code：31943

Category of this course: Specialized Courses (limited optional course)

Total credit hours: 32 lessons (including lectures: 16 lessons, Computer practice: 16 lessons)

Credits: 2.0

Prerequisites: Mechanical Drawing, Mechanical Principles, Theoretical Mechanics

Applicable major: Mechanical design and manufacturing and automation, Mechanical and electronic engineering

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

This course is a technical course with strong practicality. It focuses on cultivating students' logic in thinking and solving problems, as well as the craftsman spirit of pursuing excellence in a big country. With the extensive application of Computer technology, the traditional product design, analysis and manufacturing technology are undergoing fundamental changes. Computer-aided design (CAD), Computer-aided analysis (CAE) and Computer-aided manufacturing (CAM) technologies have been developed rapidly and applied more and more widely. This course is an indispensable part of CAD/CAE/CAM technology. The teaching purpose of this course is to enable the students mastering the 3D modeling methods, preliminarily learning 3D modeling to carry out engineering practical design problems, combining the basic knowledge of mechanics, mechanical principles, mechanical design and other courses with professional software, and assisting in analyzing and designing basic technical courses of institutions and mechanical systems.

II. Course Objectives

Objective 1: Whether traditional manufacturing or smart manufacturing, whether industrial economy or digital economy, craftsmen have always been an important role in China's manufacturing industry, and the craftsman spirit has always been an important source of innovation and entrepreneurship.' Made in China' & China need to develop more high-skilled talents and powers artisans, provided abundant impetus for economic and social development.

Objective 2: To understand the current situation and development of modern Computer-aided design;

to cultivate and improve the ability of independent analysis and design of things; to understand the interactivity between virtual technology and other related professions and its significance in reality.

Objective 3: To master the basic methods and applications of Computer graphics, and to master the basic methods and applications of the computer 3D digital modeling and assembly.

Objective 4: To be able to optimize and analyze data for complex mechanical system simulation (kinematics and dynamics) using professional software.

Objective 5: To have the ability to select relevant auxiliary analysis software or tools in mechanical system analysis reasonably, including construction of rigid body system and rigid-flexible coupling system, comparison of simulation and experimental data, data post-processing, and optimization design.

III. Graduation requirements supported by teaching objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the teaching objectives of this course and the index points supporting graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *3D Modeling and Simulation Technology*

Index points of graduation requirements	Content of the index points of graduation requirements
5.2	Being able to select and use appropriate technical means and modern engineering tools for modeling, prediction and simulation of complex engineering problems in the field of mechanical engineering.
5.3	Understanding the limitations of using modern engineering tools to solve complex engineering problems in mechanical engineering.
8.2	Understand the core socialist values, understand the national conditions, safeguard national interests, and have a sense of responsibility to promote national rejuvenation and social progress.

Table 2. The supporting relationship between the course objectives of *3D Modeling and Simulation Technology* and the index points supporting graduation requirements

Index points of graduation requirements	5.2		5.3		8.2
Objectives	3	4	2	5	1
	40%	60%	50%	50%	
Intensity of support	H		H		L

IV、Basic teaching content and class arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
1	1. Introduction (1) CAD process model, functions and characteristics of mechanical products (2) Research scope and related technologies of virtual prototyping technology.	1. Inheritting the value of the craftsmanship of the Chinese nation, and showing how ancient people finished the design (to design a furniture or a wooden house). Mastering the CAD process model, functions and characteristics of mechanical products; 2. Understanding the research scope and related technologies of virtual prototyping technology.	1	Teaching in class	1,2
2	2. Parametric design (1) Size and variable drive (2) Sketch (3) Dimension, constraints and their relationship.	1. Mastering dimensions and variable drivers 2. Mastering sketching 3. Understanding dimensions, constraints and their relationship.	3	Teaching in class	3
3	3. Feature-based solid modeling (1) Features and functions of feature modeling (2) Definition criteria of features (3) Geometric model of feature representation (4) Surface modeling (5) Feature recognition	1. Understanding the characteristics and functions of feature modeling, and understand the definition criteria of features 2. Mastering the geometric model of feature representation (Ancient Chinese people tried to make different furniture with different geometries but with the same pattern. Showing the original idea about the geometric model) 3. Mastering surface modeling and feature recognition	4	Teaching in class	4
4	4. Assembly based on parameterization and variable quantization (1) Basic assembly method (2) Implementation of interactive modification between parts entity and assembly entity (3) The explosive structure of the assembly entity	1. Mastering basic assembly methods 2. Mastering the implementation of interactive modification between parts entity and assembly entity 3. Mastering the explosive structure of the assembly entity	4	Teaching in class	3
5	5. Automatic generation technology of engineering view (1) View creation and parameter setting (2) Creation and parameter setting of section view (3) View management (4) Interaction with two-dimensional engineering drawings	1. Understanding view creation and parameter setting 2. Mastering the creation and parameter setting of section view 3. Mastering view management 4. Mastering the interaction with 2d engineering drawings	2	Teaching in class	3

Chapter	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
6	6. Modeling by simulation software ADAMS (1) Basic operation of ADAMS/View and ADAMS/View commands (2) ADAMS/View database, View window, display mode and other environment Settings, information management (3) Use basic geometric elements for modeling and feature modification (4) Construction and editing of geometric models of complex mechanical systems using SolidWorks and other CAD software	1. Being familiar with the basic operation of ADAMS/View and ADAMS/View commands 2. Being familiar with ADAMS/View database, View window, display mode and other environment Settings, information management 3. Mastering the use of basic geometric elements for modeling and feature modification 4. Mastering the construction and editing of geometric models of complex mechanical systems using SolidWorks and other CAD software	4	Teaching in class	3
7	7. Mechanism constraints and loads (1) ADAMS constraint types and tools. (2) The application and parameter modification of commonly used motion pairs (gear pairs, correlation pairs, etc.). (3) Build complex constraints and define the motion of the mechanism according to the simple plane pair. (4) Some attention problems in mechanism constraint and movement. (5) Tools and basic concepts of force application, function definition and subroutine definition of force element. (6) The application method of rigid force, flexible connection and contact force and the theoretical significance of relevant parameters.	1. Being familiar with ADAMS constraint types and tools (to show the gap at Software Progress between China and Foreign countries, to activate the learning passion of the students.) 2. Being familiar with the application and parameter modification of common motion pair (gear pair, correlation pair, etc.) 3. Being familiar with building complex constraints and defining mechanism movements according to simple plane pairs 4. Understanding some attention issues in institutional constraints and movement 5. Being familiar with tools and basic concepts of force application, function definition and subroutine definition of force elements 6. Being familiar with the application method of rigid force, flexible connection and contact force and the theoretical significance of relevant parameters	4	Teaching in class	3,4,5
8	8. Simulation analysis, debugging and post-processing (1) Setting of simulation parameters, analyzing the establishment and output of measurement. (2) Simulation analysis and test of prototype, setting of simulation control parameters and debugging	1.Mastering the setting of simulation parameters, analyze the establishment and output of measurement 2. Being familiar with prototype simulation analysis and test, simulation control parameter setting and prototype debugging 3. Being familiar with the basic	4	Teaching in class	4,5

Chapter	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
	of prototype (3) The basic operation of ADAMS/PostProcessor. (4) Draw the simulation result curve and process the simulation result data.	operation of ADAMS/PostProcessor 4. Being familiar with curve drawing and data processing of simulation results			
9	9. Parametric modeling and design (1) Parametric modeling and design of basic mechanism. (2) Commonly used design functions and operation process functions. (3) Parametric analysis: design research, test design and optimization analysis.	1. Being familiar with parametric modeling and design of basic mechanism 2. Being familiar with common design functions and operation procedure functions 3.Understanding parametric analysis: design research, test design and optimization analysis	6	Teaching in class	4,5

V. Teaching method

The teaching mainly relies on the in-class teaching, assisted by practice and homework.

VI. evaluation method

The assessment this course is to evaluate the degree of students achieving the teaching objectives of the course, which reflects the degree of students achieving the objectives of ability cultivation. The assessment methods are shown in Table 4 below.

Table 4 Course objectives and assessment methods

Scores	Evaluation parts	percentage	Evaluation details	Related objectives
Usual performance	In-class performance	20%	It mainly assesses students' understanding and mastery of basic knowledge and skills. Evaluate students' answers to questions and their participation in class discussions. Practice effect in class. will count 10% towards the course grade.	1、2、3、4
	homework	30%	It mainly assesses students' understanding and mastery of each lesson. Calculate the average score of all assignments and count it into the total score by 30%.	2、3、4
Exam on a PC	Exam result	50%	It mainly assesses students' mastery of software and their ability of using software to design and analyze complex mechanical system simulation. Students are required to complete a set of mechanical system modeling, simulation and testing tasks within the specified time, including 40 points for modeling, 40 points for simulation, and 20 points for testing. The Computer test score will be counted as 60% of the course total score.	1、2、3、4

The grading standards of this course for each assessment link of the course are shown in Table 5.

Table 5 The grading standards of this course

Evaluation parts	**Grading standards**
In-class performance	According to the situation of answering questions, there are five grades: excellent (90-100), good (80-89), middle (70-79), passed (60-69), failed (below 60 points), on the basis of grades combined with class performance as appropriate to give points.
Homework	According to the completion of the homework, there are five grades: Excellent (90-100), good (80-89), middle (70-79), passed (60-69), failed (below 60).
Exam	According to the completion of the test, according to the scoring rules will be graded.

The score distribution matrix of assessment methods and course objectives is shown in Table 6.

Table 6 Assessment methods and course target score distribution matrix

		Part 1 （in-class performance） （K1）	Part 2 （homework） （K2）	Part 3 （exam） （K3）
Percentage		0.10	0.30	0.60
Percentage of the objectives	Objective 1 （M1）	0.0	0.1	0.0
	Objective 2 （M2）	0.2	0.2	0.2
	Objective 3 （M3）	0.3	0.2	0.3
	Objective 4 （M4）	0.3	0.3	0.3
	Objective 5 （M4）	0.2	0.2	0.2

VII.Recommended teaching materials and reference materials

Books and Reference Material：

[1] Help of ADAMS software.
[2] Help of SOLIDWORKS software.

Teaching group: Yimin Wei, Wei Ye, Jianmin Li　　Course administrator: Yimin Wei

Written by: Yimin Wei　　Reviewed by: Jianmin Li

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Modified at May, 28, 2021

《工程计算方法与应用*》教学大纲

Engineering Computation Methods and Applications

Course name: Engineering Computation Methods and Applications

Course code: 31944

Course type: Specialized course (Required optional course)

Total teaching hours: 32 (Classroom Hours: 16; Programming Practice:16)

Credit: 2

Prerequisites: Calculus, linear algebra, programming

Major: Mechanical design, manufacturing and automation, Mechatronics engineering, Energy and power engineering

Department: Department of Energy and Power Engineering

I. Course Introduction

Scientific computing has become a scientific research as the same as theoretical analysis and experiment, and become more popularization with the rapid development of computer. Not only the relevant professional students and personnel specializing in science and engineering calculation, but also the research personnel and technical personnel working in Machinery, mechanics, physics, aerospace, information transmission, energy development, civil engineering, hydrology and geology exploration, medicine and health care, agricultural scientific research and population resource prediction need to master numerical analysis and scientific computing method. Even relevant personnel in finance and risk investment use numerical analysis as an important tool. This course pays equal attention to theory and practice, which requires students to have learned higher mathematics, linear algebra, differential equations and C language programming. Students can learn nonlinear equation solution, linear equation solution, interpolation and approximation, numerical integration, numerical solutions to ordinary differential equations, building a solid mathematical foundation for the following related courses. Introduce the development histories of important concepts, theorems and engineering applications to establish dialectical materialism for students, and understand contributions from domestic scholars.

II. Course Objectives

Course Objective 1： Cultivate students to develop a learning attitude that is diligent, careful, not afraid of difficulties, and hardworking; able to use dialectical viewpoints and methods to analyze, understand and solve engineering problems involving numerical analysis; understand the outstanding contributions of Chinese scholars in this field, and establish a good professional ethics and professionalism.

Course Objective 2: Understand the basic concepts and terminology involved in numerical computations in science and engineering applications. Master mathematics basic knowledge and basic knowledge of natural science needed in mechanical engineering work.

Course Objective 3: Understand the essence of numerical computation methods including error analysis, interpolation, approximation, numerical differentiation and integration, solution of initial value problem of ordinary differential equation, solution of linear systems using direct and iterative methods.

Course Objective 4: Understand the basics of programming skills using professional software such as Matlab. Use the software to solve complex problems in typical applications.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Engineering Computation Methods and Applications*

Index points of graduation requirements	**Content**
4.1	Master the testing and experimental methods of complex mechanical systems, including the testing methods and methods of force, deformation, motion, heat, etc., and grasp the relevant basic principles.
5.2	Able to choose and use appropriate technical means and modern engineering tools for modeling, prediction and simulation of complex engineering problems in the field of mechanical engineering.

Table 2. The supporting relationship between the course objectives and the index points of graduation requirements

Index points of graduation requirements	**4.1**				**5.2**			
Course objectives	1	2	3	4	1	2	3	4
Intensity of support	L	H	H	L	L	H	H	L

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	Introduction: 1. Basic concepts of numerical computation in science and engineering applications; 2. Basic knowledge of error analysis and machine number.	1. Introduce the knowledge system framework of this course; course teaching objectives, supporting graduation requirements, status in the course system of this major, teaching content, assessment methods and score ratio; 2. Understand the basic concepts and terminology of decimal and binary numbers, and their storage in computer memory; 3. Understand the basic concepts of error analysis in general calculations, and the chopping and rounding methods.	2	Lecture	1,2
2	Integration and approximation: 1. Lagrange integration, Neville's method, divided difference method, cubic spline; 2. Linear and polynomial least square approximations.	1. Understand the objective of interpolation and approximation and their differences; 2. Understand interpolation based on high-order polynomials and the way to construct the base functions; 3. Understand the differences among Lagrange interpolation, Neville's method and divided difference method; 4. Capable to use cubic splines to solve complex problems with different boundary conditions; 5. Understand the mathematical background of least square methods; 6. Comprehend the derivations of linear least square method and the computation procedures; 7. Familiar with the polynomial least square method.	8	Lecture and programming practice	1,2,3,4
3	Numerical differentiation and integration: 1. Numerical differentiation of first and second order derivatives; 2. Trapezoidal and Simpson integration; 3. Richardson extrapolation; 4. Composite integration; 5. Romberg integration.	1. Understand the mathematical derivations of computational formula for first- and second-order derivatives; 2. Comprehend the essential core and difference between trapezoidal and Simpson integration methods; 3. Understand the advantages and disadvantages of composite trapezoidal and Simpson integration methods; 4. Capable to use Richardson extrapolation method to analyze the accuracy of different	8	Lecture and programming practice	1,2,3,4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		methods; 5. Capable to use Romberg integration method to perform integration; 6. Understand the contributions from Nine Chapters in Mathematics.			
4	Initial value problem for ODE: 1. Euler method; 2. High-order Taylor method; 3. Runge-Kutta and Runge-Kutta-Fehlberg method; 4. Multistep method.	1. Understand the problem of initial value problem; 2. Understand the derivations of Euler and high-order Taylor method; 3. Understand the difference of one-step and multistep methods; 4. Capable to use Runge-Kutta and Runge-Kutta-Fehlberg methods to perform computations; 5. Comprehend the explicit and implicit methods, and the predictor-corrector method; 6. Understand the development history of Runge phenomenon.	6	Lecture and programming practice	1,2,3,4
5	Solution of linear systems: 1. Gauss elimination method; 2. Pivoting strategy; 3. Matrix factorization and special types of matrices; 4. Jacobi and Gauss-Seidel methods; 5. Acceleration techniques.	1. Understand the necessary steps to perform Gauss elimination; 2. Understand the necessity to use pivoting strategies; 3. Capable to perform matrix factorization for general matrix; 4. Understand the difference between Jacobi and Gauss-Seidel methods; 5. Familiar with different acceleration techniques; 6. Understand the contributions from Nine Chapters in Mathematics.	8	Lecture and programming practice	1,2,3,4

Table 4 Relationship between course objectives and teaching content for in-class experiments.

Name	Course content	Devices	Classes	No.	Type	Requirement	Course objectives
Numerical error analysis	Error analysis	Computer	2	<50	Basic	Compulsory	1,2,3,4
Interpolation	Lagrange interpolation; Neville interpolation; cubic spline	Computer	2	<50	Basic	Compulsory	1,2,3,4

	interpolation.						
Approximation	Least square approximation	Computer	2	<50	Basic	Compulsory	1,2,3,4
Solution of ODE	Euler method; multistep RK methods.	Computer	2	<50	Basic	Compulsory	1,2,3,4
Integration	Simpson method; Romberg method.	Computer	2	<50	Basic	Compulsory	1,2,3,4
Differentiation	First-order derivative; second-order derivative.	Computer	2	<50	Basic	Compulsory	1,2,3,4
Solution of LS using direct method	Gauss elimination method	Computer	2	<50	Basic	Compulsory	1,2,3,4
Solution of LS using iterative method	Jacob method; Gauss-Seidel method.	Computer	2	<50	Basic	Compulsory	1,2,3,4

V. Teaching method

The course mainly consists of lectures and assignments.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 5 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Assignments	50%	It mainly assesses students' understanding and mastery of the knowledge taught in the course. Each assignment is graded on a hundred-point scale. The average grade of each assignment is calculated as 25% of the total course grade.	1,2,3,4
Final exam	Exam	50%	Mainly assess students' mastery of basic knowledge and related analysis methods. The test paper includes 6-8 computational problems: 100 points,corresponding to course objectives 1, 2, 3.	1,2,3,4

The grading criteria of this course for each assessment method are presented in Table 6.

Table 6 The grading criteria for each assessment method

Assessment methods	评分标准

Assignments	According to the condition of completion, there will be four levels：Excellence (90-100, Good (75-89), Normal (60-74), Fail (below 60). Adjust the score depending the class attendance.
Exam	According to the answer and score judgement standard

The score allocation matrix of assessment methods and course objectives are given in Table 7.

Table 7 Assessment methods and score allocation matrix

		Assessment 1（Assignments）（K1）	Assessment 2（Final Exam）（K2）
Percentage		0.5	0.5
Score percentage of course objective for each assessment method	Objective 1（M1）	0.0	0.4
	Objective 2（M2）	0.3	0.2
	Objective 3（M3）	0.3	0.2
	Objective 3（M4）	0.4	0.2

VII. Recommended textbooks and reference materials

Textbook：

R. L. Burden, J. D. Faires, Numerical Analysis, 9th edition, Cengage Learning, 2011.

Teaching group: Wei Zhang, Yikun Wei, Zhengdao Wang   Course administrator: Wei Zhang

Written by: Wei Zhang   Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 5, 2021

《车辆设计*》教学大纲

Automotive Design

Course name： Automotive Design **Course code：** 31946

Course type： Specialized course (Required elective course)

Total teaching hours： 32 (Classroom Hours: 32)

Credit： 2

Prerequisites:

Major： Mechanical design, manufacturing and automation, Mechatronics engineering, Energy and power engineering

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

《Automotive Design》is a specialized elective course for engineering students. The following aspects will be involved in this course: 1. Analysis and evaluation on the basic structure and service performance of vehicles and main assembly systems. 2. Design schemes of structures and related key parameters. 3. Basic theories in designing the assembly systems and key engineering components. 4. Advanced skills and bottleneck problems in the automotive field in China. After taking this course, the students will understand the basic theories and analytical approach in designing the main structures and assembly systems of vehicles which would be applicable for any occupations in automotive fields. In addition, students will contribute themselves more in the automotive field in China in the future.

II. Course Objectives

Course Objective 1： Understand the advanced skills and important findings the Chinese researchers have obtained; Understand the bottleneck problems in the automotive field in China; Understand the importance of craftsmanship spirit; Have greatly scientific spirit and patriotic spirit.

Course Objective 2： Understand the general processes in automotive design, overall layouts, major design indicators, main assembly systems of automobiles et al; the classifications, working conditions, design requirements, materials, performance and structural characteristics of main automotive components.

Course Objective 3： Understand the influences of key parameters utilized in engines on the service performance of vehicles; Understand how to solve the common problems in design of chassis; Understand how to enhance the strength, stiffness, fatigue resistance and reduce the frictional forces of key engineering components in automobiles.

Course Objective 4： Understand the specifications in design calculations, structural design methods and preparation of technical documents.

Course Objective 5： Have the ability to demonstrate the feasibility of design of automotive components under the constraints of social, health, safety, legal, cultural and environmental conditions.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Automotive Design》

Index points of graduation requirements	**Content**
5.2	For complex engineering problems in the field of mechanical engineering, select and use appropriate technological means and modern engineering tools to model, predict and simulate.
5.3	Understand the limitations to solve complex mechanical engineering problems with modern tools.

Table 2. The supporting relationship between the course objectives of 《Automotive Design》 and the index points of graduation requirements

Index points of graduation requirements	**5.2**	**5.3**
Course objectives	1、2、3	3、4
Intensity of support	H	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**
1	1. Basic Theories in Designing Automobiles	1. The classifications and main characteristics of common vehicles. 2. The size and service performance of common vehicles. 3. The types and main characteristics of engines. 4. The types and main characteristics of wheels and tires.	2	Lecture and Discussion	1、2、3、4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		5. The overall arrangements of assembly systems in automobiles.			
2	2. Design of Clutch	1. The design requirements of clutch. 2. The key parameters in designing the clutch. 3. Design and optimization of torsion damper. 4. Structural design of key engineering components in clutch. 5. Understand the new findings obtianed by Chinese researchers and current bottleneck problems in clutch.	6	Lecture and Discussion	1、2、3、4、5
3	3. Design of Driveshaft	11. The design requirements of driveshaft. 12. The kinematic analysis and stress-strain analysis of driveshaft. 13. Structural analysis of driveshaft. 14. Understand the new findings obtianed by Chinese researchers and current bottleneck problems in driveshaft.	4	Lecture and Discussion	1、2、3、4、5
4	4. Design of Drive Axle	1. The design requirement of drive axle. 2. Structural scheme, structural elements of drive axle and the design of drive axle housing. 3. The design of main reduce and differentials. 4. Understand the new findings obtianed by Chinese researchers and current bottleneck problems in axles	6	Lecture and Discussion	1、2、3、4、5
5	5. Design of Suspension System	6. The elastic characteristics of suspension system and the main performance parameters. 7. The effects of structural design of suspension system on vehicle performance. 8. The design of air springs and oil-gas springs. 9. Understand the new findings obtianed by Chinese researchers and current bottleneck problems in suspension system.	6	Lecture and Discussion	1、2、3、4、5
6	6. Design of Steering System	6. The design requirement of steering system. 7. Basic theories of mechanical steering system, power steering system and main structural components. 8. Understand the new findings obtianed by Chinese researchers and current bottleneck problems	4	Lecture and Discussion	1、2、3、4、5

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		in steering system.			
7	7. Design of Braking System	1. The design requirement of braking system. 2. The driving mechanisms of braking system. 3. Understand the new findings obtianed by Chinese researchers and current bottleneck problems in braking system.	4	Lecture and Discussion	1、2、3、4、5

V. Teaching method

The course mainly consists of lectures, assignments and discussion.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Assignments	30%	To assess the level of understanding knowledge taught in class, accounting for 30% of total score.	2、4
Exam	Final Exam	70%	To assess the comprehensive understanding and applications of the basic knowledge, accounting for 70% of total score.	1、2、3、5

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria
Assignments	According to the condition of completion, there will be four levels: Excellence (90-100), good (75-89), normal (60-74), fail (below 60). Adjust the score depending the class attendance.
Final Exam	According to the answers of questions, there will be four levels: Excellence (90-100), good (75-89), normal (60-74), fail (below 60).

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（Assignments）（K1）	Exam（Final Exam）（K2）
Percentage		0.3	0.7
Score percentage of course objective for each assessment method	Objective 1（M1）	0.1	0.1
	Objective 2（M2）	0.4	0.5
	Objective 3（M3）	0.2	0.2
	Objective 4（M4）	0.2	0.1
	Objective 4（M5）	0.1	0.1

VII. Recommended textbooks and reference materials

Textbook：

Since lecture notes will be delivered to students, textbook is not required. However, students are encouraged to read the following reference books:

Reference books：

[1] James Halderman. Automotive Technology: Principles, Diagnosis and Service 6th. 2019

Teaching group：Bingxu Wang Course administrator：Bingxu Wang

Written by: Bingxu Wang Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: Apr 26, 2021

《热工基础 B*》教学大纲

Fundamentals of Thermal Engineering B

Course name: Fundamentals of Thermal Engineering B **Course code**: 31948

Course type: Specialized course (Required optional course)

Total teaching hours: 32 (Classroom Hours: 32)

Credit: 2

Prerequisites: Calculus, general physics

Major: Mechanical design, manufacturing and automation, Mechatronics engineering, Energy and power engineering

Department: Department of Energy and Power Engineering

I. Course Introduction

This course mainly learns the basic principles and laws of thermal engineering. Through the study of typical thermal energy conversion and transfer processes, students can establish the basic concepts of thermal energy utilization, systematically combine the knowledge of fluid mechanics, thermodynamics, heat transfer and practical engineering applications, and understand the basic processes of energy changes in complex systems. Be able to use the knowledge learned to analyze or involve mechanical products and processes in the process of thermal energy conversion and transfer. Students have preliminary ability to solve practical problems such as the operation, management and maintenance of actual products and thermal energy equipment in the production process. Introduce the development histories of important concepts, theorems and engineering applications to establish dialectical materialism for students, and understand contributions from domestic scholars.

II. Course Objectives

Course Objective 1： Cultivate students to develop a learning attitude that is diligent, careful, not afraid of difficulties, and hardworking; able to use dialectical viewpoints and methods to analyze, understand and solve engineering problems involving heat and fluid; understand the outstanding contributions of Chinese scholars in this field, and establish a good professional ethics and professionalism.

Course Objective 2： Understand the basic concepts and terminology involved in thermal energy conversion, grasp the state parameters and the calculation of the volume change work and heat of the reversible process, grasp the classification of cycles and the thermodynamic indicators of different cycles; have the ability to apply the above theories to the thermal process and thermal power in actual engineering

The ability to perform analysis in cycles.

Course Objective 3: Understand the essence of the first law of thermodynamics and the second law of thermodynamics, master the application of the laws of thermodynamics to analyze the energy conversion process of closed systems, closed systems and stable flow systems, and understand the specific ways and measures to improve the economic efficiency of energy utilization.

Course Objective 4: Understand the three basic methods of heat transfer, understand the mechanism, process and influencing factors of heat transfer, understand the concept of compound heat transfer and heat transfer process; possess the universal law of comprehensive application of the three heat transfer The ability to analyze equipment and heat transfer processes.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Fundamentals of Thermal Engineering B*

Index points of graduation requirements	**Content**
1.2	Apply knowledge of mathematics and natural sciences to mathematical modeling and solving of complex engineering problems in the field of mechanical engineering.
4.1	Master the testing and experimental methods of complex mechanical systems, including the testing methods and methods of force, deformation, motion, heat, etc., and grasp the relevant basic principles.

Table 2. The supporting relationship between the course objectives and the index points of graduation requirements

Index points of graduation requirements	**1.2**				**4.1**			
Course objectives	1	2	3	4	1	2	3	4
Intensity of support	L	H	H	L	L	H	H	L

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	Introduction: 1. Basic concepts and terminology involved in thermal energy conversion; 2. The concept of state parameters, the calculation of volume change work and heat in reversible processes; 3. Classification of thermodynamic cycles, thermodynamic indicators of different cycles.	1. Introduce the knowledge system framework of this course; course teaching objectives, supporting graduation requirements, status in the course system of this major, teaching content, assessment methods and score ratio; 2. Understand the basic concepts and terminology of the thermal energy conversion process, as well as the differences and exercises between different concepts; 3. Understand the basic concepts and requirements of reversible processes, master the calculation methods of volume change work and heat, and be familiar with the thermal analysis process of simple compression and expansion processes; 4. Understand the classification of thermodynamic cycles, define the thermodynamic indicators of each cycle, and their differences and connections.	4	Lecture	1、2、3、4
2	The laws of thermodynamics: 1. The first law of thermodynamics, the energy equation of closed-mouth systems and steady flow systems; 2. The second law of thermodynamics, Carnot cycle, Carnot theorem, Clausius inequality; 3. Calculation of irreversible processes and cycles.	1. Understand the essence of the first law of thermodynamics, and understand its practice with the law of conservation of energy; master the method of deriving the energy equations of closed-mouth systems and stable flow systems based on the first law of thermodynamics; 2. Understand the essence of the second law of thermodynamics, grasp the Carnot cycle, Carnot theorem and their meaning, understand the thermal process principles of heat engines and heat pumps; 3. Understand the entropy parameter and understand the physical meaning of Clausius' inequality; 4. Understand the analysis and calculation methods of irreversible processes and cycles based on the principle of entropy increase. 5. Understand the development history of the first and second laws of thermodynamics, the comparison of various theories, and establish the awareness that practice is the only criterion for testing truth.	12	Lecture	1、2、3、4
3	Ideal gas and vapor: 1. The concept and related parameters of the ideal gas change process; 2. Lookup graph and lookup table	1. Understand the relationship between the process equations and basic state parameters of the ideal gas's various thermal processes; 2. Calculate and analyze the power and heat of various thermal processes, and perform qualitative analysis of thermal processes based on p-v diagram and T-s diagram;	2	Lecture	1、2、3、4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	calculation of ideal gas change process; 3. The ideal gas state equation; 4. Thermal property parameters of steam; 5. Check diagram and table calculation of steam thermal process.	3. Understand the equation of state of ideal gas; 4. Grasp the specific heat capacity of ideal gas, and use the specific heat capacity to calculate the thermodynamic energy, enthalpy and entropy of ideal gas; 5. Understand the characteristics of the thermal properties of steam, and be able to accurately and skillfully use the steam thermal properties diagrams and tables to calculate the steam thermal properties; 6. Understand the steps of steam thermal process analysis and calculation, and be able to correctly use steam thermal property diagrams and tables for steam thermal process analysis and calculation.			
4	Heat transfer mechanism 1. The basic way of heat transfer; 2. The basic principles of steady-state and unsteady-state heat conduction, and the calculation method of simple model problems; 3. The basic principle of convective heat transfer, calculation method based on criterion equation; 4. The basic principles and concepts of radiation heat transfer.	1. Understand the concepts, characteristics and basic calculation formulas of the three basic heat transfer methods; master the concepts of thermal conductivity, surface heat transfer coefficient and emissivity; understand the concepts of compound heat transfer and heat transfer processes; 2. Understand the Fourier's law of heat conduction, three-dimensional rectangular coordinate heat conduction differential equation, the solution of temperature field, through the steady-state heat conduction calculation formula of flat and cylindrical walls, the concept of thermal resistance and its application, and the characteristics of heat conduction of fins; 3. Understand the engineering calculation method and lumped parameter method of the unsteady problem of simple shape objects; 4. Understand the various factors that affect convective heat transfer and the basic characteristics of various convective heat transfer processes; grasp the concept of boundary layer, the meaning and application of criterion numbers and criterion equations; master the selection of appropriate criterion equations for forced convective heat transfer and natural Calculation of convective heat transfer; 5. Understand the Stefan-Boltzmann law and Kirchhoff’s law; grasp the basic concepts of black body, gray body, effective radiation, input radiation, angle coefficient, and heat shield; grasp the relationship between the two gray body surfaces Radiation heat transfer calculation; understand the basic characteristics of gas radiation.	14	Lecture	1、2、3、4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		6. Understand the description of natural convection in the ancient Chinese book "Mengxi Bi Tan" to inspire students' feelings of home and country, sense of pride and mission. 7. Understand the development history and outstanding achievements of my country's power equipment field, so that students can establish the determination to catch up with and surpass the international advanced level.			

V. Teaching method

The course mainly consists of lectures and assignments.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Assignments	50%	It mainly assesses students' understanding and mastery of the knowledge taught in the course. Each assignment is graded on a hundred-point scale. The average grade of each assignment is calculated as 25% of the total course grade.	1、2、3、4
Final exam	Exam	50%	Mainly assess students' mastery of basic knowledge and related design and analysis methods. The test paper structure and score distribution are as follows: 1. Fill in the blank questions: 40 points, corresponding to course objectives 1, 2, 3, 4; 2. Short answer questions: 30 points, corresponding to course objectives 1, 2, 3, 4; 3. Calculation questions or analysis questions: 30 points, corresponding to course objectives 2 and 3; 70% of the volume score will be included in the total course score.	1、2、3、4

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria

Assignments	According to the condition of completion, there will be four levels：Excellence (90-100, Good (75-89), Normal (60-74), Fail (below 60). Adjust the score depending the class attendance.
Final exam	According to the answer and score judgment standard.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1 （Assignments）（K1）	Assessment 2 （Final Exam）（K2）
Percentage		0.5	0.5
Score percentage of course objective for each assessment method	Objective 1（M1）	0.25	0.25
	Objective 2（M2）	0.25	0.25
	Objective 3（M3）	0.25	0.25
	Objective 4（M4）	0.25	0.25

VII. Recommended textbooks and reference materials

Textbook：

Y.A.Cengel, Introduction to thermodynamics and heat transfer, McGraw-Hill, Second edition, 2009.

Teaching group: Wei Zhang, Yikun Wei, Zhengdao Wang Course administrator: Wei Zhang

Written by: Wei Zhang Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 5, 2020

《液压与气压传动*》教学大纲

Hydraulic and Pneumatic Power Transmission and Control

Course name：: Hydraulic and Pneumatic Power Transmission and Control**Course code**：31949
Course type：Basic Course，Compulsory Course
Total teaching hours：32(Classroom Hours: 28 Laboratory Hours: 4)
Credit：2.0
Major：Mechanical engineering
Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

Hydraulic and pneumatic powertransmission is an application-oriented course that introduces the basic knowledge of fluid power, fluid transmission, and the respective system design, it is one of the three major transmissions. It is an engineering application of the theoretical basis of mechanism and mechanics,and it is also an independent engineering subject with a complete system and is widely used in many engineering fields and electromechanical equipment.

The theoretical teaching content of this course is divided into two parts: hydraulic system and pneumatic system. The task of the course is to enable students to master the basic theoretical knowledge of fluid transmission, the main hydraulic (pneumatic) components, circuits, and the working principle, performance, and use of the overall system, so that students can identify, analyze, understand and express the engineering practice of hydraulic (pneumatic) systems, and can fully consider the safety of the hydraulic (pneumatic) system, environment andother related issues.

II. Course Objectives

Course Objective 1： Understand the wide application of hydraulic pneumatic transmission system in heavy equipment, military equipment, aerospace, civil industry and many other aspects, especially its important role in the field of national economy and national defense. Cultivated students to establish the idea of serving the country with science and technology, strengthening the country with science and technology.

Course Objective2：Master the following knowledge points: basic knowledge of hydraulic fluid mechanics related to fluid transmission, working principles of hydraulic (pneumatic) pumps and hydraulic (pneumatic) motors, working principles and control objectives of hydraulic valves, the important role of accessories in the hydraulic system, the characteristics of various basic hydraulic circuits and their applications, etc.;

Course Objective2： Establish the abilities to: comprehend the schematic diagram of a hydraulic circuit; analyze the working principle of a hydraulic circuit; analyze general failures, and design a simple hydraulic (pneumatic) circuit to implementmeet with the requirement of the system;use pneumatic logic components to build simple pneumatic logic circuits, etc.;

Course Objective3: be aware of the influence of potential social, environmental, safety, cultural, legal and other factors related to hydraulic (pneumatic) system related technical solutions, and have the ability to avoid risks from non-technical factors.

III.Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectivesand the index points of graduation requirements is shown in Table 2.

Table 1Index points of graduation requirements supported by*Hydraulic and Pneumatic Power Transmission and Control*

Index points of graduation requirements	**Content**
2.1	Able to identify and judge the key links and parameters of complex engineering problems in mechanical engineering according to the basic principles of scientific knowledge learned
3.2	Complete teaching links such as course exercises, course design, experiments, scientific and technological training, production practice and graduation design, and be able to apply the basic principles and technical methods of natural science and engineering science to the design of mechanical engineering systems, complex units and technological processes with specific needs.
8.1	Established correct values, accurately understand the relationship between individuals and society, understand and identify with China's national conditions.

Table 2. The supporting relationship between the course objectivesand the index points of graduation requirements

Index points of graduation requirements	**8.1**	**2.1**	**3.2**
Course objectives	1	2	3
Intensity of support	L	M	H

IV.Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	1 Introduction (1)Working principle of hydraulic andpneumatic transmission; (2) The composition of hydraulic and pneumatic transmission systems, the role of each component, and the relationship between each part; (3) The advantages and disadvantages of hydraulic and pneumatic transmission and their impact on society, safety and environment.	1. Master the basic principles of hydraulic transmission; 2. Understand the advantages and disadvantages of hydraulic transmission; 3. Understand the performance requirements and classification of hydraulic working media; 4.Understand the latest development of hydraulic technology, cultivated students to establish the idea of serving the country with science and technology, strengthening the country with science and technology, and undertaking the mission. 5. Understand the impact of hydraulic and pneumatic transmission on society, safety and the environment.	2	Lecture	1,2,3
2	2. Fundamentals of Fluid Mechanics (1) Hydraulic fluid; (2) Hydrostatics; (3) Liquid dynamics; (4) Pipeline flow; (5) Orifice flow; (6) Gap flow.	1. Master the characteristics of hydraulic fluid, viscosity-temperature characteristics, and viscosity-pressure characteristics; 2. Understand the advantages and disadvantages of hydraulic transmission; 3. Understand the performance requirements and classification of hydraulic working media; 4 Understand the latest development of hydraulic technology.	2	Lecture	2
3	3. Hydraulic power components and actuators (1) Basic principles of hydraulic pumps and motors; (2) Working principle and structural characteristics of gear pump; (3) Working principle and structural characteristics of vane pump; (4) Working principle and	1. Master the basic principles and efficiency calculations of pumps and motors; 2. Understand the basic structure and working principle of vane pump and vane motor, gear pump and gear motor; 3. Master the basic structure and working principle of plunger pump and plunger motor; 4. Master the method of analyzing the output torque produced by the	4	Lecture	2,3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	structural characteristics of plunger pump; (5) Working principle and structural characteristics of hydraulic motors; (6) Working principle and structural characteristics.	motor. 5. Understand the basic structure, working principle and classification of hydraulic cylinders and swing cylinders.			
4	4. Hydraulic control components (1) Classification of hydraulic valves; (2) Directional control valve; (3) Pressure control valve; (4) Flow control valve; (5) Introduction to other valves	1. Grasp the concept of position, communication and function of the directional control valve; 2. Understand the five operation modes of controlling the action of the spool valve; 3. Master the working principle of common neutral function and directional control valve; 4. Grasp the working principle and structural characteristics of overflow valve, pressure reducing valve and sequence valve; 5.Through the teaching of pressure control valve, discuss with students how to adjust and control the pressure of study and life. 6. Master the flow characteristics of the throttle; 7. Master the working principle of flow control valve.	4	Lecture	1,2,3
5	5. Hydraulic auxiliary components (1) Working principle and classification of oil filter; (2) Working principle, structural characteristics and selection calculation of accumulator; (3) Fuel tank function and structural characteristics; (4) Classification of pipe fittings; (5) The working principle and structural characteristics of the heat exchanger.	1. Master the prevention and control of oil pollution and the working principle of the filter; 2. Understand the sealing principle and classification of seals; 3. Understand the functions and basic structure of pipe fittings, pipe joints, accumulators and fuel tanks.	2	Lecture	2,3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
6	6. Basic hydraulic circuit (1) Composition and working principle of fast motion loop; (2) Working principle of speed control loop; (3) Working principle of synchronization loop; (4) Working principle of sequence loop; (5) Working principle of balance circuit; (6) Working principle of unloading circuit.	1. Master the working principle of each hydraulic basic circuit; 2. Understand the principle of throttling speed control circuit, volume speed control circuit and calculation of main parameters; 3. Ability to analyze the working principles and characteristics of simple hydraulic circuits.	4	Lecture	2,3
7	7. Typical hydraulic system analysis and hydraulic system design (1) Working principle and characteristics of hydraulic system of power sliding table of modular machine tool; (2) The working principle and characteristics of the hydraulic system of the press. (3) Working principle and characteristics of hydraulic system of injection molding machine. (4) Design and calculation of hydraulic transmission system; (5) Examples of hydraulic system design calculations.	1. Grasp the role of each hydraulic component in the system and the composition of various basic circuits; 2. Master the methods and steps of analyzing hydraulic systems. 3. Understand the design steps of hydraulic transmission system; 4. Master the method of load analysis and calculation; 5. Master the selection principle of main components.	4	Lecture	3
8	8. Pneumatic transmission system (1) The similarities and differences between pneumatic system and hydraulic system; (2) High-pressure air generating device; (3) Pneumatic actuators and control components; (4) Pneumatic basic circuit; (5) Typical air pressure system	1. Grasp the similarities and differences between pneumatic and hydraulic systems 2. Master air pumps, cylinders, air valves, pneumatic accessories; vacuum components 3. Master the basic circuit of air pressure 4. Air pressure system analysis 5.Discuss the relationship between the engineering design and the social and nature and, Disscuss job responsibilities	4	Lecture	1,2,3
9	Review	Knowledge points of hydraulic and pneumatic systems	2	Lecture	1,2,3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
10	10. Hydraulic pump performance test (1) Understand the working characteristics of hydraulic pumps (2) Measure the flow-pressure characteristic of the hydraulic pump (3) Measure the volumetric efficiency-pressure characteristics and total efficiency-pressure characteristics of hydraulic pumps	1. Through experiments, further understand the static characteristics and performance of hydraulic pumps 2. Grasp the content and significance of the static characteristics of hydraulic pumps; 3. Master the test principles and test methods of the main static characteristics of hydraulic pumps; 4. Cultivate students' analytical ability.	2	Experiment	3
11	11. Throttle speed regulation performance experiment (1) Select hydraulic pump, one-way throttle valve and hydraulic cylinder to form the basic hydraulic circuit (2) Understand the process of reciprocating movement of the hydraulic cylinder under the control of the one-way throttle valve	1. Understand the speed regulation principle of throttle valve in hydraulic system; 2. Master the basic methods of constructing hydraulic systems for industrial sites; 3. Cultivate students' ability to complete specific design tasks; 4. Cultivate students' comprehensive application ability of knowledge and preliminary innovative ideas.	2	Experiment	3

V. Teaching method

1. Lecture: This course is a strong technical course which must rely to combination of theory and practice. A variety of effective teaching methods such as heuristics and discussion are adopted to strengthen the communication between teachers and students, to guide students to think independently, strengthen thinking training and language expression skills training.

2. Experiment: Exercise course is to help students understand and consolidate the important and difficult part of the course and improve the ability to analyze and solve problems. It is also a way that teacher can evaluate how well students master the contents.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives. The course objectives and the corresponding assessment methods are listed in Table 4.

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Class participation	Classroom performance&Homework	20%	Classroom performance：Discuss the development and professional ethics about hydraulic and pneumatic corresponding objective 1 Homework: one for hydraulic components and the other for hydraulic circuits corresponding objective 2.	1、2
Experiment	Experiment Reports	20%	2 Items: one for the character of hydraulic pumps and the other for the character of speed control circuit corresponding objective 3	3
Final examination	Final examination	60%	1. Fill in the blanks and short answer, 45scores, corresponding objective 2； 2. Design and analysis, 30scores, corresponding objective 3； 3. Engineering fact analysis problem 25 scores，corresponding objective 3	2、3

The grading criteriaof this course for each assessment methodare presented in Table 5.

Table 5 The grading criteriafor each assessment method

Assessment methods	Grading criteria
Classroom performance	Classroom performance, were graded according to the discussion.
Homework	2 Items, were graded according to the amount of completion and accuracy.
Experiment Reports	2 Items, were graded according to the reference answers.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（Usual performance）（K1）	Assessment 2（Experimental report）（K2）	Assessment 3（Final exam）（K3）
Percentage		0.2	0.2	0.6
Score percentage of course objective for each assessment	Objective 1（M1）	0.5	0	0
	Objective 2（M2）	0.5	0	0.45
	Objective 3（M3）	0	1	0.55

		Assessment 1（Usual performance）（K1）	Assessment 2（Experimental report）（K2）	Assessment 3（Final exam）（K3）
method				

VII.Recommended textbooks and reference materials

Textbook

Shumei Chen, Hydraulic and pneumatic transmission (Chinese-English Bilingual Edition), China Machine Press, 2016

Reference books

Franklin D. Yeaple.Hydraulic and pneumatic power and control, Jo-SERBIULA (sistemaLibrum 2.0), 2020.

Teaching group: Zhong Xiang, Yisheng Liu, ZhenyuWu **Course administrator:** Yisheng Liu

Written by: Yisheng Liu **Reviewed by**: Zhong Xiang

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 29, 2021

《机电传动与控制*》教学大纲

Mechanical & electrical Transmission Control

Course Name: Electromechanical Transmission and Control Course Code: 31950

Course type: Basicspecialized course (optional)

Total teaching hours: 32 class hours (including lecture hours: 28 class hours, experiment 4 class hours)

Credit:2

Prerequisites: Advanced Mathematics, Fundamentals of Mechanical Design, Fundamentals of Circuit Principles, Digital Electronic Circuits, Analog Electronic Circuits, Principles of Automatic Control

Majors: Mechatronics engineering, mechanical design and manufacturing and automation, Measurement and control technology and instrument

Department: Department of mechatronic Engineering

1. Course introduction

The goal of Ideological and political education in the course of Mechanical & electrical Transmission Control is to cultivate students' sense of professional honor and professional mission, and to cultivate students' serious and rigorous attitude towards study and work. And through the understanding of the content and significance of the professional work that I will be engaged in in in the future, gradually establish a sense of professional responsibility, and lay a correct ideological foundation for the future professional work.

Mechanical & electrical Transmission Control course is a compulsory professional basic course for mechatronics engineering majors. It is a main course set up based on the actual needs of mechatronics technology to cultivate high-level technical talents in mechatronics engineering who have both high theoretical knowledge and analytical/problem-solving capabilities.

This course is a comprehensive electromechanical course integrating motors, electrical appliances, power electronics, programmable controllers, and automatic control systems. Through the study of this course, students can understand the development trend and the latest technology of electromechanical transmission and control system, broaden students' horizons, and adapt them to the needs of continuously developing modern production. The main content includes: master the basic theoretical knowledge necessary for electromechanical drive control, such as: working principles, characteristics, applications and selection methods of motors, electrical appliances, power semiconductors, etc.; master the common electromechanical drive control systems composed of relays-contactors, PLCs, etc. Working principle, characteristics, analysis and design methods; master the working principles, characteristics, performance and applications of various open-loop and closed-loop control systems such as commonly used DC speed control, AC speed control and servo control; pass specific application examples and experimental links, Improve students' ability to analyze and solve practical problems.

II Course Objective

Course Objective 1: Through the study of this course, students can understand the content and significance of related work in the future, develop a serious and rigorous learning and working attitude, gradually establish a correct sense of professional responsibility, and lay a correct ideological foundation for their future work in related majors.

Course Objective 2: by the study this course, students should master the following knowledge points: understanding the development trend and the latest technology of electromechanical transmission and control system, so that it can meet the needs of the continuous development of modern production;

Course Objective 3: Master the working principle, characteristics, application occasions and selection methods of various motors; Master the working principle, characteristics, application occasions and selection methods of common low-voltage electrical appliances, thyristors and other power electronic components;

Course Objective 4: Cultivate students' interest in electromechanical transmission and control technology, scientific research ability, engineering practice ability and innovative thinking ability in this field;;

Course Objective 5: Master the composition, control principle, application and usage of electromechanical transmission system control system; Master various common control circuits and control circuit design; To understand the application of the latest control technology in Mechanical & electrical Transmission Control

Course Objective 6: Through this course, students should be able to choose the appropriate driving scheme according to the needs of the project; Be able to propose appropriate control scheme for different motors

Course Objective 7: Having the ability of motor control system fault analysis and detection; It can design and implement a simple motion control system. For the better students should exercise and cultivate their ability to participate in engineering practice and scientific research

III Graduation Requirements

The index points of graduation requirements of this course are shown in Table 1, and the supporting relationship between the teaching objectives of this course and theindex points supporting graduation requirements is shown in Table 2

Table 1Electromechanical transmission and control graduation requirements

Graduation Requirements Index Point	The Content of Graduation Requirements Index Point
2.1	Be able to identify and judge the key links and parameters of complex engineering problems in mechanical engineering according to the basic principles of scientific knowledge.
3.2	Be able to determine the design requirements for the complex engineering problems in the field of mechanical engineering, and apply the basic principles and technical means of natural science and engineering science to the design of components, complex units, systems and processes.

3.3	Be able to identify clear design requirements and propose design solutions for complex engineering problems in the field of mechanical engineering, and be able to consider social, health, safety, legal, cultural and environmental factors.
4.1	Master the testing and experimental methods of complex mechanical system, including the testing methods and means of force, deformation, motion and heat, and master the relevant basic principles.
4.2	Be able to comprehensively use the scientific principles, design experiments according to the research needs, carry out experiments according to reasonable steps and obtain data.
5.2	Be able to select and use appropriate technical means and modern engineering tools for modeling, prediction and Simulation of complex engineering problems in the field of mechanical engineering.

Table2 Electromechanical transmission and control's relationship between graduation requirements and Index point

Graduation Index point	**2.1**	**3.2**	**3.3**	**4.1**	**4.2**	**5.2**
CourseCourse objective	2	3	1、4	5	1、6	7
Difficulty of the class	L	L	L	L	L	L

IV.The basic teaching content and school hours arrangements

Table 3 relationship between the teaching content and teaching requirement

chapter	**Teaching content**	**Teaching requirement**	**hours**	**Teaching methods**	**Course objectives**
1	1. Introduction (1)Composition of electromechanical system (2) The purpose and task of Mechanical&electrical Transmission Control (3) Overview of the development of electromechanical transmission and control system (4) Character and tasks of the course (5) Content arrangement of the course	1. Introduce the knowledge system framework of this course;Teaching objectives, graduation requirements, position in the curriculum system of the major, teaching content, assessment methods and score ratio; 2.Understanding the composition of electromechanical system; 3. Purpose and task of Mechanical&electrical Transmission Control; 4. Understand the development of electromechanical transmission and control system.	2	Lectures in the classroom	2

chapter	Teaching content	Teaching requirement	hours	Teaching methods	Course objectives
2	1.Dynamic basis of electromechanical transmission system (1) Motion equation of electromechanical transmission system (2) Load characteristics of electromechanical transmission system (3) Conditions for stable operation of electromechanical transmission system	1. Introduce the knowledge system framework of this course; Teaching objectives, graduation requirements, position in the curriculum system of the major, teaching content, assessment methods and score ratio; 2. Understand the composition of electromechanical system; 3. Purpose and task of Mechanical&electrical Transmission Control; 4. Understand the development of electromechanical transmission and control system.	2	Lectures in the classroom	3
3	3. Working principle and characteristics of DC motor (1) The basic structure and working principle of DC motor (2) The mechanical characteristics of the DC motor (3) The start-up characteristics of the DC Heli motor (4) Speed regulation characteristics of DC separately excited motor (5) Braking characteristics of DC separately excited motor	1.Understand the basic structure and working principle of DC motors; 2.Master the mechanical characteristics of DC motors; 3.Master the starting characteristics of DC separately excited motors; 4.Master the speed regulation characteristics of DC separately excited motors; 5.Master the braking characteristics of DC separately excited motors； 6.This paper introduces the typical deeds and inspirational stories of Faraday, so that students can understand that scientific knowledge is not easy to get, it needs to pay hard work, there is no shortcut to go on the road of exploration, it needs the spirit of tireless, fearless of failure and brave to challenge.	4	Lectures in the classroom	3、5
4	4. Fundamentals of Power Electronics (1) Power semiconductor devices (2) Rectifier circuit (3) Inverter circuit (4) PWM speed regulation	1. Master power semiconductor devices; 2. Master the rectifier circuit 3. Master the inverter circuit 4. Master the principle of PWM speed regulation	2	Lectures in the classroom	4、7

chapter	Teaching content	Teaching requirement	hours	Teaching methods	Course objectives
5	5. DC motor speed control system (1) Main technical indicators of speed control system (2) Thyristor-motor DC speed regulation system (3) DC pulse width modulation speed control system (4) DC drive system controlled by microcomputer	1. The main technical indicators of the demodulation speed system; 2. Understand the thyristor-motor DC speed control system; 3. Master the DC pulse width modulation speed control system; 4. Understand the DC drive system controlled by microcomputer.	4	Lectures in the classroom	3、4、6、7
6	11. Relay-contactor control (1) Commonly used control appliances (2) The composition of the relay-contactor control circuit (3) Relay-contactor control basic circuit	1. Master the commonly used control appliances; 2. Master the composition of the relay-contactor control circuit; 3. Master the basic circuit of relay-contactor control； 4.When we talk about zero excitation protection circuit of DC motor, we should cultivate students' thought of safe production, and ensure the safety, efficiency and reliability of the scheme when we are engaged in engineering scheme design.	2	Lectures in the classroom	3、4、5
7	7. Working principle and characteristics of asynchronous motor (1) Structure and working principle of three-phase asynchronous motor (2) Rated parameters of asynchronous motor (3) Torque and mechanical characteristics of three-phase asynchronous motors (4) Starting characteristics of three-phase asynchronous motors (5) Speed regulation method and characteristics of three-phase asynchronous motor (6) Braking characteristics of three-phase asynchronous motors	1. Understand the structure and working principle of three-phase asynchronous motors; 2.Understand the rated parameters of asynchronous motors; 3. Master the torque and mechanical characteristics of three-phase asynchronous motors; 4. Master the starting characteristics of three-phase asynchronous motors; 5. Understand the speed regulation methods and characteristics of three-phase asynchronous motors; 6. Understand the braking characteristics of three-phase asynchronous motors.	4	Lectures in the classroom	3、5

chapter	Teaching content	Teaching requirement	hours	Teaching methods	Course objectives
8	8. AC automatic speed control system (1) Basic composition and classification of variable voltage frequency conversion speed regulation system (2) AC-DC-AC variable frequency speed regulation system (3) Brushless DC motor speed control system (4) Permanent magnet synchronous motor speed control system	1. Understand the basic composition and classification of variable voltage and variable frequency speed regulation systems; 2. Understand the AC-DC-AC variable frequency speed control system; 3. Understand the brushless DC motor speed control system; 4. Understand the speed control system of permanent magnet synchronous motor; 5.Explain the development of frequency conversion technology, make AC servo more competitive than DC servo, let students deeply understand the importance of science and technology development, cultivate students' thought of serving the country through science and technology.	4	Lectures in the classroom	5、7
9	9. Stepper motor control system (1) Basic working principle of stepper motor (2) Power amplifier circuit of stepper motor drive power supply (3) Control and application of stepping motor	1. Master the basic working principles of stepper motors; 2. Master the power amplifier circuit of the stepper motor drive power supply;	2	Lectures in the classroom	3、6、7
10	10. Principle and Application of Programmable Controller (1) Basic structure and working principle of PLC (2) The main functions and characteristics of PLC (3) PLC programming components (4) PLC software technology;	1. Understand the basic structure and working principle of PLC; 2. Understand the main functions and characteristics of PLC; 3. Understand the programming elements of PLC; 4. Understand the software technology of PLC.	2	Lectures in the classroom	3、4、7、
11	11. DC motor starting simulation experiment (1) Analysis of the characteristics of the three starting modes of separately excited DC motors	Grasp the characteristics of the three starting methods of direct starting, series resistance starting and variable voltage starting of DC motors with other excitation methods, and observe the changes in speed, electromagnetic torque and armature current	2	Matlab simulation	4

chapter	Teaching content	Teaching requirement	hours	Teaching methods	Course objectives
12	13. DC motor PID speed regulation experiment	Master the principle of PID speed regulation	2	Experiment	4

V.Teaching methods

The teaching method is based on classroom lectures, simulation experiments, supplemented by homework and reports.

VI. Course assessment and evaluation standards

The course assessment of "Electromechanical Transmission and Control" is to evaluate the degree to which students have reached the teaching goals of the course, and reflect the degree of achievement of students' ability training goals. The specific assessment methods, content, and corresponding teaching objectives of the course are shown in Table 4.

Table 4 Course assessment methods, content and corresponding teaching objectives

Grade composition	Assessment /evaluation link	Points	Assessment/Evaluation Rules	Corresponding teaching objectives
Usual grades	Questions in Class	15%	It mainly assesses students' understanding and mastery of basic knowledge. Score each time on a hundred-point scale. The average grade of each session is calculated as 15% of the total course grade.	3、5
	Usual homework	15%	It mainly assesses students' review, understanding and mastery of the knowledge points of each lesson, and each assignment is graded on a hundred-point system. The average grade of each assignment is calculated as 15% of the total course grade.	1、2、3、4、5、6、7
Experimental results	experimental report	30%	According to the experiment process, results and report evaluation, calculate all the experimental scores and then count them into the total score at 30%.	1、2、3、4、5、6、7
Final exam	Final exam paper results	40%	It mainly assesses students' mastery of basic knowledge of electromechanical transmission and control and related design and analysis methods. The test paper structure and score distribution are as follows: 1. Short answer questions: 40 points, corresponding to course objectives 2, 4; 2. Analysis and comprehension questions: 36 points, corresponding to course objectives 2, 3, 4, and 5; 3. Design questions: 24 points, corresponding to course objectives 3, 4, 5, and 6;	3、4、5、6、7

Grade composition	Assessment /evaluation link	Points	Assessment/Evaluation Rules	Corresponding teaching objectives
			40% of the roll-out score is included in the total course score.	

Refer to Table 5 for the grading standards for each assessment link of the "Electromechanical Transmission and Control" course.

Table 5 Course assessment and grading standards

Assessment/evaluation link	Grading
Questions in Class	According to the answer to the question, it is divided into four levels, excellent (90-100), good (75-89), medium (60-74), and failing (below 60 points). Based on the level, combined with class performance, points are given as appropriate .
Usual homework	According to the completion of the homework, it is divided into four levels: excellent (90-100), good (75-89), medium (60-74), and failing (below 60 points). Minute.
Experimental results and reports	Using a percentile system, scoring is based on the reference answers and scoring rules in the experimental report.
Final exam	The final exam adopts a 100-point system and is graded according to the standard answers and grading rules of the test paper prepared by the course leader.

Refer to Table 6 for the score distribution matrix of "Electromechanical Transmission and Control" course assessment methods and course objectives.

Table 6 Assessment method and course target score distribution matrix

		Assessment 1 (Question in class) （K1）	Assessment 2 (Usual homework) （K2）	Assessment 3 (Experimental results and reports) （K3）	Assessment 4 (Final exam) （K4）
The proportion of assessment methods in the total score		0.15	0.15	0.30	0.40
The proportion of course objectives in	Course Objective 1 (M1)	0.1	0.1	0	0
	Course Objective 2 (M2)	0	0.1	0.1	0

each assessment	Course Objective 3 (M3)	0.4	0.1	0.3	0.4
	Course Objective 4 (M4)	0	0.1	0.1	0
	Course Objective 5 (M5)	0.5	0.2	0.2	0.2
	Course Objective 6 (M6)	0	0.2	0.1	0.2
	Course Objective7 (M7)	0	0.2	0.2	0.2

According to the average analysis of the achievement of the course objectives of "Mechanical&electrical Transmission Control ", the evaluation criteria for achieving the course teaching objectives are determined as follows:

Table 7 Evaluation Criteria for Achieving Course Objectives

Course targets	Evaluation standard				
	Average course goal achievement 0.9-1	**Average achievement of course goals 0.8-0.89**	**Average achievement of course goals 0.7-0.79**	**Average achievement of course goals 0.6-0.69**	**Average achievement of course objectives 0-0.59**
	excellent	**good**	**medium**	**Pass**	**failed**
1. Through the study of this course, students can understand the content and significance of related work in the future, develop a serious and rigorous learning and working attitude, gradually establish a correct sense of professional responsibility, and lay a correct ideological foundation for their future work in related majors.	Can complete and accurately develop a serious and rigorous attitude towards study and work, gradually establish a correct sense of professional responsibility, and lay a correct ideological foundation for their future work in related majors.	They can correctly develop a serious and rigorous attitude towards study and work, gradually establish a correct sense of professional responsibility, and lay a correct ideological foundation for their future professional work.	They can develop a serious and rigorous attitude towards study and work, gradually establish a correct sense of professional responsibility, and lay a correct ideological foundation for their future professional work.	Can basically correctly develop a serious and rigorous attitude towards study and work, gradually establish a correct sense of professional responsibility, and lay a correct ideological foundation for their future professional work.	Can not correctly develop a serious and rigorous attitude towards study and work, gradually establish a correct sense of professional responsibility, and lay a correct ideological foundation for their future work in related majors.

Course targets	Evaluation standard				
	Average course goal achievement 0.9-1	**Average achievement of course goals 0.8-0.89**	**Average achievement of course goals 0.7-0.79**	**Average achievement of course goals 0.6-0.69**	**Average achievement of course objectives 0-0.59**
	excellent	**good**	**medium**	**Pass**	**failed**
2. Through the study of this course, students should master the following knowledge points: enable students to understand the development trend and the latest technology of electromechanical transmission and control systems, so that they can adapt to the needs of continuously developing modern production;	Be able to fully and accurately understand the development trend and the latest technology of electromechanical transmission and control system, so that it can adapt to the needs of the ever-evolving modern production.	Able to correctly understand the development trend and the latest technology of electromechanical transmission and control system, so that it can adapt to the needs of the continuously developing modern production.	Be able to more accurately understand the development trend and the latest technology of electromechanical transmission and control system, so that it can adapt to the needs of continuously developing modern production.	Basically and correctly understand the development trend and the latest technology of electromechanical transmission and control system, so that it can adapt to the needs of the ever-evolving modern production.	Can not correctly understand the development trend and the latest technology of the electromechanical transmission and control system, so that it can adapt to the needs of the continuously developing modern production.
3.Grasp the dynamic basis of electromechanical drive systems; master the working principles, characteristics, applications and selection methods of various motors; master the working principles, characteristics, applications and selection methods of	Be able to accurately grasp the dynamics basis of the electromechanical drive system, the working principles, characteristics, applications of various motors, the working principles, characteristics, and applications of power electronic components such as	Be able to accurately grasp the dynamics basis of the electromechanical drive system, the working principle, characteristics, application occasions of various motors, the working principle, characteristics and application occasions of power electronic components	Be able to more accurately grasp the dynamics basis of the electromechanical drive system, the working principle, characteristics, application occasions of a variety of motors, the working principle, characteristics, and application occasions of common	Able to basically grasp the dynamics basis of electromechanical transmission system, the working principle, characteristics, application occasions of various motors, the working principle, characteristics and application occasions of common low-voltage electrical	It is not possible to accurately grasp the dynamic basis of electromechanical transmission system, the working principle, characteristics, application occasions of various motors, the working principle, characteristics and application

Course targets	Evaluation standard				
	Average course goal achievement 0.9-1	**Average achievement of course goals 0.8-0.89**	**Average achievement of course goals 0.7-0.79**	**Average achievement of course goals 0.6-0.69**	**Average achievement of course objectives 0-0.59**
	excellent	**good**	**medium**	**Pass**	**failed**
common low-voltage electrical appliances, thyristors and other power electronic components;	commonly used low-voltage electrical appliances, thyristors, and correct component selection.	such as common low-voltage electrical appliances, thyristors, and more correct component selection.	low-voltage electrical appliances, thyristors and other power electronic components, and the correct component selection.	appliances, thyristors and other power electronic components, and the correct component selection.	occasions of common low-voltage electrical appliances, thyristors and other power electronic components, and component selection cannot be made.
4.Cultivate students' interest in electromechanical transmission and control technology, scientific research ability and engineering practice ability in this area, and innovative thinking ability in this area, etc.;	Students have a strong interest in electromechanical transmission and control technology, as well as scientific research ability, practical ability and innovative thinking ability in this area.	Students have a strong interest in electromechanical transmission and control technology, as well as scientific research ability, practical ability and innovative thinking ability in this area.	Students have a good interest in electromechanical transmission and control technology, as well as scientific research ability, practical ability and innovative thinking ability in this area.	Students have basic interest in electromechanical transmission and control technology, as well as scientific research ability, practical ability and innovative thinking ability in this area.	Students are not interested in electromechanical transmission and control technology, as well as scientific research ability, practical ability and innovative thinking ability in this area.
5. Grasp the composition, control principle, application and use of the electromechanical drive system control system; master various common control circuits and	Be able to accurately grasp the composition, control principle, application occasions and various common control circuits of the electromechanical drive system control system, and be	Be able to accurately grasp the composition, control principles, applications and various common control circuits of the electromechanical drive system control system, and be able to design	Can more accurately grasp the composition, control principle, application occasions and various common control circuits of the electromechanical drive system control system, and	Can basically grasp the composition, control principle, application occasions and various common control circuits of the electromechanical drive system control system, and be able to design	Cannot grasp the composition, control principle, application occasions and various common control circuits of the electromechanical drive system control system, and cannot design

Course targets	Evaluation standard				
	Average course goal achievement 0.9-1	**Average achievement of course goals 0.8-0.89**	**Average achievement of course goals 0.7-0.79**	**Average achievement of course goals 0.6-0.69**	**Average achievement of course objectives 0-0.59**
	excellent	**good**	**medium**	**Pass**	**failed**
control circuit design; understand the application of the latest control technology in electromechanical drive control;	able to correctly design the control circuit.	the control circuit more correctly.	can more accurately design the control circuit.	the control circuit more correctly.	the control circuit.
6. Through the study of this course, students should acquire the following abilities: be able to choose an appropriate drive scheme according to the needs of the project; be able to propose suitable control schemes for different motors;	Can correctly choose the drive scheme according to the needs of the project; can propose accurate control schemes for different motors.	Can correctly choose the drive scheme according to the needs of the project; can propose more accurate control schemes for different motors.	Can choose the drive scheme more correctly according to the needs of the project; can propose more accurate control schemes for different motors.	Able to choose the drive scheme correctly according to the needs of the project; be able to propose basically accurate control schemes for different motors.	Can not choose the drive scheme correctly according to the needs of the project; Can not put forward accurate control schemes for different motors.
7. Ability to analyze and detect faults in the motor control system; be able to initially design and implement a simple motion control system plan. The better students should exercise and	It has the ability to analyze and detect the failure of a complete motor control system; it can correctly design and implement a simple motion control system scheme.	It has the ability to analyze and detect the failure of a complete motor control system; it can design and implement a simple motion control system more correctly.	It has the ability to analyze and detect the failure of a more complete motor control system; it can design and implement a simple motion control system more correctly.	Possess the ability of basic motor control system failure analysis and detection; can basically correctly design and implement a simple motion control system scheme.	It does not have the ability to analyze and detect faults in the motor control system; it cannot initially design and implement a simple motion control system.

Course targets	Evaluation standard				
	Average course goal achievement 0.9-1	**Average achievement of course goals 0.8-0.89**	**Average achievement of course goals 0.7-0.79**	**Average achievement of course goals 0.6-0.69**	**Average achievement of course objectives 0-0.59**
	excellent	**good**	**medium**	**Pass**	**failed**
cultivate their ability to participate in Engineering practice and scientific research.					

VII、Textbook and Reference books

Textbook:

[1] Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, edited by W. Bolton, Ashford Colour Press.

reference book:

[1] Motor and Drive Basics (Volumes 1 and 2) Fourth Edition, edited by Gu Shenggu, Machinery Industry Press, 2007

[2] Automatic control system,Li ShiqingWork, Metallurgical Industry Press, 1987

[3] Automatic control system of electric drive, Ruan Yi, Machinery Industry Press, 2010

[4] Power Electronics Technology(5th Edition), edited by Wang Zhaoan, China Machinery Industry Press, 2000

[5] Programmable Controller Tutorial-(2nd Edition)-(Basic),Hu XuelinAuthor, Electronic Industry Press, 2014

[6] Machine Tool Electrical Control Technology (Third Edition), Editor-in-Chief Qi Zhanqing, Beijing: Machinery Industry Press, 2004

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Author: NiuGuojun Reviewer: Wu Zhenyu

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 15, 2021

《机械产品设计综合实践*》教学大纲

Practice of Mechanical Product Design

Course Name: Practice of Mechanical Product Design **Course Code:** 31951

Course type: Elective course (specialized)

Total class hours: 40 class hours

Credits: 2.0

Prerequisite courses: Mechanical drawing, Theoretical mechanics, Material mechanics, Mechanical principle, Mechanical design, Mechanical system design, etc.

Majors: mechanical design and manufacturing, automation and intelligent manufacturing

Department: Department of mechanical design and manufacturing

I. Course introduction

The Practice of mechanical product design is a specialized course in the direction of mechanical design, manufacturing and automation. Through this course, the ability of mechanical product design and innovation of the students is trained. Students can combine the latest development of modern science and technology, synthesize the knowledge learned in the basic courses, carry out the principle and scheme conception design along with the detailed technical design of a practical machine or mechanism. At the same time, combining with the practical characteristics of the course, the excellent mechanical product cases of students' competition works or teachers' scientific research projects oriented to practical engineering are introduced to stimulate students' interest in learning, cultivate students' craftsman spirit of striving for perfection, and stimulate students' national passion and mission of serving the country through science and technology.

II. Teaching objectives

Objective 1: Students' competition works or excellent mechanical product cases of teachers' scientific research projects oriented to engineering practice will be introduced to cultivate students' scientific spirit of focusing on innovation, preciseness and practicality, as well as the craftsman spirit of great country of striving for perfection, so as to inspire students to serve their country through science and technology and fulfill their national mission.

Objective 2: Be able to define the design requirements and determine the functional objectives according to the specific design background; master the mechanical working principle, select proper mechanism; be able to propose design solutions for specific functional objectives; master the basic process and methods of mechanical operation and structural design, the students also need to takes social, health, safety, legal, cultural and environmental factors into consideration in the design.

Objective 3: Master 3D modeling, simulation, analysis, computer graphics and other modern engineering tools, and be able to complete the overall design of three-dimensional modeling and motion simulation, theoretical calculation and analysis, and two-dimensional engineering drawing for specific mechanical product design tasks.

Objective 4: Understand the importance of team cooperation, and be able to complete the design task through team cooperation.

Objective 5: Ability to express mechanical product solution, design process and results through report and oral presentation.

III. Graduation requirements supported by teaching objectives

The graduation requirement index points supported by the course are shown in Table 1, and the supporting relationship between teaching objectives and graduation requirements is shown in Table 2.

Table 1 graduation requirement index points supported by comprehensive practice of mechanical product design

Graduation requirement index points	**Content of graduation requirement index points**
3.3	Be able to determine clear design requirements and propose design solutions for complex engineering problems in mechanical engineering field, and be able to consider social, health, safety, legal, cultural and environmental factors.
5.2	It can select and use appropriate technical means and modern engineering tools to model, predict and simulate complex engineering problems in mechanical engineering field.
8.2	Understand the core socialist values, understand the national conditions, safeguard national interests, and have a sense of responsibility to promote national rejuvenation and social progress.
9.1	Through class group discussion, experiment, practice, curriculum design, scientific and technological training, social practice, graduation design and other links, we can understand the multi-disciplinary technical background and technical characteristics of mechanical engineering problems, and can carry out division and cooperation in team cooperation, and reasonably handle the relationship between individuals and teams.
10.1	Be able to clearly express the solutions, processes and results of complex engineering problems in the field of mechanical engineering through written reports and oral statements, and be able to understand the queries and suggestions of peers in the industry and the public.

Table 2 the supporting relationship between the teaching objectives of "comprehensive practice of mechanical product design" and the index points supporting graduation requirements

Graduation requirement index points	3.3	5.2	9.1	10.1	8.2
Teaching objectives	2	3	4	5	1
Support strength	M	M	M	M	L

IV. Teaching content and class hours arrangement

The basic teaching content, teaching requirements, class arrangement, teaching methods and the relationship with the course objectives are shown in Table 3.

Table 3 Relationship between curriculum objectives and teaching contents

Serial number	content of courses	Teaching requirements	Teaching hours	Teaching methods	Teaching objectives
1	1.Introduction of course objectives, assignment tasks, team building, data retrieval, optional design tasks (1) Design of portable walking machine (2) Design of folding bicycle (3) Design of stair climbing machine (4) Other optional mechanical design with practical significance (5) Related propositions of Mechanical Innovation Design Competition	(1) This paper introduces the teaching objectives, graduation requirements, teaching contents, assessment methods and score ratio; (2) Group them; (3) Determine the design task. (4) Access to relevant information (5) Introduce the outstanding works of previous competitions to enhance students' confidence and stimulate their learning enthusiasm. Cultivate students' scientific spirit of paying attention to innovation, being rigorous and realistic, and inspire students to serve their country through science and technology and to fulfill their mission. Such as the 10th Zhejiang Provincial Mechanical Design Competition first	1day	Lectures, guidance and discussion	1、2、4

Serial number	content of courses	Teaching requirements	Teaching hours	Teaching methods	Teaching objectives
		prize work "engineering car", the ninth Zhejiang Provincial Mechanical Design Competition first prize work "household automatic rain outside the window drying rack" and so on			
2	2. Define the design requirements and determine their functional objectives (1) Using all kinds of knowledge and innovative thinking, and using the innovative design criteria to identify the requirements, determine its functional objectives.	(1) According to the given design task, we use all kinds of knowledge and pioneering innovative thinking, and apply the innovative design criteria to identify the requirements, determine its functional objectives, and form the design requirements.	1day	Guide discussion	2、4、5
3	3.Function analysis, function solution, evaluation and decision making (1) The black box method is used to analyze and solve the total function and sub function, and the social, health, safety, legal, cultural and environmental factors are considered to conduct functional synthesis and analysis and discussion;	(1) The black box method is used to analyze and solve the total function and sub function, and the factors of society, health, safety, law, culture and environment are considered to synthesize and analyze the functions to form multiple functional principle schemes; (2) Determine the design scheme evaluation index, carry out comprehensive evaluation, and determine the design	2day	Guide discussion	1、2、3、4、5

Serial number	content of courses	Teaching requirements	Teaching hours	Teaching methods	Teaching objectives
	(2) Determine the evaluation index and conduct comprehensive evaluation	scheme (3) By introducing scientific research projects in which teachers and enterprises cooperate to solve key technical problems of intelligent equipment, students will be trained to strive for perfection in their professional qualities and craftsman spirit in a big country. Students will be inspired to serve their country through science and technology and fulfill their national mission. For example, Hangzhou major science and technology innovation project "research and development of key technology and complete sets of equipment for the manufacturing of fully automatic RF IC card core components"			
4	4.Overall design and detailed technical design (1) overall design 3D modeling and motion simulation (2) Theoretical calculation and analysis (3) Drawing of 2D engineering drawing (4) Prepare instruction manual and report ppt	(1) Complete the overall design of 3D modeling and motion simulation; (2) Complete the theoretical calculation and analysis; (3) Complete the drawing of two-dimensional engineering drawing; (4) Complete instruction and report ppt (5) Through the presentation of the PPT	5day	Guide discussion	1、2、3、4、5

Serial number	content of courses	Teaching requirements	Teaching hours	Teaching methods	Teaching objectives
		for the report of teachers' scientific research project declaration, conclusion and achievement award, the students will be trained to pay attention to innovation, rigorous and realistic scientific spirit, and inspire the students to serve the country through science and technology and take on the mission.For example, the national and international science and technology cooperation special project "Wind Power Gearbox Reliability Design and Health Monitoring Technology Cooperation Research", etc.			
5	5. defence	Ppt report and reply according to the team	1	defence	5

V. Teaching method

The course mainly consists of lectures, practice and assignments.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 curriculum objectives and assessment methods

Grade composition	Assessment / evaluation	Score	Assessment / evaluation rules	Corresponding teaching objectives
Usual performance	Daily work	20%	The performance of the design process and the participation in the discussion, and the progress of the design stage.	1、2、3、4、5

Design achievements	Mechanical product design results	80%	It mainly assesses the students to refine the design requirements according to specific requirements, carry out functional analysis, function solution, evaluation and decision-making, three-dimensional modeling and simulation, theoretical calculation and analysis, two-dimensional engineering drawing drawing, preparation of design specification, production report, PPT and defense.	1、2、3、4、5

The scoring standards for each assessment link of the course "Practice of mechanical product design" are shown in Table 5.

Table 5 scoring standard of course assessment method

Assessment / evaluation	**Scoring criteria**	
Usual performance Stage progress	According to the performance of the design process and the participation in the discussion and the stage progress of the design.It is divided into five grades: excellent (90-100), good (80-89), medium (70-79), pass (60-69) and fail (below 60).	
Mechanical product design results	The design results of mechanical products are mainly evaluated from the aspects of design requirements, design scheme, 3D model and simulation, engineering drawing quality, theoretical calculation and design specification, PPT report and defense.	Design requirements (10 points): extract the design background and design requirements.
		Design scheme (25 points): use black box method to complete functional principle design and evaluation, and complete the overall scheme design.
		3D model, simulation and engineering drawing (25 points): correctness of 3D model, simulation and engineering drawing.
		Theoretical calculation and design specification (25 points): correctness of theoretical calculation, integrity, organization and format specification of the contents of the specification
		Report PPT and reply (15 points): ppt's integrity, organization and aesthetics, clear narration and answering questions.

Table 6 assessment method and curriculum objective score distribution matrix

		Assessment 1 (usual score) (K1)	**Assessment 2 (design score) (K2)**
The proportion of assessment methods in the total score		0.2	0.8
The proportion of curriculum objectives in each assessment	Course objective 1 (M1)	0.2	0.1
	Course objective 2 (M2)	0.4	0.3
	Course objective 3 (M3)	0	0.3
	Course objective 4 (M4)	0.2	0.15
	Course objective 4 (M5)	0.2	0.15

VII. Recommended teaching materials and reference materials

Teaching materials:

[1] None

Reference books:

[1] Mechanical innovative design, edited by Zhang Chunlin, Li Zhixiang and Zhao Ziqiang, 3rd Edition, China Machine Press, 2016

[2] Gao Zhi and Huang Chunying: mechanical innovative design, 3rd Edition, higher education press, 2010

Network resources:

[1] http://umic.ckcest.cn/(official website of National Undergraduate Mechanical Innovation Design Competition)

Course teaching team: Pan Jun, Hu Ming, Yu Gaohong, Wu Chuanyu, etc.

Course administrator: Pan Jun **Written by:** Pan Jun **Reviewed by:** Wei Ye

Approved by: Teaching Committee of Faculty of mechanical and automatic control

Date: May 27, 2021

《材料力学*》大纲

Mechanics of Materials

Course Name: Mechanics of Materials **Course Code** :31952

Course type: basic courses (compulsory)

Total teaching hours：48 (Classroom Hours: 48)

Credits :3.0

Prerequisite courses: Advanced Mathematics, Theoretical Mechanics

Major：Mechanical engineering

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

The course, Mechanics of Materials, is a required basic course of mechanical platform. It uses the basic concepts of mathematics, strict logic, and assumptions based on experimental phenomena to study mechanical problems. Mechanics of Materials is not only the theoretical basis of the follow-up courses (mechanical principles, mechanical design, etc.), but also the bridge between basic and professional courses. It has been widely used in many engineering and technical fields, such as machinery, architecture, aerospace and so on.

This course is mainly concern with the strength, stiffness and stability of machines or structure components. The main contents include axial tension, shear, torsion, bending four basic deformation, stress state and strength theory, and combined deformation.

The purpose of this course is to develop students' ability of mechanical analysis of engineering structure, model simplification of engineering structure, and calculation and judgment of engineering structure. Through the study of this course, students can directly design and calculate the engineering structure of the mechanical system, and can also be used as the basis for the subsequent studies in the future.

II. Course Objectives

Objective 1: The study of the mechanics of materials is based on the understanding of basic concepts and on the use of simplified models. The main objective of course is developed in the engineering student the ability to analyze a given problem in a simple and logical manner and to apply to its solution a few fundamental and well-understood principles.

Objective 2: Master the basic concepts of strength, stiffness and stability of members, to develop students' ability to analyze the basic deformation of members, such as tensile (compression), shear, torsion, bending, etc., and to have skilled calculation ability of members' structures. (graduation requirements 2.2)

Objective 3: To grasp the concept of stress state and deformation energy of the member, understand and master the generalized hook's law and strength theory, and be able to apply the basic principles to analyze and calculate the typical problems of the member bearing various combined deformation. (graduation requirement 6.3)

Objective 4: Through the study of this course, students should have the ability to judge, analyze and simplify the structure of actual engineering member, establish mechanical models, design and calculate; be able to understand the diversity of solutions to mechanical problems of materials and be able to make reasonable choices of technical solutions. (graduation requirement 2.2)

III. Graduation Requirements Supported by Curriculum Teaching Objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by

Mechanics of Materials

Index points of graduation requirements	**Content**
2.2	It can correctly identify the diversity of complex engineering solutions, and can seek solutions and alternatives to complex engineering problems in mechanical engineering through literature research.
6.3	Ability to evaluate the social, health, safety, legal and cultural impact of complex engineering problem solutions in mechanical engineering practices and areas of mechanical engineering and to understand the responsibilities to be assumed.

Table 2. The supporting relationship between the course objectives of ***Mechanics of Materials***

Index points of graduation requirements	**6.3**	**2.2**	**6.3**	**2.2**
Course objectives	1	1	2	3
Intensity of support	L	H	H	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**Course objectives**

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	Course objectives
1	0. Introduction (1)Research on mechanics of materials (2)Methods of research on mechanics of materials (3)Purposeof studying mechanics of materials (4)Limitations and development of mechanics of materials	1.Introduce the knowledge system framework and main research contents of this course; Ideological and political theory ：Disaster analysis in mechanical engineering: the designof structures and machines should be safely and economically perform. 2.Understand the research method of material mechanics, and the difference between the course of theoretical mechanics; 3.Introduces the teaching goal, the graduation requirement, the position in the course system, the assessment method and the score ratio; 4.Understand the limitations and alternatives of material mechanics, understand its development process and direction. 5. To introduce the Chinese scientists of Mechanics as well as their contribution. .	1	Lectures, discussions	1、2
2	1. Axial tension and compression (1)Concept and examples of axial tension (2) Calculation of internal forces (3)Stress and strength conditions (4)Calculation of deformation of tension member (5) Hyperstatic problems of axial stretching and compression (6) Shear deformation	1.Master the basic concept of axial tension and compression 2.Master the application of cross section method, the calculation of stress on cross section and oblique section, the concept of allowable stress and the application of tensile strength condition; 3.Master hooke's law, the calculation of tension and deformation energy, static and indeterminate problem, the concept of shear and extrusion and the corresponding practical calculation.	9	Lectures, discussions, assignments	2、4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	Course objectives
3	2. Torsion (1)Concepts and examples of torsion (2) Calculation of internal forces of torsion (3)Torsion of thin walled cylinder (4)Stress analysis and strength condition of torsion of circular rod (5)Deformation and stiffness conditions of the rod during torsion (6)Spiral spring stress and deformation (7)Torsion of non-circular cross-sectional members (8)Free torsion of thin-walled members	1.Understanding of the basic concept of torsion; 2.Master the calculation of external torque and the drawing of torque diagram, the characteristics of stress and deformation of thin-walled cylinder during torsion and its calculation; 3.Mastering the application of strength condition and stiffness condition in torsion of circular axis, the theorem of interaction between shear hooke's law and shear stress; 4.Understand the torsion characteristics of non-circular cross-sectional members and the free torsion law of thin-walled members.	8	Lectures, discussions, assignments	2、4
4	3. Bending internal forces (1)Basic concepts and engineering examples (2) Shearing force and bending moment of beams (3) Shear and moment equations, shear and moment diagrams (4) Relationship between shearing force ,bending moment and distributed load concentration (5) Make the moment diagram by superposition principle (6)Internal force diagram of plane rigid	1.Understand the basic concept of bending; 2.Master the concept of shear force, bending moment and drawing of shear force diagram and bending moment diagram; 3.Master the relationship and application of shearing force, bending moment and load set. 4. To introduce the China High-speed railway train and stress of the axle.	5	Lectures, discussions, assignments	2、4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	Course objectives
	frame and curved member				
5	4. Bending internal forces (1) Normal stress during pure bending (2)Normal stress during transverse bending (3)Shear stress and strength conditions of beams (4)Main measures to improve beam strength	1. Master the normal stress formula on the cross section of pure curved beam; 2.Master beam normal stress calculation and corresponding strength conditions Ideological and political theory ：cultural confidence--constant strength beam 3.Master the calculation of shear stress and the corresponding strength condition of rectangular section beam; 4.Understand the concept of bending center.	5	Lectures, discussions, assignments	2、4
6	5. Bending deformation (1)Differential equation of the line of deflection (2)Calculation of bending deformation by integral method (3)Calculation of bending deformation by superposition method (4)Solution of statically indeterminate beam (5) Measures to increase bending stiffness	1.Understand the concept of deflection and rotation angle; 2.Master the use of integral method and deformation superposition method to solve the approximate differential line of deflection equation and stiffness check; 3.Can solve simple Bending statically indeterminate problem	3	Lectures, discussions, assignments	2、4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	Course objectives
7	6. Strength theory of stress-strain analysis (1) Overview of stress status (2) Analysis of plane stress state - analytical method (3) Analysis of plane stress state - graphic method (4)Three-way stress state analysis (5) Generalized hooke's law (6)Deformation specific energy of complex stress state (7) Strength theory (8)Mohr's Strength Theory	1.Master plane stress state analysis - analytic method and graphic method; 2.Master the concept and calculation of principal stress and principal plane; 3.Master the concept of generalized hooke's law, deformation energy and strength theory; 4.Understand the concept and failure characteristics of brittle and plastic materials, master the four commonly used strength theory and Mohr's strength theory.	9	Lectures, discussions, assignments	3、4
8	7. Combined deformation (1)Principle of combined deformation and superposition (2)Combination of tension (compression) and bending (3)Combination of torsion and bending	1.Understand the concept of combined deformation; 2.To master the analysis and calculation of combined deformation such as tension-bending combination and bending-torsion combination; Ideological and political theory ：craftsmanship- solving practical problem (principal and non principal deformation) 3.The combination deformation of various practical structures can be analyzed with correct strength theory. 4. By example of Combined deformation, to explain complex issues need to seize the main contradiction.	5	Lectures, discussions, assignments	3、4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	Course objectives
9	Appendix. Binding properties of cross sections (1) Static moment and centroid of section (2)Polar moment of inertia, moment of inertia and product of inertia (3) Parallel axis shift formula (4) Transformation equations	1. Master the concept and calculation of static moment, inertia of moment and product of inertia; 2. Master the formula of parallel moving axis and transformation equations.	3	Lectures, discussions, assignments	2、3、4

V. Teaching method

The teaching method is mainly classroom teaching and discussion, supplemented by homework and report after class.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives. The course objectives and the corresponding assessment methods are listed in Table 4.

Table 4 Objectives and Assessment Methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Normal grades	Classroom Questions	5%	The main assessment of students' understanding and mastery of basic knowledge. Score according to the percentage system each time. The average score of each time is 5% into the total score of the course.	1、2
	Homework assignment	15%	After class completed 60-80 exercises, the main assessment of students to each class knowledge point review, understanding and mastery. Each assignment is graded on a percentage basis. The average score of each assignment is 15% into the total score of the course.	1、2、3、4
	In-class quiz	20%	Three in-class tests were completed, when the basic deformation (tension, bending, torsion), bending deformation (internal force, stress, deformation), stress state and combined deformation were completed. Each test is scheduled for **one** class time, all for calculation questions, covering the most important course focus in this teaching unit.Finally,20% of the average score of the three tests was included in the	2、3、4

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
			total course score.	
Final exams	Final exam paper scores	60%	The test questions include application calculation questions and comprehensive analysis and calculation questions, and 60% of the test scores are included in the total course results. Among them, about 70% of the basic calculation and basic analysis, and 30% of the ability of comprehensive analysis and comprehensive calculation.	2、3、4

The grading criteria of this course for each assessment method is presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria
Classroom Questions	According to the situation of answering questions, it is divided into four grades: excellent (90-100), good (75-89), middle (60-74), failing (below 60), and giving points according to the performance of class on the basis of grade.
Homework assignment	According to the completion of the homework, it is divided into four grades: excellent (90-100), good (75-89), medium (60-74), failing (below 60 points), on the basis of grade, combined with normal classroom performance as appropriate.
In-class quiz	The test is based on the percentage system, according to the standard answers and scoring rules drawn up by the course leader.
Final exams	The final examination adopts a percentage system, according to the standard answers and scoring rules drawn up by the course leader.

The score distribution matrix of the assessment method and the course goal is shown in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1 (classroom questioning) (K1)	Assessment 2 (Operational) (K2)	Assessment 3 (in-class quiz) (K3)	Assessment 4 (Final exams) (K4)
Percentage		0.05	0.15	0.20	0.60
Score	Objective 1(M1)	0.8	0.1	0	0

		Assessment 1 (classroom questioning) (K1)	Assessment 2 (Operational) (K2)	Assessment 3 (in-class quiz) (K3)	Assessment 4 (Final exams) (K4)
percentage of course objective for each assessment method	Objective 2(M2)	0.2	0.2	0.3	0.4
	Objective 3(M3)	0	0.3	0.3	0.4
	Objective 4(M4)	0	0.4	0.4	0.2

VII.Recommended textbooks and reference materials

Textbook:

[1] Liu Hongwen, ed. Mechanics of Materials (5th Edition), Higher Education Press ,2011.01

Reference Books:

[1] Fan Yingshan, eds. Mechanics of Materials, Tsinghua University Press

[2] Sun Xunfang, Editor-in-Chief, Mechanics of Materials (3rd Edition), Higher Education Press

[3]Ferdinand P. BeerE. Russell Johnston. Mechanics of materials.3rd Edition. MeGraw-Hill

Teaching group: Li Jianmin, Yu Yaxin, Chen Yu, Zhou Xun, Yan Bo, etc
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Written by: Yu Yaxin
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Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 12, 2021

《控制工程基础*》教学大纲

Mechatronic Control Engineering

Curriculum code：31953

Course Code：Mechatronic Control Engineering

Course nature and category：Professional education（Required）

Total class Hour：48 hours（Lecture：48 hours）

Credit(s)：3.0

Prerequisite course：advanced mathematics、theoretical mechanics、mechanical principles、Fundamentals of circuit

Applicable major：Mechanical and electronic engineering、Institute of mechanical design and manufacture、measurement and control technology and instrumentation

Offering department：Institute of mechatronic Engineering

一、Introduction

Mechatronic control engineering is a compulsory basic course for all majors of mechanical platform. It is not only the theoretical basis of relevant courses in the follow-up control field, but also an independent subject with a complete system and continuous development. Moreover, it is widely applied in many engineering technology fields such as mechanical control energy and power.

Through learning this course, make the students master the basic working principles and rules of mechanical and electrical automatic control system, understand the related theories of mathematical modeling, frequency characteristic analysis, stability analysis, time response, error analysis, master the analysis methods of mechanical control system using the related theory to establish the general low order linear mathematical model of mechanical control system, and independently analyze the mechanical control system by these relevant theories and methods.

二、Objectives

Objective **1**：Organically integrate knowledge teaching, ability training and value shaping, enhance students' professional self-confidence and pride, guide students to establish scientific thinking methods, cultivate the working style of keeping improving, set up lofty ideals, and cultivate students' sense of responsibility and team spirit.

Objective **2**：Be able to elaborate the basic concept of control system, basic composition, basic requirements and control methods, to establish the basic understanding of control system engineering application background, research purposes and problem solving methods.

Objective **3**： Be able to establish multiple mathematic models such as the differential function, transfer function and frequency characteristics of the control system using Newton's law, Kirchhoff's law and Laplace transform and other methods, master the drawing and simplification of structural diagram and signal flow diagram.

Objective **4**：Be able to conduct analysis of transient response, frequency characteristic, stability and error for different control systems, and locate the key of the problem and design appropriate correction scheme for different performance requirements of complex electromechanical systems using the time-domain method and frequency-domain method.

三、Graduation requirements supported by course teaching objectives

Indicator supported by Graduation requirements is shown in Table 1, supporting relationship between Indicator and Course objectives is shown in Table 2.

Table 1 Indicator supported by Graduation requirements of Mechatronic Control Engineering

Indicator supported by Graduation requirements	Contents of Indicator
1.4	Be able to compare and synthesize solutions to complex engineering problems in the field of mechanical engineering with knowledge of design, manufacturing, control and mathematical models.
2.3	Be able to correctly describe a solution to a complex engineering problem in mechanical engineering and analyze the rationality of the solution using basic principles.
8.2	Understand and abide by the engineering professional ethics and norms of honesty and justice, integrity code and rigorous and pragmatic.

Table 2 Supporting relationship between Indicator and Course objectives of Mechatronic Control Engineering

Indicator supported by Graduation requirements	1.4	2.3	8.2
Course objectives	2、3	4	1
Support intensity	H	H	L

四、Basic teaching contents and class hour arrangements

Table 3 Relationship between course objectives and teaching content

Chapter	Teaching Contents	Teaching Requirements	Class Hour	Teaching Approaches	Course objectives

Chapter	Teaching Contents	Teaching Requirements	Class Hour	Teaching Approaches	Course objectives
1	Basic concept of automatic control system （1）Classification of control system （2）Common control signals （3）Concept of feedback （4）The feedback working principle of the control system	1. Introduce the framework and teaching objectives of this course. 2. Understand the development history of classical control theory and the classification of control system. 3. Stimulate students' interest in exploring traditional agricultural machinery in ancient China and improve their patriotic enthusiasm through the discussions on the control principle of traditional agricultural machinery such as seismograph and water wheel. 4. Understand the working principle of feedback control system and the basic composition of feedback control system. 5. Master typical control signals.	3	Teaching in class、Discussion in class	1、2
2	2. Mathematic model of control system （1）Laplace transform and inverse transform （2）Differential function （3）Typical links and transform functions （4）System block （5）Signal flow diagram	1. Master the Laplace transform and its inverse method, and their properties. 2. Master the mathematical modeling method of physical system, Master the methods of establishing the differential equation and transfer function of the system and linearization of the nonlinear system. 3. Master each typical link and its transfer function. 4. Master the modeling method of signal flow diagram of system block diagram and methods of simplification.	12	Teaching in class	2、3
3	3. Time response analysis of control system （1）Introduction （2）Time response of the first order system （3）Time response of the second order system （4）Time response of the high order system	1. Understand the concept of time response. 2. Master the analysis method of time response of first-order system. 3. Master the analysis method of the time response of the second order system and understand the analysis ways of the time response of the second order system with Zeros. 4. Understand the analysis ways of time response of high order system. 5. Master the calculation method	7	Teaching in class	2、3

Chapter	Teaching Contents	Teaching Requirements	Class Hour	Teaching Approaches	Course objectives
		of time response performance and its relation with system parameters.			
4	4. Frequency Characteristic （1）The relationship between the frequency characteristics and the transfer function （2）Method of drawing Nyquist （3）Method of drawing Bode diagram （4）Method to find the transfer function by the frequency characteristic curve （5）Method to find the transfer function by the unit time response	1. Master the basic concept of frequency characteristics. 2. Master the drawing method to drawing Nyquist. 3. Master the drawing method to drawing Bode diagram. 4. Master the method to find the transfer function by the frequency characteristic curve or the unit time response.	12	Teaching in class	2、3
5	5. Stability analysis of control system （1）Basic concept of stability （2）Algebraic Criterion for Stability （3）Nyquist Criterion for Stability （4）Stability Margin	1. Understand the basic concepts of system stability. 2. Master the method of judging system stability by algebraic stability criterion. 3. Master the method of judging system stability by Nyquist criterion. 4. Master the definition and calculation method of stability margin. 5. Enhance students' professional confidence and pride through discussions on the applications of modern control theory in robotics technology, logistics technology and intelligent manufacturing technology during the 13th Five Year Plan period.	8	Teaching in class	1、2、4
6	12. Error analysis （1）The basic concept of error in control system （2）Steady state error coefficients and steady state error	1. Understand the basic concepts of error in control system. 2. Master the calculation method of error coefficients and steady-state error	3	Teaching in class	2、3
7	7. Control system Synthesis and correction （1）System performance （2）The concept of system correction （3）Cascade compensation （4）Design of Cascade compensator	1. Understand the concept of system correction, master the ways to transfer the performance and its parameters. 2. Understand the common correction rules and correction devices. 3. Establish scientific thinking	3	Teaching in class	1、4

Chapter	Teaching Contents	Teaching Requirements	Class Hour	Teaching Approaches	Course objectives
	（5）Feedback compensator	methods through discussions on the performance, design and calibration methods of modern industrial process control system.			

V、Teaching method

The teaching method is based on classroom teaching and supplemented by homework.

VI、Assessment method

The assessment of the course is to evaluate the degree to which students have reached the teaching objectives of the course, reflecting the achievement of students' ability training objectives. The assessment method is shown in table 4 below

Table 4 course objectives and Assessment

Grading composition	Assessment/evaluation session	Score proportion	Assessment / evaluation rules	Corresponding teaching objectives
Usual exam	Homework	20%	Finish 15-20 exercises after class, mainly assess the students' understanding and mastery of each class, and calculate it into the total score by 30%.	1、2、3、4
	Quiz	20%	Once in-class test after the fourth chapter of frequency characteristic analysis. The test is arranged for 120 minutes. Contents and proportion. 1.Calculation questions, 40 points, correspond to course objective11 2.Calculation questions, 60points, correspond to course objective 2	2、3
Final exam	Exam score	60%	Mainly access the students' basic analysis and design knowledge of this course, the test consist mainly of application calculation and analysis calculation, The test is arranged for 120 minutes. Contents and proportion. 1.Multiple choice questions, 20 points, correspond to course objective 1 3.Calculation questions, 40 points, correspond to course objective 2 4.Calculation questions, 40 points, correspond to course objective 3	2、3、4

The scoring criteria for each assessment link of the course are shown in table 5 below

Table 5 Assessment methods and criteria

Assessment/evaluation session	Scoring criteria

Homework	There are four levels：excellent（90-100）、good（75-89）、medium（60-74）、fail（under 60），On the basis of levels, score is given according to class performance.
Quiz	Centesimal system, Score is given according to the standard answer.
Final exam	Centesimal system, Score is given according to the standard answer.

The score distribution matrix of assessment method and course objective is shown in table 6

Table 6 the score distribution matrix of assessment method and course objective

		Assessment 1（Homework）（K1）	Assessment 2（Ouiz）（K2）	Assessment 3（Final exam）（K3）
Proportion		0.2	0.2	0.6
Objective’s proportion in assessment	Objective 1（M1）	0.1	0	0
	Objective 2（M2）	0.1	0.4	0.2
	Objective 3（M3）	0.4	0.6	0.4
	Objective 4（M4）	0.4	0	0.4

The evaluation standard of course teaching objectives can be determined as shown in table 7 according to the assessment methods, scoring criteria, distribution matrix.

Table 7 the evaluation standard of course teaching objectives

course teaching objectives	**Evaluation standard**				
	Average achievement of course objectives 0.9-1	**Average achievement of course objectives 0.8-0.9**	**Average achievement of course objectives 0.7-0.79**	**Average achievement of course objectives 0.6-0.69**	**Average achievement of course objectives 0-0.59**
	Excellent	**Good**	**Medium**	**Pass**	**Fail**
Achieve the unity of knowledge teaching, ability training and value building, to establish professional self-confidence and pride, scientific thinking methods, improving work style, set up lofty ideals, and have a good sense of responsibility and team spirit.	Be able to completely complete the unity of knowledge imparting, ability training and value shaping, establish a high degree of professional	Be able to better complete the unity of knowledge teaching, ability training and value building, establish a higher professional self-confide	Be able to complete the unity of knowledge imparting, ability training and value shaping, establish basic professional confidence and pride,	Be able to complete the unity of knowledge imparting, ability training and value shaping, and initially establish professional self-confidence and pride,	Not be able to complete the unity of knowledge imparting, ability training and value shaping, can't establish professional self-confidence and pride,

course teaching objectives	Evaluation standard				
	Average achievement of course objectives 0.9-1	**Average achievement of course objectives 0.8-0.9**	**Average achievement of course objectives 0.7-0.79**	**Average achievement of course objectives 0.6-0.69**	**Average achievement of course objectives 0-0.59**
	Excellent	**Good**	**Medium**	**Pass**	**Fail**
	self-confidence and pride, complete scientific thinking method, constantly improving work style, set up lofty ideals, and have excellent sense of responsibility and team spirit.	nce and pride, a better scientific thinking method, a better work style, with a better sense of responsibility and team spirit.	correct scientific thinking method, work style, and have basic sense of responsibility and team spirit.	scientific thinking method and work style.	can't form scientific thinking method and work style.
Be able to elaborate the basic concept of control system, basic composition, basic requirements and control methods. Establish application background for control system engineering Have basic understanding for research purposes and problem solving methods.	Be able to accurately elaborate and master the basic concept of control system, basic composition, basic requirements and control methods. Establish accurately application background for control system engineering Have basic understanding for research purposes and problem solving methods.	Be able to correctly elaborate and master the basic concept of control system, basic composition, basic requirements and control methods. Establish correctly application background for control system engineering Have basic understanding for research purposes and problem solving methods.	Be able to fairly correctly elaborate and master the basic concept of control system, basic composition, basic requirements and control methods. Establish correctly application background for control system engineering Have basic understanding for research purposes and problem solving methods.	Be able to basically elaborate and master the basic concept of control system, basic composition, basic requirements and control methods. Establish basically application background for control system engineering Have basic understanding for research purposes and problem solving methods.	Not be able to elaborate the basic concept of control system, basic composition, basic requirements and control methods. Do not establish application background for control system engineering Have not basic understanding for research purposes and problem solving methods.

course teaching objectives	Evaluation standard				
	Average achievement of course objectives 0.9-1	**Average achievement of course objectives 0.8-0.9**	**Average achievement of course objectives 0.7-0.79**	**Average achievement of course objectives 0.6-0.69**	**Average achievement of course objectives 0-0.59**
	Excellent	**Good**	**Medium**	**Pass**	**Fail**
Be able to establish mathematical model by Newton's law Kirchhoff's law and Laplace transform and other methods. master the drawing of structural diagram and signal flow diagram simplification and other methods	Be able to proficiently establish mathematical model by Newton's law Kirchhoff's law and Laplace transform and other methods. proficiently master the drawing of structural diagram and signal flow diagram simplification and other methods	Be able to reasonably establish mathematical model by Newton's law Kirchhoff's law and Laplace transform and other methods. reasonably master the drawing of structural diagram and signal flow diagram simplification and other methods	Be able to fairly reasonably establish mathematical model by Newton's law Kirchhoff's law and Laplace transform and other methods. fairly reasonably master the drawing of structural diagram and signal flow diagram simplification and other methods	Be able to basically establish mathematical model by Newton's law Kirchhoff's law and Laplace transform and other methods. basically master the drawing of structural diagram and signal flow diagram simplification and other methods	Not be able to basically establish mathematical model by Newton's law Kirchhoff's law and Laplace transform and other methods. Do not master the drawing of structural diagram and signal flow diagram simplification and other methods
Be able to analyze the system performance and design controller by the time-domain method and frequency-domain method to conduct transient response, frequency characteristic, stability analysis and error analysis for different control systems	Be able to proficiently analyze the system performance and design controller by the time-domain method and frequency-domain method to conduct transient response, frequency characteristic, stability analysis and error analysis for different control systems	Be able to reasonably analyze the system performance and design controller by the time-domain method and frequency-domain method to conduct transient response, frequency characteristic, stability analysis and error analysis for different control	Be able to fairly reasonably analyze the system performance and design controller by the time-domain method and frequency-domain method to conduct transient response, frequency characteristic, stability analysis and error analysis for different control	Be able to basically analyze the system performance and design controller by the time-domain method and frequency-domain method to conduct transient response, frequency characteristic, stability analysis and error analysis for different control systems	Not be able to analyze the system performance and design controller by the time-domain method and frequency-domain method to conduct transient response, frequency characteristic, stability analysis and error analysis for different control

course teaching objectives	Evaluation standard				
	Average achievement of course objectives 0.9-1	Average achievement of course objectives 0.8-0.9	Average achievement of course objectives 0.7-0.79	Average achievement of course objectives 0.6-0.69	Average achievement of course objectives 0-0.59
	Excellent	Good	Medium	Pass	Fail
		systems	systems		

VII、Books and Reference

Book：

[1] Sun Jing. Fundamentals of control engineering (The first edition).Press: Science press，2017.

Reference：

[1] Dong Jingxin, Guo Meifeng. Introduction to Control engineering (The fourth edition).Press: Tsinghua University Press，2016.

[2] Gao Zhongyu. Control engineering of Electromechanical systems(The fourth edition).Press: Tsinghua University Press，2011.

Net resource：

[1] www.icourse163.org

Teaching team：Jin Yuzhen、Yang Liangliang、Jiang Xianzhi

Course director：Jin Yuzhen

Written by：Yang Liangliang

Reviewer：Jin Yuzhen

Approved by：Faculty of mechanical and automatic control

2021.05.16

《高等工程力学*》教学大纲

Advanced Engineering Mechanics

Course Name: Advanced Engineering Mechanics **Course Code** :31954

Course type: professional basic education (optional)

Total teaching hours： 32 hours

Credits :2.0

Prerequisite courses: Advanced Mathematics (A), Theoretical Mechanics, Mechanics of Materials, etc

Major: mechanical design and manufacture and automation, mechanical and electronic engineering, process control and equipment

Department: Mechanical Design and Manufacturing Division

I. Course Introduction

This course can strengthen students' understanding of complex engineering problems and their impact on society, safety and other aspects. It is the improvement part of the basic mechanics course of mechanical major. It is the deepening and extension of the basic contents and methods of mechanics on the basis of the course of ***material mechanics*** and ***theoretical mechanics*** at 48 hours. Through the study of this course, students are required to master the principle virtual displacement of dynamic mechanical analysis, Lagrange equation and the concepts of stability, deformation energy, dynamic load and fatigue of members in elastic components, and to understand and master the basic theories such as energy principle. Through the study of this course, students can directly design and calculate the engineering structure, and can also be used as the basis for future courses.

II. Course Objectives

Course objective 1: Proficient in basic mechanical analysis methods and able to evaluate the social, health, safety, legal, and cultural implications of mechanical engineering practices and solutions to complex engineering problems in the mechanical engineering field and select the right results.

Course objective 2: Master the stability calculation of the compression member, master the energy principle and analysis method of the bar, master the dynamic load calculation of the structure in the moving state, and master the preliminary calculation of the fatigue of the structure;

Course objective 3: Master the principle of virtual displacement, master the principle of virtual displacement to solve the equilibrium object, master the Lagrange equation and its application, and be able to solve the system dynamic problem of rigid body with Lagrange equation;

Course objective 4: To be able to judge, analyze and simplify the structure of actual engineering members, and to establish a mechanical calculation model of materials; to judge and analyze the established mechanical calculation model of materials, to determine its load and deformation, and to adopt corresponding calculation methods to calculate the strength and stiffness of the structure.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by ***Advanced Engineering Mechanics***

Index points of graduation requirements	**Content**
2.1	It can identify and judge the key links and parameters of complex engineering problems in mechanical engineering according to the basic principles of scientific knowledge.
6.3	Ability to evaluate the social, health, safety, legal and cultural impact of complex engineering problem solutions in mechanical engineering practices and areas of mechanical engineering and to understand the responsibilities to be assumed.

Table 2. The supporting relationship between the course objectives of

Advanced Engineering Mechanics and the index points of graduation requirements

Index points of graduation requirements	**2.1**	**6.3**
Course objectives	1、2	2、3
Intensity of support	M	L

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**
1	Stability of column	1.The concept of column stability, the significance of stability and engineering examples (Structure of China high speed railway bridge pier, to show the importance of the stability, to show the smartness of Chinese people); 2.The critical pressure of the pinned-pinned slender column, the critical pressure is solved by using the approximate differential equation; 3.The critical pressure of slender column	4	Classroom instruction	1,2,4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		under other criteria, critical pressure of various supports; 4.The range and empirical formula of Euler's formula and the calculation formula of critical pressure of column of various sizes; 5.Check the stability of the column and calculate the stability of the column under various conditions; Measures to improve the stability of the column.			
2	Dynamic load	1.Overview, the concept and requirements of dynamic load; (the dynamic load of CRH Train and the way to design and make it, indicated the importance to passengers) 2.Application of dynamic and static method, application of D’Alembert’s principle, calculation of acceleration, calculation of dynamic load coefficient; 3. Application of deformation energy method , the application of impact stress and calculation of dynamic load coefficient; 4.Toughness, concept of impact toughness and acquisition process of impact toughness.	4	Classroom instruction	2,4
3	alternating stress	1The concept of stress, fatigue failure, alternating stress and fatigue concept; 2.Concept and formula of characteristics, stress amplitude and average stress; (the fracture of the real component, such as the crack of the wheel of the CRH bogie, to show the responsibility of engineers) The definition , acquisition method and the function of endurance limit; 3.**The factors of endurance limit..**Endurance limit under the influence of stress focus, size, surface quality; 4.**Fatigue calculation of cyclic components.** Fatigue strength calculation under	4	Classroom instruction	2,4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		various conditions.			
4	Principle of virtual displacement	1. Basic concepts of virtual displacement and virtual work 2. Relationship between imaginary displacements 3. Equilibrium equation expressed by virtual displacement principle	4	Classroom instruction	3
5	Lagrange’s equation	1. General principles of dynamics 2. Lagrangian function 3. Second Lagrangian equations 4. Initial integration of Lagrangian equations	4	Classroom instruction	3
6	Energy method	**1.Method**.The concept and status introduction of energy method; **2.The calculation of deformation energy.** The deformation energy calculation under various deformation conditions; **3.A general expression of energy**. The calculation of deformation energy under arbitrary structure and deformation; **4.Reciprocity theorem:** the reciprocity of work and displacement; **Castigliano's theorem**: the derivation of Castigliano's equation, the use of Castigliano's theorem to solve the deformation problem; 5. The concept of virtual work principle; Unit load method, derivation and calculation of Moore’s theorem.	8	Classroom instruction	2,4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
7	Statically indeterminate system	1The concept of statically indeterminate structure; 2.Force method to solve statically indeterminate problems; the establishment and solution of canonical equations, and the application of unit load method.	4	Classroom instruction	2,4

V. Teaching method

1. classroom teaching: teachers teach engineering mechanics knowledge in class, students finish homework after class;

2. small class discussion: the teacher carefully designs the research task and the discussion rule, at least 2 weeks before the class starts, carries on the small class (about 20 people / class) and the grouping (2-3 people / group) to the student, and sends the discussion task book and the discussion rule. Students prepare for more than two weeks according to the seminar task book and participate in the classroom discussion. Class discussion is mainly conducted and organized by students, and teachers conduct process guidance, supervision, evaluation and comprehensive evaluation.

VI. Curriculum Assessment and Evaluation Criteria

The assessment is to evaluate the degree of students achieving the course objectives. The course objectives and the corresponding assessment methods are listed in Table 4.

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Normal grades	Homework assignment	40%	usual work takes up 40% of the final score	1、2
Final exams	Final exam paper scores Small papers	60%	Final exam results, or small paper report assessment results, 60% of the final course results.	1、2

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria

Homework assignment	Single peacetime homework results: according to the completion and accuracy of the five-level scoring system to judge. The total score of peacetime homework: all single peacetime homework results are weighted average, according to the five-level scoring system to judge.
Final exams	The final examination adopts a five-level scoring system, according to the test paper standard answers and scoring rules.
Small papers	According to the layout of the topic, literature review, program elaboration, model building, theoretical analysis, results discussion, etc., to complete the writing of small papers.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（Usual performance）（K1）	Assessment 2（Final exam）（K2）
Percentage		0.4	0.6
Score percentage of course objective for each assessment method	Objective 1(M1)	0.1	0.0
	Objective 2(M2)	0.3	0.3
	Objective 3(M3)	0.3	0.4
	Objective 4(M4)	0.3	0.3

VII. Recommended textbooks and reference materials

Textbook:

Liu Hongwen, ed. Mechanics of Materials (6th Edition), Higher Education Press

Reference books:

1.Edited by Fan Qinshan, Mechanics of Materials, Tsinghua University Press

2.Sun Xunfang, Editor-in-Chief, Mechanics of Materials (3rd Edition), Higher Education Press

3.Ferdinand P.Beer E.Russell Johnston.Mechanics of materials.3rd Edition.MeGraw-Hill.

Online resources:

http://www.mechanics.zju.edu.cn

Teaching group: Wei Yimin, Li Jianmin, Yaxin Yu, Yi Liu   Course administrator: Wei Yimin

Written by:Wei Yimin Reviewed by: Jianmin Li

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 28, 2021

《微机原理及应用*》教学大纲
Principles and Applications of Microcomputer

Course name： Principles and Applications of Microcomputer **Course code：** 31955

Course type： Specialized course (Required elective course)

Total teaching hours： 32 (Classroom Hours: 24, Laboratory Hours:8)

Credit：2

Prerequisites: Introduction to Computer Basics, Fundamentals of Circuit Principle

Major： Mechanical design, manufacturing and automation, Mechatronics engineering, Energy and power engineering

Department: Institute of Mechatronics Engineering

I. Course Introduction

Microcomputer Principles and Application is a professional course or professional elective course for undergraduates majoring in mechanical engineering. It is a basic course for the embedded technology. The teaching content of this course is divided into three parts: the architecture, working principle of the single-chip microcomputer system; C51 language and programming; basic knowledge and application methods of microcomputer resources such as, interrupt, serial communication, parallel communication, etc.; methods of expanding memory, input/output interface and analog input and output interface. Understand the development history and application fields and development trends of single-chip microcomputers

II. Course Objectives

Course Objective 1: Understand the job responsibilities and professional ethics in the embedded work field, understand international status in related fields, and enhance the sense of mission of the times and social responsibility.

Course Objective 2： Understand the basic architecture, working principle of the single-chip microcomputer system, C language programming, characteristics and basic methods of the embedded microcomputer.

Course Objective 3： Master the basic knowledge and application methods of microcomputer resources such as memory, timer/counter, register, interrupt, serial communication, and parallel communication; master the methods of expanding memory, input/output interface and analog input and output interface.

Course Objective 4： Master at least one programming language. And can build a control system according to the control requirements, have the ability to use modern tools to build an experimental program, and perform simulations and experiments.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Principles and Applications of Microcomputer》

Index points of graduation requirements	Content
2.3	Able to correctly express solution for a complex engineering problem in mechanical engineering, and use basic principles to analyze the rationality of the plan.
3.3	Be able to identify clear design requirements and propose design solutions for complex engineering problems in the field of mechanical engineering, and be able to consider social, health, safety, legal, cultural and environmental factors.
5.2	Be able to select and use appropriate technical methods and modern engineering tools to model, predict and simulate complex mechanical and electronic engineering problems, and be able to understand the limitations of related tools in practice.
8.2	Understand the core values of socialism, understand national conditions, safeguard national interests, and have a sense of responsibility to promote national rejuvenation and social progress.

Table 2. The supporting relationship between the course objectives of 《Principles and Applications of Microcomputer》 and the index points of graduation requirements

Index points of graduation requirements	**8.2**	**2.3**	**3.3**	**5.2**
Course objectives	1	2	3	4
Intensity of support	L	M	H	L

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	1.Introduction the 8051 microcontrollers 1.1 Introduce the application of single-chip microcomputer 1.2 Microcontrollers and embedded processors 1.3 Overview of the 8051 family	15. "Made in China" that can be seen everywhere in daily life, and cultivate students' national pride and mission. 16. understand the basic architecture of 8051 3. two simulation software	2	Lecture	1，2
2	2. 8051 Programming in C 2.1 Data types and time delay in 8051C 2.2 I/O programming in 8051 C 2.3 Logic operations in 8051 C 2.4 program structure	1. basic program in c language for 8051 2. main function, reg51.h 3. logical and arithmetic process 4. In recent years, high-end products have come out, such as Huawei's Kirin chip.	4	Lecture and tutorial	1，4
	3. Timer Program 3.1 Programming 8051 timers 3.2 Counter programming 3.3 Programming timers 0 and 1 in 8051 C	9. timer mode and how to start and stop timer 10. timer and counter difference 11. how to program using timer and counter	4	Lecture and tutorial	2,3
	4.Interrupts Programming 4.1 8051 interrupts 4.2 Interrupt programming in C	1. how many interrupts 2. interrupt number, 3. IP and IE function 4. program in interrupt mode for timer or counter 5. programming and simulation for application 6. Cultivate students' scientific thinking, do a good job in time planning and scientific management.	2	Lecture and tutorial	1,2，3
	5 Serial Port Programming in C 5.1Basics of serial communication 5.2 Serial port programming in C	1. serial communication mode and set 2. pin number for serial communication 3. baudrate set 4. programming and simulation for application	4	Lecture and tutorial	2,3
	6.Combination with peripheral devices 6.1 Controlling a switch 6.2 Operation with LCD	1. switch connection 2. LCD connection 3. programming and simulation for switch and LCD	4	Lecture and tutorial	2,3
	7. ADC,DAC 13.1 Parallel ADC 13.2 DAC interfacing	1. analog concept 2. ADC and DAC case study	4	Lecture and tutorial	2,3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	Experiment 1 Timer/Counter and I/O application	1. Familiar with MCS-51 timer and IO initialization programming method; 2. Master the software programming of Timer/Counter and I/O	2	Lab.	4
	Experiment 2 Serial communication	1. Learning the interface connection and hardware circuit design of serial communication between single-chip microcontroller and PC 2. Master the software programming of serial communication	2	Lab.	4
	Experiment 3 man - machine interaction experiment	1. Learn the interface connection and hardware circuit design of single-chip microcomputer and LCD 2. LCD programming	2	Lab.	4
	Experiment 4 Analog signal processing	1. Interface ADC (analog-to-digital converter) chips to the 8051 . 2. Program ADC0804 chips in 8051 C	2	Lab.	4

V. Teaching method

The course mainly consists of lectures, practice on computer and assignments.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Assignments and quiz	40%	To assess the level of understanding knowledge taught in class, accounting for 40% of total score	1、2，3
Lab.	Experiment process and report	20%	Each experiment is 100 points, according to the experiment process, results and report evaluation, and finally calculate the average score of all the homework and then count 20% into the total score.	4
Exam	Final exam paper results	40%	Mainly assess students' mastery of basic knowledge of microcontroller. The test paper structure and score distribution are as follows: 1. Fill in the blank and true and false questions: 30 points, corresponding to course objective 1;	2、3

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
			2. Essay questions: 20 points, corresponding to course objectives 1, 2; 3. program for comprehensive application: 50 points, corresponding to course objectives 2. 40% of the paper score is included in the total course score.	

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria
Quiz	According to the quiz in the classroom, it is divided into five levels, excellent (90-100), good (80-89), medium (70-79), passing (60-69), and failing (less than 60 points).
Homework	According to the completion of the homework, considering the neatness of writing, accurate answers, and independent completion, it is divided into five grades, excellent (90-100), good (80-89), medium (70-79), and passing (60-69) , fail (60 points or less).
Lab.	According to experiment process, results and report evaluation, it is divided into five levels, excellent (90-100), good (80-89), medium (70-79), passing (60-69), and failing (less than 60 points).
Final Exam	The final exam adopts a 100-point system and is graded according to the standard answers and grading rules drawn up by the person in charge of the course.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（quize and assignments）（K1）	Assessment 2（Lab.）（K2）	Assessment 3（Final Exam）（K3）
Percentage		0.4	0.2	0.4
Score percentage of course objective for each assessment method	Objective 1（M1）	0.1	0	0
	Objective 2（M2）	0.5	0	0.5
	Objective 3（M3）	0.4	0	0.5
	Objective 4（M4）	0	1	0

VII. Recommended textbooks and reference materials

Textbook：

Since lecture notes will be delivered to students, textbook is not required. However students are encouraged to read the following reference books:

Reference books：

[1] Muhammad Ali Mazidi,The 8051 Microcontroller and Embedded Systems, Pearson Prentice Hall
[2] Matthew Chapman, the Final Word on the 8051 , 1994

Online resource:
[1] http://www.51c51.com/bbs/index.asp
[2] http://www.mcustudy.com/
[3] http://www.laogu.com/
[4] http://www.mcustudio.com/

Teaching group： embedded system teaching group Course administrator：Yanhong Yuan

Written by: Yanhong Yuan Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 27, 2021

《机械制造工艺学课程设计*》教学大纲

Coursework for Mechanical Manufacturing Technology

Course name： Coursework for Mechanical Manufacturing Technology **Course code：** 31956

Course type： Specialized practice course (Compulsory)

Total teaching hours： 40 (Laboratory Hours or Tutorial Hours:40)

Credit：2.0

Prerequisites: Engineering material and heat treatment, fundamentals of mechanical manufacturing, Mechanical Manufacturing Technology

Major： Mechanical design, manufacturing and automation

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

Coursework for mechanical manufacturing technology is specialized practice course to cultivate students with the ability to design manufacturing process. This course is the compulsory practice course for the students to study processing technology and assembly technology for mechanical parts. The coursework utilizes the knowledge learnt in the course of mechanical manufacturing technology to train students designing manufacturing process and fixtures with the example of connection rod.

II. Course Objectives

Course Objective 1： Create the socialist core values of patriotism, dedication and loyalty to duty, and cultivate the creative spirit of pursuing excellence and the "craftsman spirit" of keeping improving.

Course Objective 2： Ability to analyze the machinability of typical parts, understand the structural features of different types of machine fixtures, carry out process design of typical parts, design fixtures according to process features, and consider the impact of operation, economy, society, heath, safety, law and culture in the design process.

Course Objective 3： Have the ability to explicitly express the solution procedure in the design report in the aspects of looking up document, analysis and calculation, utilizing manual and standards, code and experiment data and drafting engineering drawings.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Coursework for Mechanical Manufacturing Technology*

Index points of graduation requirements	**Content**
3.3	Able to ensure explicit design requirement, propose solution plan and consider factors of society, heath, safety, law, culture and environment.
8.3	Understand the core concept of engineering ethics and the social responsibility of mechanical engineers, and consciously abide by the professional ethics and code of conduct of mechanical engineers in engineering practice.
10.1	Able to express solution plan, procedure and results of complex engineering problem in mechanical engineering field by written report and oral statement

Table 2. The supporting relationship between the course objectives of *Coursework for Mechanical Manufacturing Technology* and the index points of graduation requirements

Index points of graduation requirements	**3.3**	**8.3**	**10.1**
Course objectives	2	1	3
Intensity of support	H	M	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**
1	1 Design preparation 1.1 Design task sheet. 1.2 Design guidance sheet.	1. Understand the explicit design task 2. Master the design procedure 3. Encourage students to be serious and meticulous, dare to innovate and pursue excellence with the deeds of "great craftsman"	2	Lecture	1,2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
2	2 Manufacturing process design 2.1 Processability analysis of mechanical parts 2.2 Process rules 2.3 Selection of machining methods and equipment	1. Master processability analysis of mechanical parts 2. Able to decide process rules 3. Able to select machining methods and equipment 4. Describe the contribution and importance of manufacturing technology to manufacturing power strategy. With this as the starting point, it will tell the outstanding figures and contributions in the field of technology in China, so that students can resonate with the sense of pride and mission in their career.	10	Lecture and practice	2, 3
3	3 Fixture design 3.1 Operation analysis 3.2 locating and clamping calculation 3.3 Selection of fixture elements	17. Carry out process analysis 18. Determine locating and clamping plan 19. Select locator and clamping elements	10	Lecture and tutorial	2, 3
4	4 Fixture drawing 4.1 Operation drawing 4.2 Drawing of locating and clamping plan 4.3 Assembly drawing	1. Complete the drawings for operation, fixture elements and assembly 2. Organize students to check the design and drawings in groups to keep improving	10	Practice	1, 2, 3
5	5 Coursework defenses 5.1 Report of process and fixture design 5.2 PPT	10. Complete coursework report 11. Satisfactorily pass the defense 12. Encourage students to carry out innovative design and physical production, improve engineering practice ability	8	practice	1, 2, 3

V. Teaching method

The course mainly consists of lectures and tutorials.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Class room performance	10%	To assess the performance during coursework including attendance and progress.	1
Report	Design report	60%	More than 5000 words, the main content of report include economic analysis, processability analysis, create process rules, process methods and equipment selection, fixture design, fixture drawings.	1、2
Defenses	Defense performance	30%	Quality of PPT, explicit of oral statement, performance of QA	2

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	Grading criteria
Usual performance	According to the performance, there will be four levels：Excellence (90-100, good (75-89, normal (60-74), fail (below 60). Adjust the score depending the class attendance.
Report	Integrity of the report (30%), Reasonability of design (30%), format of drawing (30%), format of text (10%),
Defenses	According to the performance , there will be four levels：Excellence (90-100, good (75-89, normal (60-74), fail (below 60).

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（Usual performance）（K1）	Assessment 2（Report）（K2）	Assessment 2（Defense）（K3）
Percentage		0.1	0.6	0.3
Score percentage of course objective for each assessment method	Objective 1（M1）	0.5	0.2	0.2
	Objective 2（M2）	0.5	0.5	0.3
	Objective 3（M3）	0	0.3	0.5

VII. Recommended textbooks and reference materials

Textbook：

[1] Dahua Xu, Design of Machine Tools, China Machine Press, 2018.

Reference books：

[1] Xiuben Zheng, Mechanical Manufacturing Process(3rd edition), China Machine Press, 2018.

Teaching group：Hongjun Li, Jian Zhou, Haili Zhou   Course administrator：Hongjun Li

Written by: Hongjun Li,   Reviewed by: Jian Zhou

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 27, 2021

《生产实习*》教学大纲

Curriculum Design of Mechanical Design A

Course name：Production Practice **Course code**：31957

Course type：Specialized course (Practice compulsory)

Total teaching hours：40

Credit：2

Prerequisites: Descriptive Geometry & Mechanical Drawing, Mechanics Principle, Mechanical Design, Mechanical manufacturing technology

Major：Mechanical design, manufacturing and automation

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

Production practice is a comprehensive practical course of mechanical design, manufacturing and automation, and is an important part of engineering education. Through the visit and practice of actual production enterprises, students can understand the relationship between theoretical knowledge and engineering practice on the basis of the basic knowledge of mechanical design, manufacturing and automation major, which can play a bridge role between theory and engineering practice, and play a good transitional role for students from school to society. Through production practice, students are trained to investigate, observe problems, analyze problems and solve problems in production practice, so as to enable students to understand the connections between theoretical knowledge and engineering practice, broaden their horizons, enrich their knowledge, and lay the foundation for students to work.

The main task of this course is to train students to be familiar with the processing enterprises and their product types, the working principle and mechanism composition of production equipment in the field of mechanical manufacturing through the teaching methods of data consulting, video teaching, on-site observation of enterprises, on-site explanation of enterprise engineers, etc., and be familiar with the processing process flow and processing methods of typical mechanical parts, and have the basic machining process specification of mechanical parts Ability to design, analyze and solve complex engineering problems

II. Course Objectives

Course Objective 1： Cultivate the spirit of patriotism, dedication, excellence, meticulousness and pursuit of excellence, inherit the value concept of Chinese craftsmanship, and establish the sense of mission to realize the Chinese dream of the great rejuvenation of the Chinese nation.

Course Objective 2： Through the enterprise visit practice, understand the latest development of mechanical manufacturing technology, process and equipment, understand the processing technology and processing economy of parts, and understand the application of mechanical manufacturing process design method in production.

Course Objective 3： Understand the relationship and technical characteristics between mechanical manufacturing and quality, safety, environmental protection, economy, management and other disciplines, understand the significance of team division and cooperation in the process of mechanical manufacturing, reasonably handle the relationship between individuals and teams, and perform the responsibilities of team members and team leaders.

Course Objective 4： Understand the whole life cycle of mechanical products, have a sense of time and efficiency in the design and manufacturing process of mechanical products, and be able to consciously preview, review and summarize the learning tasks.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Production practice*

Index points of graduation requirements	**Content**
6.1	Have experience in mechanical engineering practice and social practice.
8.2	Understand the socialist core values, to understand the national conditions, to safeguard national interests, has the sense of responsibility to promote national rejuvenation and social progress.
9.1	Through class group discussion, experiment, practice, curriculum design, scientific and technological training, social practice, graduation design and other links, understand the multi-disciplinary technical background and technical characteristics of mechanical engineering problems, and can carry out division and cooperation in team cooperation, and reasonably handle the relationship between individuals and teams.
12.1	With the concept of time and efficiency consciousness, students can consciously carry out preview, review and summary for learning tasks.

Table 2. The supporting relationship between the course objectives of *Production practice* and the index points of graduation requirements

Index points of graduation requirements	**6.1**	**8.2**	**9.1**	**12.1**
Course objectives	1	1	2	3
Intensity of support	H	M	H	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**
1	1. Practice mobilization (1) Practice arrangement and discipline requirements (2) Safety education (3) The importance of practice (4) How to improve the effect of practice	(1) Understand the practice plan; (2) Safety education; (3) Group them; (4) Attendance, internship report requirements, etc; (5) Make use of spare time to check the relevant information of visiting enterprises on the Internet.	2	Lecture	1, 2, 3
2	2. Video and discussion (1) Introduction of enterprise background (2) Main products and production site (3) The interaction between mechanical manufacturing process and non-technical factors e	(1) Understand the industry, main products, production types, process procedures, process methods, process equipment, production management and its impact on society; (2) Understand the existing processing technology of internship enterprises, discuss the relationship between mechanical manufacturing technology and other disciplines, and the interaction between non-technical factors. (3) Understand the development and trend of manufacturing industry and the significance of "craftsman spirit" in promoting national and social development.	6	Lecture	1,2,3, 4
3	3. Lectures by engineers (1) Introduction of processing technology of typical parts (2) Development trend of manufacturing technology and process (3) Career	(1) Understand the current situation and improvement of existing processing technology in energy consumption, environmental impact, etc; (2) Understand the design drawing, processing scheme, process flow and special process equipment of a part in process; (3) Understand the format, function and compilation process of process specification.	8	Lecture	1,2,3, 4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	development of Mechanical Engineers				
4	4. Site visiting (1) Visit to the production site of important parts of automobile and other mechanical products (2) Site visit of general assembly process of automobile and other mechanical products	(1) Understand the role of important parts of automobile and other mechanical products, production process, process and equipment used; (2) Understand the characteristics and equipment of important production processes such as turning, milling, planing and grinding, assembly process, quality control process, production management, etc; (3) Understand the impact of these processes on society and environment. (4) From the actual production of enterprises to understand the "craftsman spirit", to understand its impact on the development of the country, society, enterprises at all levels.	24	On-the-spot teachin	1,2,3,4

V. Teaching method

Advocate heuristic teaching, discussion teaching and research teaching, combine theory with practice, and highlight the cultivation of students' innovative thinking and innovative consciousness.

The course teaching is divided into two parts: in class and after class.

In class teaching: classroom teaching, on-site teaching and video teaching

Extracurricular study: data collection and practice report

In terms of teaching means, it is advocated to adopt multimedia teaching, computer-aided teaching, on-site visit and case teaching reasonably and appropriately, so as to achieve the organic combination of traditional means and modern means. The internship report of extracurricular part requires not only recording what we have seen and heard, but also professional thinking and discussion. We should put forward our own summary, reflection and useful suggestions on the internship content.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives. The assessment of production practice adopts the combination of usual performance, data access report and practice report. The main purpose is to assess the achievement of students' ability training objectives, and the important content is to check students' mastery of various knowledge points. The internship report requires a detailed description of the process of typical parts produced by manufacturing enterprises, the structure and working principle of key equipment Theory, typical parts tooling design and the corresponding independent solutions for complex engineering practice problems, and to be able to use professional knowledge for reasonable analysis.

The assessment results include: practice performance accounted for 10%, development status report accounted for 20%, and practice report score accounted for 70% (the calculation results were evaluated according to the grade formula).

Table 4 Course objectives and assessment methods

Score category	**Assessment methods**	**Percentage**	**Assessment details**	**Corresponding objectives**
Practice performance score	Practice performance	10%	The performance of the practice process and the participation in the discussion.	1, 2, 3
Development status report score	Development status report	20%	More than 2000 words of development status report, including practice involving the composition of various mechanical equipment, principle, performance, role and operation, understand the overall process of mechanical processing and the latest development trends. According to the completion of the report, the completeness of the report and the richness of the content.	1, 2, 3, 4
Practice report score	Practice report	70%	The above 5000 words practical report (including the photos of practice site), is based on the completeness of the report. The main contents include the richness of the enterprise and its main products, production types, process regulations, process methods, process and equipment, production management, product life cycle and so on, and the analysis and evaluation of the advanced technology and environmental friendliness.	1, 2, 3, 4

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	**Grading criteria**
Practice performance	According to the practice performance (such as whether to comply with the internship arrangements, strictly abide by the practice discipline and norms, whether to actively participate in all aspects of the practice), it is divided into four grades: excellent (90-100), good (75-89), medium (60-74), and failed (below 60 points).
Report score	The main contents include: (1) the interaction and improvement between the existing processing technology and non-technical constraints such as society, safety, economy and Law (50 points); (2) the current situation and improvement of the processing technology in the aspects of safety and environmental protection, gas emission, social impact, etc., and can evaluate the complex engineering problems in the mechanical manufacturing process from the aspects of environmental friendliness and energy consumption (50 points).

Practice report	The practice report is a summary of the student internship process and achievements, mainly from the content integrity, the advanced nature of the views, description and format standardization.	Content integrity (40 points): whether the internship report is more than 5000 words (including photos of the internship site, with pictures and texts). Whether we should combine the theoretical knowledge and practical practice of mechanical manufacturing technology around the production type, process regulation, process method, process equipment, production management enrichment, advanced technology and environmental friendliness, etc., will elaborate and analyze the key technologies, important products process, important equipment, fixture and equipment, advanced technology in the process of practice.
		Advancement (20 points): whether it is concerned about new directions, new theories and new technologies in related fields, and is reflected in the internship report. Combined with whether or not to put forward their own understanding of the specific professional problems, put forward solutions to important technical problems and the future development of a certain technology, and summarize the experience and feelings in the process of practice.
		Description and expression (20 points): whether the information expression mode can be reasonably selected to describe relevant viewpoints in detail and accurately, whether the key points are prominent, whether the hierarchy is clear, whether the language is fluent and whether the structure is reasonable
		Format standardization (20 points): whether it is in accordance with the format requirements of the internship manual provided, whether it meets the requirements of the school on the practice report, and whether it meets the format requirements of the instructor in the internship.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（practice performance）（K1）	Assessment 2（Development status report）（K2）	Assessment 3（Practice report）（K3）
Percentage		0.1	0.2	0.7
Score percentage of course objective for each assessment method	Objective 1（M1）	0.2	0.1	0.1
	Objective 2（M2）	0.4	0.3	0.3
	Objective 3（M3）	0.4	0.3	0.3
	Objective 4（M4）	0	0.3	0.3

VII. Recommended textbooks and reference materials

Textbook:

N/A

Reference books:

N/A

Teaching group： Jian Zhou, Hongjun Li, Haili Zhou **Course administrator**： Wei Ye

Written by: Hongjun Li Reviewed by: Jian Zhou

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 4, 2021

《电工技术基础*》教学大纲

Fundamentals of Electrical Technology

Course name：Fundamentals of Electrical Technology

Course code：31959

Course type：Specialized Basic Course (required course)

Total teaching hours：40 (Classroom Hours: 32, Laboratory Hours:8)

Credit：2.5

Prerequisites: Advanced mathematics, General physics

Major：Major in Machinery

Department: Department of automation

I. Course Introduction

Fundamentals of Electrical Technology is a basic course of mechanical major. It provides a theoretical basis for following courses such as electronic technology foundation, microcomputer principle and application. The main task of this course is to study the laws and applications of electricity. The purpose is to enable students to understand the framework of circuit theory, master the basic concepts, basic laws and basic methods of circuit analysis, and have the basic skills of circuit analysis. Through the study of this course, the students' scientific thinking ability is cultivated, the engineering viewpoint of combining theory with practice is established and the students' ability of analyzing problems is improved, so as to lay a solid theoretical foundation for the study of subsequent courses.

II. Course Objectives

Course Objective 1：To cultivate the spirit of patriotism, the scientific attitude of being meticulous, logical and diligent in thinking, and the sense of mission of aspiring to become a "craftsman of a great power" and participating in the research of " The pillars of a great power".

Course Objective 2：Master component characteristics and basic circuit laws. Master resistance circuit analysis method; Master the time domain analysis method of linear dynamic circuit; Master the basic methods of sinusoidal steady-state circuit analysis and calculation; Develop the habit of considering problems comprehensively, and build and deduce engineering models in mechanical engineering field.

Course Objective 3：Be able to analyze engineering problems using voltmeters, ammeters, etc. Have good scientific attitude and innovation consciousness, have the preliminary engineering accomplishment, have the ability to continuously learn and adapt to the development.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Fundamentals of Electrical Technology》

Index points of graduation requirements	**Content**
1-3	Have the ability to extend mathematical models to engineering models of complex engineering problems in the field of mechanical engineering.
2-1	Be able to identify and judge the key links and parameters of complex engineering problems in mechanical engineering according to the basic principles of scientific knowledge.
5.1	Be able to use relevant network tools, databases, modern engineering tools and other information technologies to query and analyze relevant research materials needed to solve complex engineering problems in the field of mechanical engineering.

Table 2. The supporting relationship between the course objectives of 《Fundamentals of Electrical Technology》 and the index points of graduation requirements

Index points of graduation requirements	**1-3**	**2-1**	**5-1**
Course objectives	2	1	3
Intensity of support	H	L	L

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**
1	1. Circuit model and circuit law (1) Circuit and circuit model (2) The reference	20. Introduce the knowledge system framework, course teaching objectives, supported graduation requirements, position in the course system, teaching content, assessment method and score ratio of this	4	Lecture	1、2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	direction of current and voltage (3) Electric power and energy (4) Circuit elements and their volt-ampere characteristics (5) Kirchhoff's law	course; 21. Understand the concept of the actual circuit and the circuit model as well as the constituent relationship of circuit elements; 22. Understand the concepts of linear and non-linear elements; 23. Be familiar with the calculation of voltage-ampere characteristics and power of resistance elements, voltage sources, current sources and controlled sources; 24. Proficient in Kirchhoff's current law and Kirchhoff's voltage law. 25. By introducing Kirchhoff's law and discovering the stories behind it, cultivate students' scientific research spirit of discovering and solving problems.			
2	2. Analysis of resistance circuit (1) The concept of equivalent transformation of circuits (2) General analysis methods of resistance circuits (3) Fundamental theorem of circuit	1. Understand the concept of external equivalence, the concept of KCL and KVL independent equation number; 2. Proficient in equivalent analysis method, proficient in applying two models of actual power supply and their equivalent transformation, proficient in calculating resistance series and parallel circuit, and equivalent transformation of star connection and triangle connection; 3. Master the concept of input resistance of passive one port network and its solution; 4. Familiar with general circuit analysis methods: branch current method, nodal voltage method, Thevenin theorem and maximum power transmission theorem and their applications. 5. Introduce topological graph theory: Leonhard Euler, Swiss mathematician and physicist, introduce topological analysis, stimulate students' objective and dialectical way of thinking and positive attitude of exploration.	10	Lecture	1、2
3	3. Dynamic circuit analysis (1) Initial conditions of energy storage elements and dynamic circuits (2) Zero input, zero state and full response of first-order circuit	1.Understand the whole working process of the dynamic circuit and distinguish the states of each stage; 2.Skilled in applying basic circuit knowledge to solve the initial value of circuit variables; 3. Able to skillfully use the classical solution method of differential equation to analyze the first-order circuit; 4. Proficient in solving zero input response, zero state response and full response, as well as specific solution, general solution, steady state response and transient response of the circuit.	6	Lecture	2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
4	4. Steady state analysis of sinusoidal current circuit (1) Phasor method (2) Impedance and admittance (3) Analysis of sinusoidal steady state circuit (4) Calculation of symmetrical three-phase circuit	1. Understand the expression of the phasor of sinusoidal quantity, the form of the phasor of the constituent relation of circuit elements, the form of kirchhoff's law, and the method of phasor; 2. Fully grasp the concepts of impedance and admittance; Analyze phasor diagram; 3. Compared with the linear resistance circuit, fully grasp the analysis method of sinusoidal steady-state circuit; And skilled use of calculation; 4. Master the calculation and analysis of three-phase circuit power; 5. Introduce the example of China's leading in the field of power transmission, and guides students to establish confidence in the system and culture of the country.	12	Lecture	1、2
5	5. The Lab. (1) Verification of Kirchhoff's law (2) Test and equivalent transformation of out-of-power characteristics (3) Verification of Thevenin's theorem (4) Measuring the equivalent parameters of the circuit by three-table method	1. Understand kirchhoff's laws of current and voltage and verify them; 2. Master the external characteristics of the power source and verify the conditions of equivalent transformation of voltage source and current source; 3. Understand Thevenin's theorem and master the method of measuring equivalent parameters of active two-terminal network; 4. Learn to use basic measuring instruments to measure ac equivalent parameters.	8	Lab.	3

Table 4 Schedule of laboratory class hours

Lab. Title	Lab. content	Main equipment or laboratory environment	Lab. hours	Group members	Lab. attributes (Basic/comprehensive/design/Research innovation)	Request (required/optional)

Verification of Kirchhoff's law	Learn to use current plug and other instrument equipment to measure the current of each branch and the voltage at both ends of the element, verify kirchhoff's current and voltage law.	DC adjustable power supply, DC digital voltmeter, multimeter, etc	2	3-6	Basic	Required
Test and equivalent transformation of external power supply characteristics	The voltage and current of DC stabilized voltage source and actual voltage source and current source are measured to verify the condition of equivalent transformation.	Adjustable DC voltage regulator, adjustable DC constant current source, resistor, etc	2	3-6	Basic	Required
Verification of Thevenin's theorem	Measurement of active two - terminal network open - circuit voltage, short - circuit current calculation resistance, voltammetry measurement resistance, and verification.	Adjustable DC voltage regulator, adjustable DC constant current source, potentiometer , Thevenin theorem experiment circuit board,	2	3-6	Comprehensive	Required

		etc				
Measuring the equivalent parameters of the circuit by three-table method	Use AC meter to measure the parameters of incandescent lamp, ballast and capacitor.	AC voltmeter, AC ammeter, power meter, capacitor, etc	2	3-6	Comprehensive	Required

V. Teaching method

The course is based on classroom lecture and Lab., and supplemented by assignments and discussion.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 5 Course objectives and assessment methods

Score category	**Assessment methods**	**Percentage**	**Assessment details**	**Corresponding objectives**
Usual performance	Assignments and Class participation	20%	To assess students' understanding and mastery of the characteristics of circuit components, circuit analysis methods, basic knowledge and basic circuit operations, accounting for 20% of total score	1、2
Lab.	Operational skills and lab reports	20%	To assess students' safety awareness, operational ability, cooperation ability, problem-solving ability and other skills. accounting for 20% of total score.	3
Exam	Final exam paper results	60%	Mainly assesses students' mastery of basic knowledge of circuit system, relevant analysis and calculation methods. The paper structure and grade distribution are as follows: 1. Concepts and laws :30 points, corresponding to course goal 1; 2. Basic operation and analysis :40 points, corresponding to course goal 2; 3. Comprehensive analysis :30 points, corresponding to course goal 2; The paper grade will be counted as 60% of the course grade.	2

The grading criteria of this course for each assessment method are presented in Table 6.

Table 6 The grading criteria for each assessment method

Assessment methods	**Grading criteria**
Class participation	According to the answers to the questions, grades are divided into four grades: excellent (90-100), good (75-89), medium (60-74), and fail (below 60 points). Grades will be given according to the grade based on the class performance.
Homework	According to the completion of the homework, the grades are divided into four grades: Excellent (90-100), good (75-89), medium (60-74), and fail (below 60). Based on the grades, the grades will be given according to the circumstances in combination with the usual classroom performance.
Lab.	Lab. attendance and preview (10 points), performance during the experiment (10 points), Lab. results (20 points), Lab. report (60 points) : experimental principle description (10 points); Description of experimental operation process (10 points); Proper data processing method and clear presentation of processing process (10 points); The error results did not deviate from the normal range (10 points); Error analysis and problem discussion have been conducted correctly and comprehensively (10 points); The experiment report is written in correct handwriting and arranged neatly (10 points).
Final Exam	The final exam will be based on the 100-point system and will be graded according to the standard answers and grading rules drawn up by the course leader.

The score allocation matrix of assessment methods and course objectives are given in Table 7.

Table 7 Assessment methods and score allocation matrix

		Assessment 1（Class participation）**（K1）**	**Assessment 2（Homework.）（K2）**	**Assessment 3（Lab.）（K2）**	**Assessment 4（Final Exam）（K4）**
Percentage		0.10	0.10	0.20	0.60
Score percentage of course objective for each assessment method	Course objective 1	0.2	0	0	0
	Course objective 2	0.8	0.7	0.2	0.7
	Course objective 3	0	0.3	0.8	0.3

VII. Recommended textbooks and reference materials

Textbook：

Allan R. Hambley, Electrical Engineering Principles and Applications, Electronic Industry Press，5th Edition

Reference books：

[1] Qiu Guanyuan, Ed. Circuit (5th edition), Higher Education Press, 2006.

[2] Liu Jingxia, Fundamentals of Circuit Analysis, Tsinghua University Press, 2012.

[3] Li Hansun, Ed. Fundamentals of Circuit Analysis (4th edition), Higher Education Press, 2006.

[4] Jiang Jiguang and Liu Xiucheng edited circuit Principles, Tsinghua University Press, 2007.

Online resource:

[1] http://www.cndzz.com

[2] http://www.icourses.cn/coursestatic/course_4123.html

[3]http://jpkc.scezju.com/dlyl/redir.php?catalog_id=107602

[4]http://course.jingpinke.com/details?uuid=8a833999-1e4881f5-011e-4881fe3d-0c23&courseID=S0600364

Teaching group： Hongfei Zu　　Course administrator：Hongfei Zu

Written by: Hongfei Zu　　Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 31, 2021

《3D 打印与增材制造技术*》教学大纲

Syllabus of 3D Printing and Additive Manufacturing Technology

Course Name/Title：3D Printing and Additive Manufacturing Technology **Course code：**31960

Course Type：Specialized Course (Optional Course)

Total teaching hours：32

Course Credit：2.0

Prerequisites: mechanics of materials, Foundation of Mechanical Design

Major： Intelligent manufacturing engineering, Mechatronics engineering, Machine design manufacture and automated

Department: Department of Intelligent manufacturing engineering

I. Course Introduction

This course is an elective course for undergraduates majoring in Intelligent manufacturing engineering. 3D printing is a technology based on digital model files, which uses adhesive materials such as powdered metal or plastic to construct objects by printing layer by layer. 3D printing is a new rapid prototyping technology based on additive manufacturing principle. There will be incredible work in scientific research and industrial production, and it is also to cultivate the craftsman spirit of perseverance, dedication, excellence, meticulousness and pursuit of excellence in a big country, to inherit the value of craftsmanship of the Chinese nation, and to start the mechanical engineering professional courses required for the transformation from a manufacturing country to a manufacturing power.

This course is a professional extension elective, designed to introduce students to additive manufacturing technology in a scientific, objective, calm and easy to understand manner. It is mainly used to cultivate talents with strong sense of social responsibility, broad scientific basic theory and solid knowledge and skills of mechanical design, manufacturing and automation, who can engage in product development, technology research, scientific research, production organization and management in mechanical engineering additive production and related fields. The graduates of this major have strong innovation ability, humanistic quality, communication ability, international vision and lifelong knowledge seeking spirit. They can play a backbone role in enterprises and research institutions related to this major, and show a certain degree of engineering leading talent potential.

II. Course Objectives

Course Objective 1：Cultivate the spirit of patriotism, the craftsmanship spirit of perseverance, dedication, perfection, meticulousness and pursuit of excellence, carry forward the values of craftsmanship of the Chinese nation, and establish the mission of transforming China from a manufacturing power to a manufacturing power.

Course Objective 2：Familiar with the forming characteristics and common problems of different materials, understand the general rules and methods of designing and selecting additive manufacturing methods and equipment for different needs, and expand the understanding of material forming manufacturing technology.

Course Objective 3： Master the working principle, structural features and application scenarios of various 3D printing forming equipment, and have the ability to operate and use the equipment, adjust and control parameters and maintain the equipment. Then understand the application direction and development trend of additive manufacturing technology in different fields, and to cultivate students' comprehensive ability to apply knowledge of multi course, multi subjects and marginal subjects such as physics, chemistry, electrical and mechanical.

III. Correlations between Course Objectives and Graduation Requirements

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by this course

Index points of graduation requirements	Content
2-3	Be able to correctly describe the solution of a complex engineering problem in intelligent manufacturing engineering, and be able to analyze the rationality of the solution with basic principles.
3-1	Understand the current situation and development trend of intelligent manufacturing major, familiar with the basic process of research and development of new products, new processes, new technologies and new equipment, and have the attitude and awareness to pursue innovation in solving complex engineering problems in intelligent manufacturing engineering filed.
12-2	Have a correct understanding of lifelong learning, and have the ability to continuously learn and adapt to development.

Table 2. The supporting relationship between the course objectives and the index points of graduation requirements

Index points of graduation requirements	12-2	3-1	2-3
Course objectives	1	2	3
Intensity of support	M	M	M

IV Correlations between Course Content and Course Objectives

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	Course objectives

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	Course objectives
1	Summary of additive manufacturing (3D printing) (1) Additive manufacturing technology (2) Additive manufacturing process (3) Development history of additive manufacturing technology (4) The role of additive manufacturing technology	1. Master the forming principle of additive manufacturing technology 2. Familiar with the process of additive manufacturing 3. Master the additive manufacturing process 4. Understand the development history of additive manufacturing technology, Cultivate students' patriotism feelings.	2	Lecture	1，2
2	Pretreatment of additive manufacturing (3D printing) (1) Construction method of 3D model (2) STL formatting of 3D models (3) Slice processing of 3D model	1. Familiar with the construction method of 3D model by CAD software 2. Familiar with STL formatting of 3D models 3. Understand the slice processing of 3d model	3	Lecture	2
3	Photosensitive material selective curing additive manufacturing (1) SLA additive manufacturing principle and classification (2) Basic process and support structure of SLA additive manufacturing (3) Materials and selection of SLA additive manufacturing (4) Advantages and disadvantages of SLA additive manufacturing	1. Familiar with SLA additive manufacturing principle and forming process 2. Understand the advantages and disadvantages of SLA additive manufacturing	3	Lecture	2、3
4	Powder material selective sintering additive manufacturing (1) Principle and classification of SLS additive manufacturing (2) Forming process of SLS	1. Familiar with SLS additive manufacturing principle and forming process	3	Lecture	2、3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	Course objectives
	additive manufacturing (3) Materials and selection of SLS additive manufacturing (4) Advantages and disadvantages of SLS additive manufacturing	2. Understand the advantages and disadvantages of SLS additive manufacturing， and cultivate students to establish the craftsman spirit of pursuing excellent quality.			
5	Silk material selective cladding additive manufacturing (1) The working principle and forming process of FDM additive manufacturing (2) Materials and selection of FDM additive manufacturing (3) Advantages and disadvantages of FDM additive manufacturing (4) Common control software for FDM additive manufacturing (5) Introduction of typical FDM additive manufacturing equipment	1. Familiar with FDM additive manufacturing principle and forming process 2. Understand the advantages and disadvantages of FDM additive manufacturing	3	Lecture	2、3
6	Thin material laminated cutting additive manufacturing (1) Working principle of LOM additive manufacturing (2) Process parameters and post-treatment of LOM additive manufacturing (3) Materials and selection of LOM additive manufacturing (4) Advantages and disadvantages of LOM additive manufacturing	1. Familiar with LOM additive manufacturing principle and forming process 2. Understand the advantages and disadvantages of LOM additive manufacturing	3	Lecture	2、3
7	Additive manufacturing of metal materials (1) Selective Laser Melting manufacturing technology (2) Laser Solid Forming manufacturing technology (3) Electron Beam Selective Melting manufacturing technology (4) Electron beam fuse deposition manufacturing technology	1. Familiar with the principle and forming process of additive manufacturing of metal materials 2. Understand the advantages and disadvantages of additive manufacturing of metal materials	3	Lecture	1，2，3
8	Post-treatment and technical selection of additive manufacturing (1) Post-processing of additive	1. Familiar with common post-treatment process	3	Lecture	2、3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	Course objectives
	manufacturing (2) Precision analysis of additive manufacturing (3) Comparison and selection of main additive manufacturing	of additive manufacturing 2. Understand the advantages and disadvantages of various post-treatment processes			
9	Application of additive manufacturing technology (1) Application in the mold field (2) Application in biomedical field (3) Application in aerospace field (4) Application in the field of art design (5) Application in other fields	Understand the position of additive manufacturing technology in intelligent manufacturing industry, and cultivate students' feelings of home and country and patriotism education.	3	Lecture	2、3
10	Development trend of additive manufacturing technology (1) Demand analysis for additive manufacturing technology innovation (2) Development principles and goals (3) Development direction of additive manufacturing technology (4) Development trend of additive manufacturing technology	1. Understand the development trend of additive manufacturing technology 2. Understand specific innovation needs and improvement problems of additive manufacturing, and use innovative methods to solve problems	2	Lecture	2、3
11	3D printing modeling technology	Modeling skills training	2	Laboratory	1，2，3
12	3D printing and post-processing of parts	3D printing exercises	2	Laboratory	1，2，3

V. Teaching method

The course is based on classroom teaching, supplemented by homework and report after class.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives.

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	classroom questioning	10%	It mainly assesses students' understanding and mastery of basic knowledge. Mark each time on a 100-point scale.The grade of each question will be counted as 5% of the course grade.	2

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
	homework	20%	It mainly assesses students' understanding and mastery of 3D printing technology. Each homework will be graded on a 100-point scale.The average grade of each homework will be counted as 20% of the course grade.	2、3
	report	10%	Students' ability of literature retrieval, data collection, analysis, induction and summary related to additive manufacturing (3D printing) is mainly assessed. 35 marks for application background and basic knowledge of key technologies related to 3D printing, 30 marks for research status, 20 marks for development trend and 15 marks for content format. The grade of report will be counted as 10% of the course grade.	1、3
Exam	3D printed products	60%	product display	1、2、3

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

<table>
<tr><th>Assessment methods</th><th colspan="2">Grading criteria</th></tr>
<tr><td>Classroom questioning</td><td colspan="2">According to the answers to the questions, students are divided into four grades: excellent (90-100), good (75-89), medium (60-74), and fail (below 60 points). On the basis of grades, students are given points according to their class performance.</td></tr>
<tr><td>homework</td><td colspan="2">According to the completion of the homework, students are divided into four grades: excellent (90-100), good (75-89), medium (60-74), and fail (below 60 points). On the basis of grades, students are given points according to their class performance.</td></tr>
<tr><td rowspan="4">report</td><td rowspan="4">The inspection report is mainly evaluated from the aspects of the organization, completeness, format and standardization of the contents of inspection.</td><td>Key technology application background and basic knowledge (35 points) : Should be able to reflect the generation of the key technology and related basic knowledge concepts.</td></tr>
<tr><td>Summary of research status (30 points) : Summarize the scientific problems and methods involved in the technology, and cite appropriate literature.</td></tr>
<tr><td>Development trend (20 points) : mainly reflects the new direction, new theories and new methods in the related field, it is better to put forward their own opinions.</td></tr>
<tr><td>Content format (15 points) : Abstract (5 points), key words (5 points), references (5 points) according to the current requirements of journals and magazines, the report should be edited and typeset in a standardized way.</td></tr>
<tr><td>3D printed products</td><td colspan="2">Evaluate innovative products.On the basis of grades, students are given points according to their class performance.</td></tr>
</table>

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（classroom questioning）（K1）	Assessment 2（homework）（K2）	Assessment 3（report）（K3）	Assessment 4（3D printed products）（K4）
Percentage		0.1	0.2	0.10	0.6
Score percentage of course objective for each assessment method	Objective 1（M1）	0	0	0	0.2
	Objective 2（M2）	1	0.5	0	0.5
	Objective 3（M3）	0	0.5	1	0.3

VII. Textbooks and References

Textbooks：

[1] Zhanyao Yang, Jingyun zhao. Additive manufacturing and 3D printing technology and its application.Beijing：Tsinghua University Press,2017.

(二) References：

[1] Jimin Chen.3D printing technology basic tutorial:National Defense Industry Press,2016.

[2] Zhouyi Lai.3D printing project tutorial. Chongqing University Press，2015.

Teaching group：Gaoshen Cai, Xiao Cheng, Hongjun Li Course administrator：Gaoshen Cai

Written by: Gaoshen Cai **Reviewed by: Hongjun Li**

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May. 21, 2021

《智能制造技术基础*》教学大纲

Intelligent Manufacturing Technology Foundation

Course name：Intelligent Manufacturing Technology Foundation **Course code**：**31963**

Course type：Professional basic courses (Optional course)

Total teaching hours：32 (Classroom Hours: 24, Laboratory Hours or Tutorial Hours:8)

Course Credit：2.0

Prerequisites: Fundamentals of mechanical design, Fundamentals of mechanical manufacturing, Fundamentals of artificial intelligence, mechanical drawing, Fundamentals of circuit principles, Fundamentals of electronic technology, etc

Major： Mechanical and electronic engineering, Mechanical design ＆ manufacturing and Automation, Measurement ＆ control technology and instruments, etc

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

Intelligent manufacturing technology foundation is a basic course for undergraduates majoring in intelligent manufacturing engineering. Intelligent manufacturing technology is the main development direction of modern advanced manufacturing industry. Through the study of this course, students can understand the development, connotation, architecture, basic theories and basic methods of intelligent manufacturing technology, understand the current situation and trend of cutting-edge development in the field of manufacturing, broaden their horizons, cultivate the basic ability of analyzing, selecting and designing intelligent manufacturing cells, and consolidate the basic theories they have learned, We should cultivate students' ability to solve practical engineering problems by using their professional knowledge, expand their innovative thinking, strengthen their awareness of "strengthening the country through science and technology", and stimulate their enthusiasm of "serving the country through science and technology", so as to lay a solid foundation for carrying forward the spirit of craftsmen in a big country.

II. Course Objectives

Course Objective 1：To cultivate students' ability to solve practical engineering problems by using intelligent manufacturing technology and theoretical analysis, to strengthen students' awareness of "strengthening the country through science and technology", and to consolidate students' spiritual foundation of "strengthening the country through science and technology";

Course Objective 2： Master the knowledge representation methods involved in artificial intelligence and represent the knowledge of simple problems. Be able to use blind search and heuristic search algorithm to solve specific problems, understand the concept of deterministic reasoning, and be able to use reasoning methods to solve more complex artificial intelligence problems;

Course Objective 3： Understand the frontier status and development trend of intelligent manufacturing technology, understand the new process, new technology, new equipment and its development process involved in the intelligent manufacturing process, and have the ability to select manufacturing process in combination with product requirements and production conditions in the intelligent manufacturing process of products.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Intelligent Manufacturing Technology Foundation 》

Index points of graduation requirements	**Content**
1.4	Be able to use the knowledge and mathematical model of design,manufacturing, control and other related knowledge to compare and synthesize the solutions of complex engineering problems in the field of mechanical engineering
3.1	Understand the frontier status and development trend of mechanical engineering, be familiar with the basic process of research and development of new products, new processes, new technologies and new equipment, and have the attitude and consciousness of pursuing innovation in solving complex engineering problems in the field of mechanical engineering.
8.2	Understand the socialist core values, to understand the national conditions, to safeguard national interests, has the sense of responsibility to promote national rejuvenation and social progress.

Table 2. The supporting relationship between the course objectives of 《Intelligent Manufacturing Technology Foundation》 and the index points of graduation requirements

Index points of graduation requirements	**8.2**	**1.4**	**3.1**

Course objectives	1	2	3
Intensity of support	L	M	L

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	1. Introduction to intelligent manufacturing technology (1) The development and significance of intelligent manufacturing technology; (2)Theconnotation, characteristics, goals and development trend of intelligent manufacturing technology; (3) Intelligent manufacturing technology system.	1. Introduce the knowledge system framework of the course; teaching objectives, supporting graduation requirements, position in the professional curriculum system, teaching content, assessment methods and score ratio. 2. Understand the development and significance of intelligent manufacturing technology; 3. Understand the development of intelligent manufacturing technology in the United States, European Union, Asia and China; 4. Master the connotation and definition of intelligent manufacturing technology, the characteristics and objectives of intelligent manufacturing; 5. Understand the development trend of intelligent manufacturing; 6. Understand the intelligent manufacturing system under the framework of "made in China 2025". 7. Through group discussion, this paper discusses the gap between China's intelligent manufacturing technology and European and American manufacturing power, strengthens students' awareness of "science and technology power", and stimulates students' enthusiasm of "science and technology serving the country"	4	Lecture and tutorial、Panel discussion	1、3
2	2. Artificial intelligence (1) Overview of artificial intelligence; (2) Knowledge representation method; (3) Deterministic reasoning; (4) State space search; (5) Expert system; (6) Machine learning; (7) Artificial neural	1.Understand the concept, characteristics, development history and application fields of artificial intelligence; 2.Understand the concept, characteristics, classification and representation of knowledge; 3. Master the knowledge expression methods of first-order predicate logic, production representation and frame representation, and understand their respective advantages and disadvantages	4	Lecture	2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	network.	and scope of application; 4.Understand the concept of deterministic reasoning; 5. Understand the basic principles of artificial intelligence reasoning control strategy, pattern matching and replacement and natural deduction reasoning; 6. Understand the main process of AI search; 7. Understand the state space search method; 8. Master the basic principles of blind search algorithm and heuristic search algorithm; 9. Understand the concept, basic working principle, process and mode of knowledge acquisition and establishment steps of expert system; 10. Understand the concept of machine learning and the method of machine learning; 11. Understand the basic principle and application of artificial neural network.			
3	3. Intelligent design (1) The connotation and development of intelligent design; (2) Intelligent design system and its product model; (3) Design method and development example of intelligent CAD system.	26. 1. Understand the connotation and development of intelligent design; 27. Understand the basic structure and design of intelligent system; 28. Understand intelligent product model requirements, knowledge model and representation model; 29. Understand the design method, development process and application examples of intelligent CAD system.	4	Lecture	2、3
4	4. Process intelligent planning and intelligent database (1) General situation of intelligent database; (2) Computer aided process planning and its intellectualization; (3) Cutting intelligent database; (4) Grinding intelligent database; (5) NC machining automatic programming.	1. Understand the development route, structure and development direction of database system, and understand the composition of intelligent database; 2. Understand the basic meaning of process planning and computer aided process planning (CAPP); 3. Understand the working principle and characteristics of derived CAPP and generative CAPP system, and understand the basic structure of CAPP system; 4. Understand the algorithm flow of rs-cbr process intelligent optimization module and the basic principle of key calculation links; 5. Understand the basic structure and information processing flow of cutting intelligent database and grinding intelligent database;	4	Lecture	2、3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		6. Understand the key technology of NC machining automatic programming system.			
5	5. Intelligent monitoring, diagnosis and control of manufacturing process (1) The characteristics and significance of intelligent monitoring and diagnosis; (2) Sensor classification, signal transformation and interface circuit, signal processing and feature extraction and monitoring technology in intelligent detection system; (3) The definition, development, structural characteristics, methods, theoretical techniques and applications of intelligent diagnosis; (4) The definition, development, method and application of intelligent control; (5) Typical application examples.	1. Understand the characteristics and significance of intelligent monitoring and diagnosis; 2. Understand the sensor classification method, MUX connection structure of multi-channel analog converter, ADC chip selection method and advantages of intelligent monitoring technology in intelligent detection system; 3. Understand the connotation, significance and development status of intelligent diagnosis; 4. Understand the structure of intelligent diagnosis system, the advantages and disadvantages of each diagnosis method and the application prospect of intelligent diagnosis theory and technology Understand the structure and functions of the intelligent diagnosis system of the Internet of things; 30. Understand the typical application examples of intelligent monitoring, diagnosis and control system. 31. Introduce the application of intelligent detection, monitoring and diagnosis technology in the field of mechanical engineering, and guides students to reserve their existing knowledge to solve complex engineering problems.	4	Lecture	1、3
6	6. Intelligent manufacturing system (1) The development of intelligent manufacturing system; (2) Intelligent manufacturing system	1. Understand the development and composition of intelligent manufacturing system; 2. Understand the basic principles of flow scheduling, non flow scheduling, rule scheduling, simulation scheduling and artificial intelligence scheduling; 3. Understand the functions and supporting technologies of intelligent	2	Lecture	2、3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	architecture; (3) Intelligent manufacturing system scheduling control; (4) Supply chain management of intelligent manufacturing system.	manufacturing supply chain management system.			
7	7. Intelligent manufacturing equipment (1) The connotation, development, characteristics and significance of intelligent manufacturing equipment; (2) The functions, characteristics and development status of intelligent CNC machine tools at home and abroad; (3) The basic composition, key technologies and typical applications of industrial robots; (4) Development history and principle of 3D printing equipment; (5) Intelligent production line architecture, key technologies and development status; (6) Characteristics and development status of intelligent factory.	1. Understand the characteristics and definition of intelligent manufacturing equipment; 2. Understand the definition and functional characteristics of intelligent machine tools; 3. Understand the development status, basic components, key supporting technologies and typical applications of industrial robots; 4. Understand the development history of 3D printing equipment and the principle of common 3D printing technology; 5. Understand the intelligent production line architecture, key technologies and development status; 6. Understand the characteristics and development status of intelligent factory. 7.Through the analysis of engineering examples, we can cultivate students' craftsmanship spirit and strengthen their sense of mission from a big manufacturing country to a powerful manufacturing country.	2	Lecture	1、3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
8	Experiment 1 intelligent manufacturing cognition and intelligent CAD system product design experiment	1. Through the demonstration of typical intelligent manufacturing system, be familiar with the characteristics and objectives of intelligent manufacturing; 2. Be familiar with the function and design steps of intelligent CAD system; 3. Be able to use intelligent CAD system to realize simple product development.	4	Experiment teaching	2、3
9	Experiment 2 intelligent control demonstration experiment and industrial robot operation experiment	1. Through the demonstration experiment of intelligent control, we can understand the key technologies of sensors, signal processing and analysis in the process of intelligent manufacturing; 2. Through the operation experiment of industrial robot, understand the basic structure, function and key supporting technology of industrial robot.	4	Experiment teaching	2、3

V. Teaching method

The main method is to teach students by themselves. In the course of teaching, many effective teaching methods, such as case-based teaching and heuristic teaching, are used to strengthen the mutual communication between teachers and students and between students, guide students to think independently, strengthen thinking training, and further broaden their horizons.

Students should be impressed by the contents they are familiar with, and emphasize them repeatedly, so as to make the students deeply impressed and firm in their concepts, explain the ideas, and clarify the application scope of principles and methods. To understand the content, we should take the basic laws, basic concepts, basic methods, basic principles and basic problems as the basis, develop students' knowledge structure, straighten out the organic connection with other disciplines and scientific research topics, and further improve students' interest in learning.

Adopt a variety of teaching methods, design flexible teaching activities, provide a variety of learning experience, and effectively mobilize the enthusiasm of students. Optimize the combination and use of a variety of teaching methods, pay special attention to the application of modern educational technology. Reasonable use of presentation tools, inquiry tools, interactive tools, design tools, effectively improve the quality of teaching.

VI. Assessment

"Intelligent manufacturing technology foundation" course assessment is to evaluate the degree of students to achieve the teaching objectives, reflecting the degree of achievement of students' ability training objectives. The specific assessment methods, evaluation rules and corresponding course objectives are shown in Table 4.

Table 4 Course objectives and assessment methods

Score category	**Assessment methods**	**Percentage**	**Assessment details**	**Corresponding objectives**
Usual performance	Assignments	10%	It mainly grasps the attendance rate of students and assesses their understanding and mastery of basic knowledge.Each time according to the hundred mark system. The average score of each time is calculated as 10% of the total score of the course.	1、2、3
	Daily work	10%	It mainly investigates the students' mastery of classroom knowledge. Each assignment is scored on a 100 point system. The average score of each assignment is calculated as 10% of the total score of the course.	2
Experiment	Experiment and Report	20%	It mainly assesses the completion of the experiment and the completeness, accuracy and standardization of the experimental report writing.According to the report evaluation score, 20% is included in the total score of the course.	2、3
Exam	Final exam paper score	60%	It mainly assesses the students' mastery of the overall knowledge and application ability of intelligent manufacturing technology.The paper structure and score distribution are as follows: 1. Multiple choice questions or explanation of terms: 30 points, corresponding to course objectives 2and 3; 2. Judge or fill in the blank: 20 points, corresponding to the course objectives 2 and 3; 3. Design question: 30 points, corresponding to the course objective 2. 4. Calculation: 20 points, corresponding to the course objective 2. 60% of the grade is included in the total score of the course.	2、3

The scoring standards of each assessment link of the course of "intelligent manufacturing technology foundation" are shown in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	**Grading criteria**
Assignments	According to the answering questions and attendance rate, it is divided into four grades: excellent (90-100), good (75-89), medium (60-74) and failing (below 60). The score is given according to the grade and the class performance.

Daily work	According to the completion of the homework, it is divided into four grades: excellent (90-100), good (75-89), medium (60-74) and failing (below 60 points). Based on the grade, the students will be given a score according to their usual classroom performance.
Experiment	According to the results of the experiment, the students were divided into four grades: excellent (75-89), poor (90), excellent (74-89).
Exam	The final examination adopts the hundred mark system, which is graded according to the standard answers and scoring rules of the examination paper formulated by the course director.

For the score distribution matrix of assessment methods and course objectives of "intelligent manufacturing technology foundation" in Table 6

Table 6 Assessment methods and score allocation matrix

		Assessment 1（Assignments）（K1）	Assessment 2（Daily work）（K2）	Assessment 3（Experiment）（K3）	Assessment 4（Exam）（K4）
Percentage		0.1	0.1	0.2	0.6
Score percentage of course objective for each assessment method	Objective 1（M1）	0.3	0	0	0
	Objective 2（M1）	0.4	0.5	0	0.5
	Objective 3（M2）	0.3	0.5	1	0.5

According to the analysis of the average value of the achievement of the course objectives of the foundation of intelligent manufacturing technology, the evaluation criteria for the achievement of the teaching objectives are determined as follows:

Table 7 Evaluation criteria of the course objectives

Course objectives	**Evaluation criteria**				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.89**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
To cultivate students' ability to solve practical engineering problems by	Be able to **skillfully** use intelligent manufacturin g technology and	The ability to make **good** use of intelligent manufacturin g technology	**Be able** to solve practical engineering problems by using	**Basic** ability to solve practical engineering problems by using intelligent manufacturing	They **can't** solve practical engineering problems by using intelligent manufacturing

Course objectives	Evaluation criteria				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.89**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
using intelligent manufacturing technology and theoretical analysis, to strengthen students' awareness of "strengthening the country through science and technology", and to consolidate students' spiritual foundation of "strengthening the country through science and technology"	theoretical analysis to solve practical engineering problems, and have the consciousness of "strengthening the country through science and technology" and the spirit of great craftsman;	and theoretical analysis to solve practical engineering problems, with the "awareness of strengthening the country through science and technology" and the spirit of great craftsman;	intelligent manufacturing technology and theoretical analysis, and have the consciousness of "strengthening the country through science and technology" and the spirit of great craftsman;	technology and theoretical analysis, with the consciousness of "strengthening the country through science and technology" and the spirit of great craftsman;	technology and theoretical analysis, and have the consciousness of "strengthening the country through science and technology" and the spirit of great craftsman;
Master the knowledge representation methods involved in artificial intelligence and express the knowledge of simple problems, be able to use blind search and heuristic search algorithm to solve specific problems, understand the concept of deterministic reasoning, and be able to use reasoning	They are able to **skillfully** discuss various main methods of knowledge representation, be able to use basic knowledge representation methods to express knowledge of simple problems, fully master the principles of blind search and heuristic search algorithms, and be	It can **well** discuss the main methods of knowledge representation, use the basic knowledge representation method to express the knowledge of simple problems, grasp the principles of blind search and heuristic search algorithm, and make good use of these search algorithms to solve specific	They can discuss the main methods of knowledge representation, can use the basic knowledge representation method to express the knowledge of simple problems, master the principles of blind search and heuristic search algorithm, and be able to use these search algorithms to	They can **basically** discuss the main methods of knowledge representation, and can basically use the basic knowledge representation methods to express the knowledge of simple problems; basically master the principles of blind search and heuristic search algorithms, and basically be able to use these search algorithms to	They **can't** discuss the main methods of knowledge representation, we can't use the basic knowledge representation to express the knowledge of simple problems, They **can't** master the principles of blind search and heuristic search algorithm, and They can't use these search algorithms to solve specific problems;

Course objectives	Evaluation criteria				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.89**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
methods to solve more complex artificial intelligence problems	proficient in using these search algorithms to solve specific problems; **Accurately** explain the concept of deterministic reasoning, and skillfully use reasoning methods to solve complex artificial intelligence problems.	problems; **Well** explain the concept of deterministic reasoning, and can use reasoning method to solve complex artificial intelligence problems.	solve specific problems; Able to **correctly** explain the concept of deterministic reasoning, can use reasoning methods to solve more complex artificial intelligence problems.	solve specific problems; Able to **roughly** explain the concept of deterministic reasoning, and can use reasoning method to solve complex artificial intelligence problems.	
Understand the frontier status and development trend of intelligent manufacturing technology, understand the new process, new technology, new equipment and its development process involved in the intelligent manufacturing process, and have the ability to select manufacturing process in combination with product requirements and production conditions in	**Fully** understand the frontier status and development trend of intelligent manufacturin g technology; **Fully** understand the new process, new technology, new equipment and its development process involved in the intelligent manufacturin g process, and have the ability to select manufacturin g process in combination	Able to **very correctly** understand the frontier status and development trend of intelligent manufacturi ng technology; Able to **very correctly** understand the new process, new technology, new equipment and its development process involved in the intelligent manufacturi ng process, and have the ability to	Able to **correctly** understand the frontier status and development trend of intelligent manufacturin g technology; Able to **correctly** understand the new process, new technology, new equipment and its development process involved in the intelligent manufacturin g process, and have the ability to select manufacturin	Able to **roughly** understand the frontier status and development trend of intelligent manufacturing technology; Able to **roughly** understand the new process, new technology, new equipment and its development process involved in the intelligent manufacturing process, and have the ability to select manufacturing process in combination with product requirements and production conditions in the intelligent	**Don't** understand the cutting-edge status and development trend of intelligent manufacturing technology, the new process, new technology, new equipment and their development process involved in the intelligent manufacturing process, and **do not** have the ability to select manufacturing process in combination with product requirements and production conditions in the intelligent

Course objectives	Evaluation criteria				
	Course objectives achievement, average value 0.9-1	Course objectives achievement, average value 0.8-0.89	Course objectives achievement, average value 0.7-0.79	Course objectives achievement, average value 0.6-0.69	Course objectives achievement, average value 0-0.59
	Excellent	Good	Middle	Pass	Fail
the intelligent manufacturing process of products.	with product requirements and production conditions in the intelligent manufacturing process of products.	select manufacturing process in combination with product requirements and production conditions in the intelligent manufacturing process of products	g process in combination with product requirements and production conditions in the intelligent manufacturing process of products	manufacturing process of products.	manufacturing process of products.

VII. Recommended textbooks and reference materials

Teaching material:

[1] Deng Chaohui, Wan Linlin, Deng Hui, et al. Fundamentals of intelligent manufacturing technology[M]. Huazhong University of science and Technology Press, 2017.

Reference books：

[1] Liu Qiang, Ding Deyu, Fu Gang, et al. The road of intelligent manufacturing[M]. China Machine Press, 2017

[2] Wanrong. Internet plus intelligent manufacturing[M]. Science Press, 2016.

[3] Xin Guobin. Exploration and practice of intelligent manufacturing[M]. Electronic Industry Press, 2016

[4] Xin Guobin, Tian Shihong. Case collection of intelligent manufacturing standards[M]. Electronic Industry Press, 2016

Online resource:

[1] https://www.icourse163.org/course/YZPC-1207118807

[2] https://www.icourse163.org/course/UJS-1206271809

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Written by: Li Haoran　　Reviewed by:Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 27, 2021

《物联网技术与应用*》教学大纲

Technology and Application of the Internet of things

Course name：Technology and Application of the Internet of things **Course code**：31958

Course type：Basic subject elective course

Total teaching hours：32

Credit：2

Prerequisites: Basis of computer

Major：Automation, Electrical engineering and automation，Robot engineering，Mechanical Design and Manufacture,

Department: Department of Automation

I. Course Introduction

i. Course Introduction

This course is a basic subject elective course faced to Measurement technology and equipment, Electrical engineering and automation, Automation and Mechanical and Electronic Engineering. Through the study of this course, students will understand the basic concepts and developing status about the latest Internet of things technology, the application of Internet of things in people's lives, as well as the development status and typical applications of the Internet of things in China. This allows students to experience the rapid development of our country's high-tech while comparing the advanced technologies of western developed countries, thereby inspiring students' patriotic enthusiasm, national self-confidence and national pride. The study of this course lays a solid and necessary foundation for the cognition and learning of related technologies of the Internet of things.

ii. Course Objectives

Course Objective 1：Through learning, students will master the common basic concepts, theories and applications about Internet of things, understand some necessary knowledge about related technologies, and its developing tread, what will inspire students' patriotic enthusiasm, national self-confidence and national pride

Course Objective 2：Through learning, students will acquire the following abilities: a basic understanding of the concept of the Internet of things technology, a mastery of the development direction of the Internet of things technology, and a clear understanding of the theories and basic applications involved in the Internet of things. Combining personal reality, teachers need to help students clarify learning goals, and have strong independent learning, active exploration and independent thinking ability, the course can stimulate students' sense of application innovation.

Course Objective 3： Through learning, teachers should pay attention to training students following qualities: rigorous engineering quality, multi-disciplinary overall quality, a good scientific attitude, innovative spirit, and teamwork spirit.

III Basic course content and teaching arrangement

Table 1 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**
1	1. Introduction to Internet of things technology; 1.1 The social background development of the Internet of things; 1.2 Technical background of Internet of things development; 1.3 The definition and main technical features of the Internet of things; 1.4 The architecture of Internet of things; 1.5 Key technologies and industrial development of the Internet of things.	1. Master the basic concepts, characteristics, development and application prospects of the Internet of things technology; 2. Familiar with the architecture of Internet of things, as well as its key technology and industrial development. 3. Inspire students' home country feelings, sense of pride and mission, through a group discussion of typical application cases and strategic planning of the development of the Internet of things in our country.	4	Tutorial in class	1
2	2. The applications of RFID and Internet of things 2.1 Automatic identification technology; 2.2 RFID tags and EPC coding system; 2.3 EPC and ONS 2.4 RFID tag reader.	1. Master the developing history of automatic identification and its representative technology; 2. Master the principle and classification of RFID technology; 3. Understand the EPC coding system; 4. Familiar with the function, working principle and classification of RFID tag reader.	3	Tutorial in class	1、2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
3	3. Sensors, smart sensors and wireless sensor network technology 3.1 The concept and classification of sensors; 3.2 Physical sensors, chemical sensors, biological sensor, nano sensors; 3.3 The performance index of the sensor; 3.4 Smart sensors and wireless sensors; 3.5 Wireless sensor network.	1. Master the concept and classification of sensors and be able to list each type of sensor; 2. Master the calculation method of various performance indicators of the sensor; 3. Familiar with the concepts of smart sensors and wireless sensors; 4. Master the working principle of wireless ad hoc network; 5. Familiar with the characteristics and structure of wireless sensor networks.	4	Tutorial in class	2
4	4. Smart devices and embedded technology for Internet of things 4.1 The research and development of smart devices; 4.2 The development process and characteristics of embedded systems; 4.3 The basic concept of smart hardware; 4.4 The research content, human-computer interaction, virtual human-computer interaction technology in artificial intelligence; 4.5 Virtual reality and augmented reality; 4.6 Classification of wearable computing devices and introduction of each category.	1. Familiar with the research and development of smart devices; 2. Master the development process and characteristics of embedded systems; 3. Understand the concept of intelligent hardware, the research content in artificial intelligence, human-computer interaction, and virtual human-computer interaction technology in artificial intelligence; 4. Master the concepts of virtual reality, augmented reality and be able to analyze and judge these concepts; 5. Master the classification and characteristics of wearable computing devices.	3	Tutorial in class	2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
5	5. Communication and Network Technology for Internet of things 5.1 Research and development of computer network technology; 5.2 The formation and development of computer networks, packet switching technology, ARPANET, and the concept of "three networks fusion"; 5.3 TCP/IP protocol and SDN; 5.4 The basic concepts and development of cellular systems, 5G networks; 5.5 M2M, D2D technology and their application in the Internet of things.	1. Familiar with the research and development of computer network technology; 2. Master packet switching technology, ARPANET, and the concept of "three networks fusion"; 3. Master the concepts of TCP/IP and SDN and the problems they solved; 4. Master the cellular system and the concepts involved, and be familiar with the technical indicators of 5G; 5. Master the concepts of M2M and D2D technologies and the problems they solve.	4	Tutorial in class	2
6	6. Location information, location technology and location services 6.1 The basic concepts of location information and location services; 6.2 Aerospace remote sensing technology; 6.3 Global Navigation Satellite System GNSS and Geographic Information System GIS; 6.4 Internet of things and high-precision maps.	1. Familiar with the basic concepts of location information and location services; 2. Master the related concepts of aerospace remote sensing technology; 3. Familiar with Global Navigation Satellite System GNSS and geographic information system GIS; 4. Understand the concept of high-precision maps used in the Internet of Things and the technologies involved.	2	Tutorial in class	2
7	7. The intelligent data processing technology and network security for Internet of things 7.1 Basic concepts of intelligent data processing technology of the Internet of things; 7.2 Internet of things and Cloud Computing; 7.3 Internet of things and Big Data; 7.4 The basic concepts of cyberspace security and	1. Familiar with the basic concepts of intelligent data processing technology; 2. Understand the concept of cloud computing and big data; 3. Familiar with the basic concepts of cyberspace security and cyber security; 4. Understand the OSI security architecture; 5. Understand the security	4	Tutorial in class	2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	cyber security; 7.5 OSI security architecture; 7.6 Main content of security research of Internet of things	issues involved in the Internet of things.			
8	8. The applications of Internet of things 8.1 Smart industry 8.2 Smart agriculture; 8.3 Smart transportation; 8.4 Smart power grid; 8.5 Smart environmental protection; 8.6 Smart medical treatment; 8.7 Smart security; 8.8 Smart home furnishings; 8.9 Smart logistics.	Familiar with the application of the Internet of things in industry, agriculture, transportation, power grid, environmental protection, medical treatment, security, home furnishings, and logistics, focus on understanding and analyzing the typical application cases of domestic frontier Internet of things to understand the rapid development of our country's high-tech in recent years, while enhancing national self-confidence and national pride.	4	Tutorial in class and discussion	1、3
9	Point-to-point radio frequency communication and temperature and humidity sensor experiment	1. Understand the relevant knowledge of the IEEE802.15.4-2006 standard; master the basic usage methods of data transmission and reception of the CC2530 internal radio module. 2. Understand the structure of the wireless sensor network; master the data collection method of the temperature and humidity sensor.	4	Group experiment and discussion	3

IV. Teaching method

i. Course hours allocation

Table 2 Experimental cource content hours allocation

Teaching methods / Teaching hours / Course content	Theory			Theory practice in class		Total
	Theory teaching	Exercise class	Discussion class	Experiment	Others	

1. Introduction to Internet of things technology	4					4
2 The applications of RFID and Internet of things	3					3
3. Sensors, smart sensors and wireless sensor network technology	4					4
4. Smart devices and embedded technology for	3					3
5. Communication and Network Technology for Internet of things	4					4
6. Location information, location technology and location services	2					2
7、The intelligent data processing technology and network security for Internet of things	4					4
8 The applications of Internet of things	2		2			4
9 Point-to-point radio frequency communication and temperature and				4		4
Total	26		2	4		32

TABLE 3 Experimental cource content hours allocation

Experimental project	The summary of content	Equipment or experimental environment	Hours	students numbers per group	Experimental Property (Basic/ Comprehensive/ Design/Research Innovation)	Requirements (Must Do/Optional Do Cheng	Target
Point-to-point radio frequency communication	Understand the relevant knowledge of the IEEE802.15.4-2006 standard; master the basic usage methods of data transmission and reception of the CC2530 internal radio module.	The Comprehensive Experiment Box of Internet of things	2	2-3 people	Compulsoriness	Must Do	

Temperature and humidity sensor experiment	Understand the structure of the wireless sensor network; master the data collection method of the temperature and humidity sensor.	The Comprehensive Experiment Box of Internet of things	2	2-3 people	Compulsoriness	Must Do	

ii. Teaching method

The course is mainly based on teaching, supplemented by self-study. The course uses a variety of effective teaching methods such as case-based and heuristic methods to strengthen the communication between teachers and students, and among students, guide students to think independently, strengthen thinking training, and further broaden their horizons.

Teachers should use graphics, application examples and other methods in teaching.

V. Assessment

Course assessment adopts a combination of multiple assessment methods, emphasizing the cultivation of practical skills. It is presented in Table 6.

Table 4 Course objectives and assessment methods

Score category	**Assessment methods**	**Percentage**	**Assessment details**	**Corresponding objectives**
Usual performance	Classroom questioning and rolling call	10%	It mainly assesses students' understanding and mastery of basic knowledge, as well as their learning attitude. This is scored on a hundred-point scale. The average grade of each session is calculated as 10% of the total course grade.	1
	Usual homework	30%	It mainly assesses students' understanding and mastery of the knowledge points of each chapter. Each homework is graded on a four-level system. The average grade of each homework is calculated as 30% of the total course grade.	1

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Exam	Final exam paper score	40%	It mainly assesses students' understanding and mastery of the knowledge points of each chapter. The test paper structure and score distribution are as follows: 1. Basic knowledge: 40 points, corresponding to course objective 1; 2. Hardware selection: 20 points, corresponding to course objective 2; 3. Design questions: 40 points, corresponding to course objective 2; 40% of the paper score is calculated in the total course score.	1、2
Experiment	Experimental report score	20%	Through group experiments, the students' mastery of the knowledge, organization and management ability, and the ability to formulate work plans reasonably according to the requirements of the experimental project are tested. Each experiment report is scored on a hundred-point scale.	3

VI. Recommended textbooks and reference materials

Textbook：

[1] 吴功宜编著，物联网工程导论(第二版)，机械工业出版社，2018 年。

[1] Gongyi W. “Introduction to Internet of Things(Second Edition) ”, China Machine Press, 2018.

Reference books：

[1] 吴功宜编著，解读物联网，机械工业出版社，2016 年；

[2] 吴功宜主编，物联网技术与应用(第二版)，机械工业出版社，2018 年；

[3] 吴功宜编著，物联网工程导论，机械工业出版社，2012 年

[4] 刘云浩编著，物联网导论(第二版)，科学出版社，2013 年。

[1] Gongyi W. “Interpretation of the Internet of Things”, China Machine Press, 2016.

[2] Gongyi W. “Internet of Things Technology and Application(Second Edition) ”, China Machine Press, 2018.

[3] Gongyi W. “Introduction to Internet of Things”, China Machine Press, 2012.

[4] Yunhao L. “Introduction to the Internet of Things(Second Edition) ”, China Science Press, 2018.

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Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 21, 2021

《机械工程测试技术*》教学大纲

Fundamentals of Measurement Technology

Course name：Fundamentals of measurement technology **Course code**：**34902**

Course type：Specialized course (Required elective course)

Total teaching hours：32 (Classroom Hours: 28, Laboratory Hours or Tutorial Hours:4)

Course Credit：2

Prerequisites: Advanced mathematics, general physics, theoretical mechanics, mechanics of materials, Fundamentals of electronic technology

Major：Mechanical design, manufacturing and automation, Mechatronics engineering, Energy and power engineering

Department: Department of measurement and control, School of machinery and automatic control

I. Course Introduction

Mechanical engineering testing technology is a compulsory basic course for all majors of mechanical platform. It mainly describes the theoretical basis of testing technology and engineering test methods of various common mechanical quantities. The main contents include sensor principle, test signal analysis and processing, characteristics of test system, error theory and data processing, computer and test technology. It is a comprehensive and multi-disciplinary course Interdisciplinary courses.

This course emphasizes both mathematics and physics, and provides modern testing technology for parameter measurement in mechanical engineering based on sensors, electronic technology and signal processing. The preceding course is the basis of advanced mathematics, general physics, theoretical mechanics, material mechanics and electronic technology. It is a highly integrated mechanical and electronic technology. Engineering Testing Technology is applied in machinery, architecture, aerospace, etc. It is widely used in the field of multi engineering technology.

The teaching purpose of this course is to train students to correctly analyze the tested object, determine the test scheme, correctly select the sensor according to the test task, reasonably constitute or select the test device, obtain the test signal, analyze in the time domain and frequency domain, and master the test method of typical parameters in Mechanical engineering..

II. Course Objectives

Course Objective 1： Using relevant cases and content in the development of test technology, combine professional knowledge with ideological and political theory, to cultivate students 'patriotism, national pride and self - esteem, help students establish a correct world outlook, outlook on life, values, and cultivate students' socialist craftsman spirit; (support graduation requirements 12.2)

Course Objective 2: Understand the various analysis methods of test signal, master the basic principle and method of signal spectrum analysis, be able to analyze the frequency spectrum of periodic signal and typical aperiodic signal, master the working principle of common sensors, calculate the main technical indexes of sensors, and select the conversion circuit of common sensors. (supporting graduation requirements 4.1)

Course Objective 3: Master the description and measurement method of static and dynamic characteristics of the first and second order system, understand the concept of static and dynamic measurement error, and correctly select the test device according to the condition of undistorted measurement. (supporting graduation requirements 2.2, 2.3)

Course Objective 4: It can correctly analyze the tested object, determine the test scheme, correctly select the sensor according to the test task, reasonably constitute or select the test device, obtain the test signal, and get the test result after analysis. (supporting graduation requirements 4.2).

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Fundamentals of measurement technology 》

Index points of graduation requirements	**Content**
2.2	be able to correctly identify the diversity of solutions to complex engineering problems, and seek solutions and alternative solutions for complex engineering problems in mechanical engineering through literature research. [M]
2.3	be able to correctly describe the solution of a complex engineering problem in mechanical engineering, and analyze the rationality of the scheme by using the basic principles. [M]
4.1	master the test and experimental methods of complex mechanical system, including the test methods and means of force, deformation, motion, heat, etc., and master the relevant basic principles. [M]
4.2	be able to comprehensively use the scientific principles learned, design experiments according to research needs, carry out experiments according to reasonable steps and obtain data. [H]

12.2	Be able to use all kinds of effective means to obtain effective knowledge, through learning to develop their own ability to adapt to social development..[L]

Table 2. The supporting relationship between the course objectives of 《Fundamentals of measurement technology》 and the index points of graduation requirements

Index points of graduation requirements	**2.2**	**2.3**	**4.1**	**4.2**	**12.2**
Course objectives	3	3	2	4	1
Intensity of support	M	M	M	H	L

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**
1	The research contents and methods of mechanical engineering testing technology, the purpose of learning mechanical engineering testing technology, the limitations and development process of mechanical engineering testing technology.	1. Master the composition of test system; 2. Understand the basic concepts of dynamic testing and static testing; 3. Know the main content of testing technology course. 4. Encourage students to strive. Cultivate students to love the country.	2	Lecture	1.2
2	2. Signal Analysis 2.1. Classification of signals 2.2.Periodic signal and discrete spectrum 2.3 Transient aperiodic signal and continuous spectrum 2.4 signal processing	1. Master the time domain representation classification of signals; 2.Master the spectrum of typical periodic signal; 3.Master the spectrum of typical aperiodic signal; 4. The key concept of signal processing. 5. Understand the history of information theory and stimulate students' enthusiasm for learning	8	Lecture and tutorial	2
3	3. Measurement system Features 3.1. Static characteristics of test device 3.2 Dynamic characteristics of testing device 3.3 Undistorted measurement	32. Master the basic characteristics and main characteristic parameters of the first-order and second-order systems; 33. Understand the static and dynamic measurement errors;	6	Lecture and tutorial	3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	conditions	34. Master the conditions for realizing undistorted testing.			
4	4. Sensor principle 4.1 Classification of common sensors; 4.2 Resistance sensor; 4.3 Capacitive sensor; 4.4 Inductive sensor; 4.5 Magnetoelectric sensor; 4.6 Piezoelectric sensor.	1. The working principle and signal output characteristics of the sensor; 2.The elimination and improvement of nonlinear error; 3.The elimination of temperature error. 4. Understand the history of sensor development and stimulate students' enthusiasm for learning.	12	Lecture and experiment	4
5	5. Signal conditioning 5.1 Bridge; 5.2 Modulation and Demodulation; 5.3 Signal amplification; 5.4 Wave filtering.	13. Master balance condition of bridge; 14. Amplitude modulation and demodulation; 15. Impedance transformation; 16. Charge amplifier.	4	Lecture and experiment	3

V. Teaching method

The course mainly consists of lectures, experiment and assignments.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Assignments	20%	To assess the level of understanding knowledge taught in class, accounting for 40% of total score;	1, 2, 3
Experiment	Experiment and Report	20%	Two sensor and measurement circuit experiments were completed , accounting for 20% of total score;	4
Exam	Software operation on computer	60%	To assess the ability to use Ansys solving practical problems, accounting for 50% of total score.	2, 3, 4

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	**Grading criteria**
Assignments	According to the condition of completion, there will be four levels：Excellence (90-100), good (80-89), normal (70-79), pass(60-69),fail (below 60). Adjust the score depending the class attendance.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment （Assignments）（K1）
Percentage		0.2
Score percentage of course objective for each assessment method	Objective 2（M2）	0.6
	Objective 3（M3）	0.4

The evaluation criteria of the course objectives can be determined on the basis of assessment method, grading criteria and course objective allocation matrix, as shown in Table 7.

Table 7 Evaluation criteria of the course objectives

Course objectives	**Evaluation criteria**				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.89**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
Course Objective 2：Understand the basic theory of measurement signal analysis and processing;	Able to **accurately** and **correctly** understand and command the governing equations and frequency spectrum of typical signals.	Able to **very correctly** understand and command the governing equations and frequency spectrum of typical signals.	Able to **correctly** understand and command the governing equations and frequency spectrum of typical signals..	Able to **roughly** understand and command the governing equations and frequency spectrum of typical signals.	**Not** able to understand and command the governing equations and frequency spectrum of typical signals.
Course Objective 3：	**Fully** understand	Able to **very correctly**	Able to **correctly**	Able to **roughly** understand	**Not** able to understand

Course objectives	Evaluation criteria				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.89**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
Familiar with measurement system features, Understand the characteristics of typical sensor output signal.	theory of sensors; **Fully** able to calculate the output and input of typical measurement systems.	understand theory of sensors; Able to **very correctly** calculate the output and input of typical measurement systems.	understand theory of sensors; Able to **correctly** calculate the output and input of typical measurement systems.	theory of sensors; Able to **roughly** calculate the output and input of typical measurement systems.	theory of sensors; Not able to calculate the output and input of typical measurement systems.

VII. Recommended textbooks and reference materials

Textbook：

Since lecture notes will be delivered to students, textbook is not required. However students are encouraged to read the following reference books:

Reference books：

[1]. Richard S. Figliola, Theory and Design for Mechanical Measurements. John Wiley & Sons, Inc. , 2011.

[2].Alan s. Morris, Measurement and Instrumentation principles, ElSEVIER, 2005.

[3]. John Bentley, Principles of measurement systems, Person Education, 2004.

Online resource:
https://mooc1-1.chaoxing.com/mycourse/teachercourse?moocId=206959684&clazzid=13986909&edit=true&v=0&cpi=89920565&pageHeader=0

Teaching group： Wang ying, Guo xiaozhong   Course administrator：Wang ying

Written by: Wang ying   Reviewed by: Guo liang

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 28, 2021

《工程流体力学*》教学大纲

Engineering Fluid Mechanics

Course name： Engineering Fluid Mechanics **Course code：** 36905

Course type： Basic course

Total teaching hours： 32 (Classroom Hours: 30, Laboratory Hours or Tutorial Hours:2)

Credit： 2

Prerequisites: Advanced Mathematics, Theoretical Mechanics, Physics

Major： Mechanical design, manufacturing and automation, Mechatronics engineering, Energy and power engineering

Department: Department of Fluid Engineering

I. Course Introduction

Engineering fluid mechanics takes fluids (including liquids and gases) as the research object to study the macroscopic balance and motion laws of fluids, the interaction laws between fluids and solid walls, and the applications of these laws in engineering practice. It is a subject with strong foundation and wide application. It has a long history and is full of youthful vitality.

The "Engineering Fluid Mechanics" course is one of the indispensable courses for mechanical majors. Its main task is to clarify the basic physical phenomena, basic concepts, basic principles and laws in fluid mechanics, as well as the application of these laws in practical engineering problems, and to cultivate students'ability to analyze and solve problems, form a positive view on world, life and values, inherit and innovate Chinese excellent traditional culture, establish a correct view on the country, nation, history, and culture, and laid a solid foundation for various engineering technology works and scientific researches in the future, become a qualified builder of the cause of socialism with Chinese characteristics.

II. Course Objectives

Course Objective 1： To teach students to solve puzzles, educate people and cultivate talents in an organic way; to realize the diversified unity of knowledge transfer, value shaping and ability training; to promote the free and comprehensive development of students.

Course Objective 2: To understand the basic concepts of fluid physical properties in engineering fluid mechanics, and master basic theories such as the basic equations of hydrostatics and the three major equations of fluid dynamics. Master the basic principles and laws of similarity principles and dimensional analysis in engineering fluid mechanics.

Course Objective 3: To understand the basic ideas and methods of similar experiment design in fluid mechanics; to analyze and solve engineering problems such as the fluid force and the interaction between fluid and solid when the fluid is in equilibrium and motion in engineering design practice.

Course Objective 4: To learn to use correct standpoints, viewpoints and methods to analyze problems, closely integrate learning, observation, and practice with thinking; have a good scientific attitude and self-learning ability, be able to independently propose, abstract and study complex fluid mechanics in engineering problems, pay attention to the latest developments in the industry; be good at grasping the phenomenon and essence of problems, tributaries and mainstreams, develop the habit of diligent thinking and in-depth research, and cultivate historical thinking, dialectical thinking, systematic thinking and innovative thinking.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown inTable 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown inTable 2.

Table 1 Index points of graduation requirements supported

Index points of graduation requirements	**Content**
1.2	Be able to apply knowledge of mathematics and natural sciences to mathematical modeling and solving of complex engineering problems in the field of mechanical engineering.

Table 2 The supporting relationship between the course objectives and the index points of graduation requirements

Index points of graduation requirements	**1.2**
Course objectives	1, 2, 3, 4
Intensity of support	M

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	**Course content**	**Teaching requirements**	**Teaching hours**	**Teaching type**	**course objectives**

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	**Introduction** The tasks and research objects of fluid mechanics Force acting on the fluid The main mechanical properties of fluids	Understand the great achievements made in China's modern aerospace field, and cultivate national self-confidence and cultural identity; Focus on understanding the concept of fluid particles	2	Lecture	1, 2
2	**Hydrostatics** Basic equations of hydrostatics Distribution law of hydrostatic pressure Pressure gauge display method and measurement unit The total pressure of the liquid on the flat wall The total pressure of the liquid on the curved wall	Focus on understanding and mastering the basic equations of statics, the concept of pressure bodies, and the calculation of total pressure	6	Lecture and tutorial	2, 3
3	**Fluid kinematics** Two methods of describing fluid movement Classification, traces and streamlines of fluid movement Continuity equation	Introduce the relationship between the two kinematics methods, and cultivate students' interest and ability to understand problems objectively and comprehensively; Focus on understanding and mastering the difference and connection between streamlines and traces	4	Lecture and tutorial	1, 2, 3
4	**Fluid Hydrodynamics** Euler differential equation of motion Bernoulli equation The practical application of Bernoulli equation, Momentum Theorem for Constant Flow	Emphasis on understanding and mastering Bernoulli equation, the simplification of conditions for solving practical problems by momentum theorem, etc.	8	Lecture and tutorial	2, 3
5	**Flow in pipes** Reynolds experiment-laminar and turbulent flow Laminar flow in pipes Turbulent flow in pipes Turbulent head loss Minor loss in pipe flow	Introduce the hydraulic difficulties in the construction of the Three Gorges Dam and the great contribution it brings, and increase the national pride of students; Focus on understanding and grasping the origin and treatment of turbulence, and calculation of loss along the way	6	Lecture and tutorial	1, 2, 3, 4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
6	**Dimensional analysis and similarity theory** Dimensional analysis Similarity theory Model experiment foundation	Focus on understanding and mastering the basic dimensions, similarity criterion and dimensional analysis π theorem	4	Lecture and tutorial	1, 2

Table 4 The time allocation of the teaching content of the experiment course

Experiment project name	Content summary	Mainly used equipment Or experimental environment	Experimental hours	Number of people in each group	Experimental attributes (basic/comprehensive/design /research innovation)	Open request (required /optional)	course objectives
Flow resistance measurement experiment	1. Master the general experimental methods for measuring the resistance loss of fluid flowing through straight pipes, pipe fittings and valves. 2. The relationship between the friction coefficient λ of the straight pipe and the Reynolds number Re is measured to verify the relationship curve between λ and Re in the general turbulent zone.	Main equipment: water storage tank, centrifugal pump, water pipes of different pipe diameters and materials, various valves, pipe fittings, turbine flowmeters and inverted U-shaped differential pressure gauges, etc.	2	6	basic	required	1, 2, 3

V. Teaching method

The course mainly consists of lectures, practice on assignments and an experiment course.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives, as shown in Table 5.

Table 5 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Assignments	30%	To assess the level of understanding knowledge taught in class, accounting for 30% of total score	1, 2, 3, 4
Experiment	Report	10%	To assess students' understanding and mastery of relevant basic knowledge and their practical ability in the actual experiment process.	1, 2, 3
Exam	Software operation on computer	60%	To assess the ability to use Ansys solving practical problems, accounting for 60% of total score.	1, 2, 3, 4

The grading criteria of this course for each assessment method are presented in Table 6.

Table 6 The grading criteria for each assessment method

Assessment methods	Grading criteria
Assignments	According to the condition of completion, there will be four levels：Excellence (90-100, good (75-89, normal (60-74), fail (below 60). Adjust the score depending the class attendance.
Experiment report	According to the experimental report submitted by the student, based on the fullness of the experimental process recorded by the student and the reasonable degree of the experimental result, the score will be based on a percentage system.
Exam	The closed-book examination adopts a hundred-point system and is graded according to standard answers and grading rules.

The score allocation matrix of assessment methods and course objectives are given in Table 7.

Table 7 Assessment methods and score allocation matrix

		Assessment 1（Assignments）（K1）	Assessment 2（report）（K2）	Assessment 2（report）（K2）
Percentage		0.3	0.1	0.6
Score percentage of course objective for each assessment	Objective 1（M1）	0.2	0.2	0.2
	Objective 2（M2）	0.4	0.3	0.2
	Objective 3（M3）	0.3	0.5	0.5
	Objective 4（M4）	0.1	0	0.1

		Assessment 1 （Assignments）（K1）	Assessment 2（report）（K2）	Assessment 2（report）（K2）
method				

The evaluation criteria of the course objectives can be determined on the basis of assessment method, grading criteria and course objective allocation matrix, as shown in Table 8.

Table 8 Evaluation criteria of the course objectives

Course objectives	**Evaluation criteria**				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
1: Understand the basic concepts of fluid physical properties in engineering fluid mechanics, and master basic theories such as the basic equations of hydrostatics and the three major equations of fluid dynamics	Able to **accurately** and **correctly** understand the basic concepts, basic equations and basic theories of fluid mechanics	Able to **very correctly** understand the basic concepts, basic equations and basic theories of fluid mechanics	Able to **correctly** understand the basic concepts, basic equations and basic theories of fluid mechanics relatively correctly	Able to **roughly** understand basic concepts, basic equations and basic theories of fluid mechanics correctly	**Not** able to understand the basic concepts, basic equations and basic theories of fluid mechanics
2: Master the basic principles and laws of similarity principles and dimensional analysis in engineering fluid mechanics, and understand the basic ideas and methods of similar experimental design in fluid mechanics	Ability to fully and accurately master the design methods of similarity principles, dimensional analysis and similar experiments	Ability to accurately master the design methods of similarity principles, dimensional analysis and similar experiments	Ability to master the design methods of similarity principles, dimensional analysis and similar experiments	Be able to **roughly** master the principle of similarity, dimensional analysis and design methods of similar experiments basically and accurately	**Not** able to accurately grasp similar principles, dimensional analysis and design methods of similar experiments

Course objectives	Evaluation criteria				
	Course objectives achievement, average value 0.9-1	**Course objectives achievement, average value 0.8-0.9**	**Course objectives achievement, average value 0.7-0.79**	**Course objectives achievement, average value 0.6-0.69**	**Course objectives achievement, average value 0-0.59**
	Excellent	Good	Middle	Pass	Fail
3: Ability to analyze and solve engineering problems such as the fluid force and the interaction between fluid and solid when the fluid is in equilibrium and motion in engineering design practice	Able to fully and accurately understand and master the solutions to engineering problems such as fluid forces and interactions in engineering design practice	Able to accurately understand and master the solutions to engineering problems such as fluid forces and interactions in engineering design practice	Able to understand and master the solutions to engineering problems such as fluid forces and interactions in engineering design practice	Able to **roughly** understand and master the solutions to engineering problems such as fluid forces and interactions in engineering design practice	**Not** able to understand and master the solutions to engineering problems such as fluid forces and interactions in engineering design practice
4: Have a good scientific attitude and self-learning ability, be able to independently propose, abstract and study complex fluid mechanics problems in engineering, pay attention to the latest developments in the industry, and develop the habit of diligent thinking and in-depth research	Pay great attention to the development of technology, pay great attention to extracurricular learning, and actively think	Pay attention to the development of technology, pay attention to extracurricular learning, and be able to think actively	Pay some attention to the development of technology, pay some attention to extracurricular learning, and be able to think actively	Pay little attention to technology development trends, pay little attention to extracurricular learning, and less active thinking	Do not pay attention to the development of technology, do not pay attention to extracurricular learning, do not take the initiative to think

VII. Recommended textbooks and reference materials

Textbook：

Fluid Mechanics Fundamentals and Applications, Second Edition. Yunus A. Cengel, John M. Cimbala

Reference books：

[1] Yu Linghong, editor in chief. "Engineering Fluid Mechanics", Mechanical Industry Press, January 2017

[2] Wang Hongwei: "Fluid Mechanics as I understand", National Defense Industry Press, published in 2014.

Online resource:

[1] http://www.4juan.com/zixuekaoshi/html/gongxuelei/gongcheng liutilixue/ index .html

[2] http://big5.dushu.com/book/11877518/

[3] http://www.abab123.com/bbs/down.asp?html=446683

Teaching group：Peifeng Lin, Zhe Lin

Course administrator：Peifeng Lin

Written by: Peifeng Lin

Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 21, 2021

《电子技术基础*》教学大纲

Syllabus of Fundamentals of Electronic Technique

Course name: Fundamentals of Electronic Technique

Course code : 36909

Category : Professional education（Required）

Total teaching hours: 40 (Lecture: 32, Experiment: 8)

Credit: 3.5

Major: Mechanical Design Manufacturing and Automation, Industrial Engineering, Process Equipment and Control Engineering, Material Forming and Control Engineering.

Department: Mechantronic Engineering.

I. Course Introduction

Fundamentals of electronic technique is the basic course for students of mechantronic engineering and electronic engineering. This course mainly introduces the passive components, D.C. circuits, A.C. circuits and logic circuits. Not only the relevant professional students and personnel specializing in science and engineering, but also the research personnel and technical personnel working in robotics, electronics, mechanics, aerospace, information transmission, energy development and agricultural scientific research. This course pays equal attention to theory and practice, which requires students to have learned advanced mathematics, linear algebra, differential equations, mechanical principles and fundamentals of circuit. It’s a solid foundation for the following related courses.

II. Course Objectives

Course Objective 1：Understand the wide application of electronic system in heavy equipment, military equipment, aerospace, civil industry and many other aspects, especially its important role in the field of national economy and national defense.Cultivated students to establish the idea of serving the country with science and technology, strengthening the country with science and technology.

Course Objective 2：Understand the basic concepts and terminologyof analogue circuit and digital circuit, AC and DC circuits, passive components include resistors, capacitors, inductors and the sereis and parallel combinations. Understand the basic functions of diodes, transistors, amplifiers and logic gates.Be able to analyse the working status of transistors, calculate the out of the operational amplifier circuits, work on calculation of logic algebra, analyse the circuits of logic gates and bistables.

Course Objective 3：Be able to design complex circuits with passive components, to design simple amplifier circuit with transistors and operational amplifier chips and design complex circuits with logic gates and design simple timing circuits with bistables.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by《Fundamentals of Electronic Technique》

Index points of graduation requirements	Content
1.3	Knowledge of analysis, designing, and modeling of electronic system. Abilities of definition, modeling, analyse and evaluation of complex electronic system. Be able to specify the design requirements and solution.
2.3	Be able to select appropriate analysis methods and processes according to engineering principles, key problems and technical difficulties involved in mechanical and electronic engineering, especially complex electronic circuit engineering problems, formulate reasonable solutions and conduct technical feasibility demonstration.
8.2	Understand the core socialist values, understand the national conditions, safeguard national interests, and have a sense of responsibility to promote national rejuvenation and social progress.

Table 2. The supporting relationship between the course objectives of 《Finite Element Technology and Application》 and the index points of graduation requirements

Indicator supported by Graduation requirements	1.3	2.3	8.2
Course objectives	1	2	3
Support intensity	H	M	M

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	1. Types of semiconductors and property of PN junction. 2. Specifications of diodes. 3. Characteristics of transistors and the ability of amplifying.	1. Understand the basis parameters of semiconductors and the structure of PN junction. 2. Be able to work on circuit of diodes.and be able to analyse the transistors circuits. 3. Study the history of Chinese manufacturing, understand the national conditions and establish	3	Lecture	1,2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
		a sense of mission from a large manufacturing country to a powerful manufacturing country.			
2	1. Structure of basic amplifiers. 2. Analysis of common emitter configuration amplifier circuits. 3. Analysis of D.C. and A.C. circuits of the amplifier circuits.	1. Be able to analyse the common emitter configuration amplifier circuits. 2. Be able to analyse D.C. and A.C. circuits of the amplifier circuits.	9	Lecture and experiments	1,2
3	1. Basic definition of feedback and analysis methods. 2. Influence to the amplifier circuits caused by feedback. 3. Structure, symbol and basic functions of operational amplifiers. 4. Analysis methods of operational amplifier circuits.	1. Understand the asic definition of feedback and analysis methods. 2. Understand the influence to the amplifier circuits caused by feedback. 3. Understand the structure, symbol and basic functions of operational amplifiers. Master the analysis methods of operational amplifier circuits. 4.Cultivate students' craftsman spirit of dedication, excellence, meticulousness and pursuit of excellence.	8	Lecture and experiments	1,2,3
4	1. Structure, symbol and basic functions of power supplies. 2. Reservoir and smoothing circuits. 3. Structure and analysis of half-wave and full-wave rectifiers. 4. Design of practical power supply circuits.	1. Understand structure, symbol and basic functions of power supplies , and reservoir and smoothing circuits. 2. Understand the performance of half-wave and full-wave rectifiers. 3. Be able to design of practical power supply circuits.	8	Lecture	2,3
5	1. Basic logic gates such as AND, OR, NOT, etc. 2. Truth table and symbols of basic logic gates. 3. Binary, octonary, hexadecimal and decimal numbers. 4. Basic logic expressions and logic laws. 5. Logic expressions. 6.TTL and CMOS logic gates.	1. Understand the circuit of basic logic gates such as AND, OR, NOT, etc. 2. Understand the truth table and symbols of basic logic gates. 3. Master conversions between binary, octonary, hexadecimal and decimal numbers. 4. Be able to work on basic logic expressions and logic laws. 5. Be able to simplify of complex logic expressions. 6. Understand the characteristics of TTL and CMOS logic gates.	10	Lecture and experiments	2,3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
6	1. Basic analysis and design methods of combinational logic circuits. 2. The working process of encode and decode circuits. 3. Bistable devices, counters and shift registers. 4. Basic logic expressions and logic laws. 5. analyse and design of timing logic circuits and drawing timing diagrams.	1. Understand the combinational logic circuits. 2. Understand the working process of encode and decode circuits. 3. Understand bistable devices, counters and shift registers. 4. Be able to work on basic logic expressions and logic laws. 5. Be able to design of timing logic circuits and drawing timing diagrams. 6. Inherit the value of craftsmanship of the Chinese nation.	10	Lecture and experiments	2,3

V. Teaching method

The course mainly consists of lectures, assignments and experiments.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 4 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	Assignments	30%	To assess the level of understanding knowledge taught in class, accounting for 30% of total score	1,2,3
Lab.	Experiment process and report	20%	Each experiment is 100 points, according to the experiment process, results and report evaluation, and finally calculate the average score of all the homework and then count 20% into the total score.	2,3
Exam	Final exam paper results	50%	Mainly access the students' basic analysis and design knowledge of this course, the test consist mainly of design, calculation and analysis. The test is arranged for 120 minutes.	2,3

The grading criteria of this course for each assessment method are presented in Table 5.

Table 5 The grading criteria for each assessment method

Assessment methods	评分标准
Assignments	According to the condition of completion, there will be four levels：Excellence (90-100, Good (75-89), Normal (60-74), Fail (below 60). Adjust the score depending the class attendance.
Experiments	According to experiment process, results and report evaluation, it is divided into five levels, excellent (90-100), good (80-89), medium (70-79), passing (60-69), and failing (less than 60 points).

Exam	The final exam adopts a 100-point system and is graded according to the standard answers and grading rules drawn up by the person in charge of the course.

The score allocation matrix of assessment methods and course objectives are given in Table 6.

Table 6 Assessment methods and score allocation matrix

		Assessment 1（Assignments）（K1）	Assessment 1（Experiments）（K2)	Assessment 2（Final Exam）（K3）
Percentage		0.20	0.20	0.60
Score percentage of course objective for each assessment method	Objective 1（M1）	0.2	0.3	0.6
	Objective 2（M2）	0.4	0.4	0.2
	Objective 3（M3）	0.4	0.3	0.2

VII. Recommended textbooks and reference materials

Textbook:

[1]. Mike Tooley, Electronic Circuits Fundamentals and Applications, 4th Edition, Routhledge, 2015.

References:

[1]. Qin Cenghuang, Electronic Techniques, 7rd Edition, High Education Press, 2012.

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Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: Setp. 8th, 2021

《机械原理*》教学大纲

Principles of Machinery

Course Name/Title： Principles of Machinery **Course code：31935**

Course Type： Basic Course, Compulsory Course

Total Teaching Hours： 48 (Classroom Hours: 48)

Course Credit： 3.0

I Course Introduction

Principles of Machinery is an important compulsory course of subject foundation. Firstly, it is more combined with engineering practice than physics, theoretical mechanics and other theoretical courses. Moreover, it teaches not only knowledge about professional machinery profiles, but also makes a more in-depth discussion on common problems and practical mechanisms. The course content is about the fundamental knowledge about machinery, which mainly includes two specific parts: one is to study the general common problems of various mechanisms and machinery; the other is to study the performance and design methods of typical mechanisms commonly used in various machines.

The study of this course focus on clarifying basic concepts, understanding basic principles, and mastering basic methods of analysis and synthesis on mechanisms and machinery. Combining with practical cases, this course aims to clarify the important development achievements of the machinery industry in our country, show great regards to comprehensive national strength and power, stimulate students' interests in professional subjects, enhance their sense of national pride and historical responsibility. This course will also focus on cultivating students' innovative spirit, and the ability to use basic theories and methods to analyze and solve practical engineering problems. Throughout the study of this course, the student will be encouraged to understand and use the knowledge of the principles of mechanics, develop the habit of comprehensive analysis and comprehensive consideration of problems, persist in a scientific, rigorous and meticulous working style and a conscientious and responsible work attitude from practical engineering point of view.

II Course Objective

Objective 1: Learn the great achievements and understand the important status and role of the machinery industry in promoting the development of our country, stimulate interest in professional learning, and cultivate patriotism and self-consciousness to contribute to the country.

Objective 2: Master the basic theory and knowledge of mechanism science and mechanical dynamics, including: structure analysis, motion analysis and force analysis of mechanism; master the characteristic application and basic knowledge of typical mechanism; understand the basic problems of machine dynamics.

Objective 3: Improve the ability of structure analysis, motion analysis and force analysis, the ability of motion design of common mechanisms, and the ability of drawing mechanical motion scheme, analyzing and designing mechanism.

Objective 4: Obtain the skills to solve, simulate and analyze the mechanism model with modern engineering tools.

Objective 5: Cultivate the habit of comprehensive analysis and comprehensive consideration of practical problems, improve the ability of analysis, judgment and decision-making of things, have a good scientific attitude and innovation consciousness, have a sense of efficiency in time, and carry out preview, review and summary for learning tasks consciously.

III Correlations between Course Objectives and Graduation Requirements

Graduation Requirements	**Graduation Requirements Index Point**	**Course Objectives**
Graduation Requirement 1.3	Have the ability to deduce the mathematical model to the engineering model of complex engineering problems in the field of mechanical engineering.	Course Objective 1,2,3
Graduation Requirement 2.1	Have the ability to identify and judge the key links and parameters of complex engineering problems in mechanical engineering according to the basic principles of scientific knowledge.	Course Objective 4,5

IV Correlations between Course Content and Course Objectives

Num.	**Course Content**	**Teaching Requirement**	**Period**	**Teaching modes**	**Course Objectives**
1	Introduction Structural analysis of planar mechanism (1)	(1) Understand the concepts of elements, links, kinematic pairs and kinematic chains, mechanisms, machinery and machines. (2) Master the drawing of mechanism movement diagram. (3) Understand the constraints of the	6	Teaching in class	1,2,4

Num.	Course Content	Teaching Requirement	Period	Teaching modes	Course Objectives
	Introduction to the framework of curriculum knowledge system (2) Introduction to basic concepts of mechanical principle (3) Schematic diagram of mechanism movement (4) Degrees of freedom and constraints (5) The concept of rod group	mechanism after the introduction of the kinematic pair, master the calculation of the degree of freedom of the planar mechanism and the conditions for determining the motion of the mechanism, and be able to identify the composite hinges, local degrees of freedom and virtual constraints in the mechanism. (4) Understand the method of high pair replacement and the structural characteristics of grade II and grade III bar group of planar mechanism, and understand the composition principle and structural analysis method of planar mechanism. (5) Introduce the role of the machinery industry in national development and indicate the achievements on the lunar exploration project to stimulate students' interests in professional course learning, as well as enhance their "Four Self-Confidences".			
2	Kinematic analysis of planar mechanism (1) Instantaneous center of velocity (2) Graphic method of mechanism motion	(1) Understand the concept of velocity instantaneous center, master the determination method of velocity instantaneous center and the application of velocity instantaneous center method in mechanism velocity analysis. (2) Master the speed analysis method of relative motion graphic method and understand the general principle of acceleration analysis. (3) Understand the general principle of solving displacement, velocity and	3	Teaching in class	2,4

Num.	Course Content	Teaching Requirement	Period	Teaching modes	Course Objectives
	(3) Analytical method of mechanism motion	acceleration of plane mechanism by analytic method.			
3	Planar Linkage Mechanisms and its Design (1) Basic concepts of planar four bar linkage (2) Working characteristics of planar four bar mechanism (3) Design of planar four bar mechanism	(1) Understand the basic types, characteristics and evolution of planar four-bar mechanism. (2) Familiar with the main working characteristics of planar four-bar mechanism. (including the conditions for the existence of crank in planar four-bar mechanism, the angle between quick return characteristic and extreme position, the position of pressure angle, transmission angle and minimum transmission angle, and the dead point position) (3) Master the graphic design method of planar four-bar mechanism. (a) realize the kinematic design of the connecting rod position; (b) the corresponding position of the two connecting rods; (c) The variation coefficient of travel speed and additional conditions are known. (4) Understand the analytic design principle of four-bar planar mechanism. (5) Learn about the train linkage mechanism used in high-speed rail which is an independent innovation cases, to strength confidence of technology innovation in our country.	6	Teaching in class	1,2,4,5
4	Cam mechanism and its design (1) Cam types	(1) Understand the type characteristics and application of cam mechanism. (2) Master the basic motion law and characteristics of the follower and be able	6	Teaching in class	2,3,4,5

Num.	Course Content	Teaching Requirement	Period	Teaching modes	Course Objectives
	and characteristics (2) Basic law of follower (3) Parameters of cam mechanism (4) Design of cam mechanism	to draw the displacement line diagram of three basic motion laws (constant speed motion law, equal acceleration deceleration motion law and simple harmonic motion law). (3) Understand the concepts of cam mechanism eccentricity, cam base circle, push motion angle, far repose angle, return motion angle, near repose angle, theoretical contour and actual profile, follower stroke and mechanism pressure angle, and be able to mark them in the diagram. (4) To understand the influence of positive and negative configuration on the pressure angle of disk cam mechanism with translating follower and understand the qualitative influence relationship between base circle radius and pressure angle. (5) Master the design of all kinds of disc cam profile curve according to the given motion law, focus on graphic method, understand the principle of analytical method.			
5	Gear mechanism and its design (1) Characteristics, application and classification of gears (2) Basic law of meshing	(1) Understand the characteristics, applications and types of gear transmission. (2) Understand the basic law of tooth profile meshing. Understand the meshing properties of involute and involute tooth profile (constant transmission ratio, separability of center distance). Master the name, basic parameters and geometric dimension calculation of each part of involute standard spur gear. Understand the concepts of meshing line, meshing angle,	9	Teaching in class	1,2,3,4,5

Num.	Course Content	Teaching Requirement	Period	Teaching modes	Course Objectives
	(3) Gear modification principle (4) Helical gear transmission (5) Worm gear transmission (6) Bevel gear transmission	pitch circle, standard gear, standard installation and standard center distance. (3) Understand the conditions (correct meshing condition, no backlash meshing condition, standard installation and continuous transmission condition) of involute standard spur gear meshing transmission. Understand the cutting characteristics, undercutting phenomenon and minimum number of teeth of involute standard gear and modified gear. (4) Understand the principle of gear modification. (5) Understand the formation of tooth profile surface of standard helical cylindrical gear, the relationship between normal surface parameters and end face parameters, geometric dimension calculation and the concept of equivalent gear. (6) Understand the characteristics and types of worm drive. Understand the main parameters and geometric dimension calculation of worm drive. Understand the relationship between worm, worm gear steering and tooth rotation. (7) Understand the tooth profile surface, back cone, equivalent number of teeth and geometric dimension calculation of straight bevel gear. (8) Understand the application of gear mechanism in the ancient direction-guide car and its long development history in China.			

Num.	Course Content	Teaching Requirement	Period	Teaching modes	Course Objectives
6	Gear train and its design (1) Composition and concept of gear train (2) Gear ratio calculation	(1) Understand the composition, motion characteristics and application of various gear trains. (2) Master the calculation method of transmission ratio of fixed axle gear train, epicyclic gear train and compound gear train, and determine the steering relationship between driving wheel and driven wheel.	6	Teaching in class	2,3
7	Other common institutions	(1) Understand the composition, working principle, movement characteristics and application occasions of ratchet mechanism and Geneva mechanism. (2) Understand the escapement mechanism, cam intermittent movement mechanism, incomplete gear mechanism, star gear mechanism, non-circular gear mechanism, screw mechanism, universal hinge mechanism, working principle, motion characteristics and application occasions.	3	Teaching in class	2
8	Force analysis and mechanical efficiency of planar mechanism (1) Determination of friction force of moving pair (2) Calculation and self-	(1) Understand the determination of the friction force in the kinematic pair and the static analysis method of the mechanism when considering the friction of the kinematic pair. (2) Understand mechanical efficiency and calculation method, mechanical self-locking concept, and be able to judge mechanical self-locking through force analysis or efficiency analysis.	3	Teaching in class	2

Num.	Course Content	Teaching Requirement	Period	Teaching modes	Course Objectives
	locking of mechanical efficiency				
9	Balance of rigid rotating parts	(1) Master the static balance of rigid rotating parts. (2) Understand the principle of dynamic balance.	3	Teaching in class	2,3
10	Operation of machinery and adjustment of its speed fluctuation	(1) Understand the equivalent principle of mechanical system equivalent dynamic model. (2) Understand the concept of average speed and non-uniformity coefficient of mechanical operation, the causes and adjustment methods of periodic and non-periodic speed fluctuation and master the flywheel speed regulation principle of machine periodic speed fluctuation.	3	Teaching in class	2,3

V Period Distribution and Teaching Modes

Period Distribution: 1st-16th academic weeks

Teaching modes:

1. Teaching in class: the teaching mainly relies on the in-class teaching, assisted by practice and homework.

2. Online study: students can do online study and review the chapters with open online courses independently, complete homework online and take exams online to obtain grades.

VI Assessment

Assessment Methods or Approaches	Assessment Requirements	Assessment Weighting	Evaluation of Course Objectives
Conventional assignment	Mechanical principle exercise set, a total of 8 assignments, mainly to assess the students	15%	3

	reviewing, understanding and mastery of knowledge points in each class.		
Classroom performance	Check attendance and performance on discussion or answering questions in class.	5%	1,5
Big assignment	Complete a literature review on institutions (5%). Finish innovative design and motion analysis of typical mechanism (15%) by group oral reports.	20%	4
Final exam	Close-book exam includes multiple choice questions, basic concept filling- in questions, analysis and comprehensive analysis, and calculation questions.	60%	2,3

Note: 1. Assessment methods or approaches mainly include classroom performance, conventional assignments, unit tests, mid-term exam, final exam, big assignments, course paper, project design and works, etc.

2. Assessment requirements include frequencies of assignments, assessment methods (open-book, close-book), and project design requirements, etc.

3. Assessment Weighting refers to the percentage that assessment methods or approaches take up in the total score.

VII Textbooks and References

Textbooks:

[1] 张颖、张春林主编：机械原理（英汉双语）（第二版）, 机械工业出版社，2016 年

[2] 赵自强、张春林主编：机械原理习题集（英汉双语）, 机械工业出版社，2012

[3] Teaching and Research Office of Mechanical Principle and Mechanical department of Northwest Polytechnic University, Mechanical principle (9th Edition), Higher Education Press, 2018

Network resources:

[1] https://www.icourse163.org/course/NWPU-20007?from=searchPage

[2] https://www.icourse163.org/course/BIT-47016?from=searchPage

Written by：Jianxin Hu **Reviewed by: Wei Ye**

Date：2021/5/31

《工程化学*》教学大纲

Engineering Chemistry

Course name： Engineering Chemistry **Course code：** 31945

Course type： core curriculum-Compulsory and optional

Total teaching hours： 32 (Classroom Hours: 32,Experiment, computer or extracurricular practice 0 hours)

Credit： 2

Prerequisites: High school chemistry

Major： Mechanical design and manufacture and its automation, mechanical and electronic engineering, process equipment and control engineering, civil engineering

Department:Department of Chemistry, Faculty of Science

I. Course Introduction

Chemistry is a natural science that explores the changes in composition, structure and properties of atoms and atomic combined state units and their applications.The development of modern society is inseparable from the intersection of chemistry, physics, machinery, civil engineering and biology.Chemistry is not only closely related to these disciplines but also at the center of them. Engineering Chemistry B is aimed at basic chemistry teaching for non-chemical engineering undergraduates.Through the study of this course, I will understand the basic chemical concepts, properties of substances, chemical thermodynamics, chemical kinetics, chemistry and energy, chemistry and environmental protection.From the time of high school substances and reactions, rise to the level of chemical theory and engineering applications.Through study, I can deepen my understanding of dialectical materialism, establish the spirit of analyzing problems with scientific point of view, combine chemical theory and method with engineering technology, analyze and understand chemical problems in engineering technology, and think deeply about the relationship between chemical theory and chemical application and my specialty.This course starts from the course ideological and political mode of collaborative education, integrates the ideological and political education into the teaching process, gives full play to the main role of the classroom, and realizes the goal of the ideological and political reform of the course.This course mainly carries on the ideological and political content design from seven aspects, including the dialectical thinking, the responsibility and mission of the role of youth, the consciousness of environmental protection, the spirit of craftsman, the spirit of innovation, the patriotism, the consciousness of energy conservation and so on.

II. Course Objectives

Course Objective 1： This course cultivates students' dialectical thinking and makes them realize the responsibility and mission of the role of youth.As the Chinese characteristic socialist qualified builders and reliable successors, insist on the dialectical materialism and historical materialism, combined closely with the new era conditions and practical requirements, in a whole new field of vision to deepen to the ruling communist party rule, socialist construction rule, law of development of human society, the thought of socialism with Chinese characteristics to form the new era. Through the study of theoretical courses, I realized the importance of the spirit of innovation and craftsmanship, and enhanced students' awareness of environmental protection and energy conservation.

Course Objective 2： Causes the student to the structure of the chemical problems in engineering, material base, chemical reactions and energy, solution chemistry, materials and chemistry and its protection, water pollution and protection, such as chemical and life, there is a comprehensive and systematic understanding, especially for the basic theory, basic knowledge of the chemical can correct understanding, and has the ability of initial application.

Course Objective 3： Can use the basic theoretical knowledge of chemistry, through observation, analysis, experiment, induction, scientific abstraction, analogy association, experiment and other methods to cultivate students' ability to find and solve problems, use the basic knowledge of chemistry and experimental methods to analyze and study the practical problems in engineering.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Engineering Chemistry*

Index points of graduation requirements	Content
1	the structure of the chemical problems in engineering, material base, chemical reactions and energy, solution chemistry, materials and chemistry and its protection, water pollution and protection, such as chemical and life, there is a comprehensive and systematic understanding, especially for the basic theory, basic knowledge of the chemical can correct understanding, and has the ability of initial application.
2	Can use the basic theoretical knowledge of chemistry, through observation, analysis, experiment, induction, scientific abstraction, analogy association, experiment and other methods to cultivate students' ability to find and solve problems, use the basic knowledge of chemistry and experimental methods to analyze and research the practical problems in engineering.

Table 2. The supporting relationship between the course objectives and the index points of graduation requirements

Index points of graduation requirements	1	2
Course objectives	1、2	2、3
Intensity of support	H	H

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	1. Introduction 1.1 Chemistry and Science and Technology 1.2 Educational purpose of Engineering Chemistry 1.3 The Discipline System of Chemistry 1.4 The hierarchy of the matter 1.5 System and environment, aggregation and phase, mass conservation and energy changes, amount of matter and reaction progress	1. Master the basic concepts: material quantity, aggregation state, phase, reaction progress and system; 2. Understanding the chemical issues in Engineering; 3. Introducing the development of chemistry, so that students understand the development of things is always advancing in the twists and turns, enhance the spirit of students moving forward; 4. The development of chemistry cannot be separated from exploration, making students understand the importance of innovative spirit in social development.	2	Lecture,Video Data, Group discussion	1,2
2	2. Chemical composition and aggregation state of substances 2.1 Chemical composition of substances 2.1.1 Free radical and Spectrum Technology(The production of free radicals is the focus) 2.1.2 Biomacromolecule 2.1.3 Polymer compound(key) 2.1.4 Cluster 2.1.5 Nonspecific compound 2.1.6 Metal organic compound 2.1.7 Coordination	1. Master the chemical composition of substances, the classification and naming of substances;; 2. Master the structure and properties of crystal and non-crystal; 3. Master the solution dependence and its application 4. Familiar with the ideal gas, air humidity, aerosol and other concepts, and understand the environmental pollution problems. 5. Through the relationship between the crystal purity control and the electronic device function, the students can understand that the Chinese technology still needs to be developed, and	2	Lecture,Video Data, Group discussion	1,2,3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	compound(key, difficulty) 2.2 Solid(key) 2.2.1 Crystal(key, difficulty) 2.2.2 amorphous 2.2.3 Solid adsorbent 2.2.4 Solid waste 2.3 Liquid and LCD crystal 2.3.1 The Nature and Application of the Water 2.3.2 Vapour pressure, solidification point, boiling point, and penetration pressure of the solution(key, difficulty) 2.3.3 Liquid fuel 2.3.4 Surfactant substance(key) 2.3.5 LCD crystal(key, difficulty) 2.4 Gas and Plasma 2.4.1 Ideal Gas and Actual Gas 2.4.2 atmospheric relative humidity 2.4.3 Global Atmospheric Change 2.4.4 aerosols 2.4.5 Plasma (difficulty)	strengthen the student's sense of social responsibility and historical mission. 6. By introducing the greenhouse effect , ozone hole , acid rain and other problems, to enhance the students' environmental awareness and social responsibility.			
3	3. Structure of the material and the properties of the material 3.1 electron motion state outside the nucleus 3.1.1 Wave-particle duality is the basic characteristic of electron motion outside nucleus(key, difficulty) 3.1.2 Three methods of electronic motion state description 3.1.3 about electron spin	1. Atomic theory: master the atomic structure and outer electron movement and filling rules; 2. Element periodic table: master the development and use of the element periodic table; 3. The action force between chemical bonds and molecules: master the valence bond theory of the reaction, explain the causes of covalent compounds, ion compounds, metal compounds, explain the spectral phenomena; master the intermolecular forces, and explain the causes and	6	Lecture,Video Data, Group discussion	1,2

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	3.1.4 Energy level transitions and atomic spectroscopy analysis 3.2 Periodic laws of the elements and metallic materials 3.2.1 Electronic arrangement of multi-electron atoms(key, difficulty) 3.2.2 element periodic law (key) 3.2.3 Metal Key and Metal Materials (key) 3.2.4 Distribution of various elements in the human body (understanding, familiar) 3.2.5 Drug Chemistry (Understanding, familiar) 3.3 Chemical bond,intermolecular force,polymer materials 3.3.1 Chemical bond (key, difficulty) 3.3.2 Van der Waals force, Subvalent force, and hydrogen bond(key, difficulty) 3.3.3 polymer material 3.3.4 molecular-level transitions and molecular absorption spectroscopy 3.4 Crystal defective ceramics and composites 3.4.1 Solid Energy Belt Theory 3.4.2 Crystal Defects and Crystal Materials 3.4.3 Ceramic Materials and Composites 3.4.4 X-ray diffraction and electron microanalysis	properties of atomic crystals, molecular crystals, and ion crystals. 4. Through the relationship between electron pairing theory / molecular orbital theory / hybridized orbital theory, the students can learn to learn to think critically.			

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
4	4. Chemical reaction and energy source 4.1 Chemical thermodynamics and energy transformation 4.1.1 Thermodynamic energy U and its changes 4.1.2 Caltermination in during isoometric process 4.1.3 Thermodynamic energy changes and enthalpy changes in chemical reactions(key, difficulty) 4.1.4 Standard Moore generation enthalpy and Standard Moore generation entropy 4.2 Direction and limit of chemical reaction (key, difficulty) 4.2.1 Energy changes in spontaneous reactions(key, difficulty) 4.2.2 Entropy variation 4.2.3 Gibbs function variant 4.3 Chemical balance and reaction rate 4.3.1 Chemical and Standard Balance constants (key, difficulty) 4.3.2 The Relationship between the Standard Balance Constant and the Standard Moore Gibbs Function Change 4.3.3 Reasons affecting chemical balance movement and equilibrium constants(key, difficulty)	1. Master the energy conversion in the chemical reaction process; 2. Master the direction and limit of the chemical reaction; 3. Master the relationship between the state function and the degree of reaction balance and the degree of reaction progress; 4. Understand the chemical reaction speed and its influencing factors; 5. Master the composition, calculation and application of electrode reaction and the generation and application of electrode potential.	8	Lecture,Video Data, Group discussion	2,3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	4.4 The redox reaction and the energy development and utilization 4.4.1 Redox reaction and energy changes of the primary battery 4.4.2 Composition and electrode reaction of the primary battery 4.4.3 Generation, calculation and application of the electrode potentia(key, difficulty) 4.4.4 Chemical Power Supply 4.4.5 The Development and Utilization of Energy				
5	5. Chemical reaction and water protection in an aqueous solution 5.1 Weak acid and weak alkali solution 5.1.1 acid-alkali theory 5.1.2 weak acid 5.2 Precipitation reaction and coordination reaction in the aqueous solution 5.3 Chemical reactions in phase equilibrium and non-aqueous solutions 5.4 Water quality and water body protection	1. Master the ionized acid and alkali theory, proton acid and base theory, and Lewis acid and alkali theory; 2. Master the basic concept and simple calculation of acid-alkali reaction in solution; 3. Master the precipitation and coordination reactions in the solution; 4. Understands water quality and water protection. 5. Introduces the hazards of water pollution, so that students can understand the importance of sewage treatment and industrial upgrading, and strengthen environmental awareness.	6	Lecture,Video Data, Group discussion	2,3
6	6. Chemical reactions and material protection 6.1 Occurrence of metal corrosion 6.1.1 Chemical corrosion 6.1.2 Electrochemical corrosion 6.1.3 Biological corrosion 6.1.4 Corrosion rate of metal	1. Master the principle of metal corrosion; 2. Understand the protection and utilization of metal corrosion; 3. Familiar with protection mechanism and application of polymer materials. 4. Electrochemistry can be used to generate electrical energy, but also to accelerate the corrosion of metals. Students learn to treat	4	Lecture,Video Data, Group discussion	1,2,3

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
	6.2 Protection and utilization of metal corrosion 6.2.1 Selection of corrosion resistant metal materials 6.2.2 Coating protection method 6.2.3 Electrochemical protection method 6.2.4 Utilization of metal corrosion 6.3 Aging of living bodies and polymer materials 6.3.1 Photosynthesis and Oxygen 6.3.2 Oxygen free radicals 6.3.3 Aging of polymer materials 6.4 Protection of polymer materials 6.4.1 Light stabilizers and antioxidants 6.4.2 Oxygen index and flame retardants 6.4.3 Filler and coupling agent 6.4.4 Electroless Plating and Plastic Plating	problems with dialectical thinking. 5. Make students understand the importance of innovative thinking through the use of metal corrosion.			

V. Course hours allocation and teaching method

(1) Distribution of course hours

Table4 Time allocation table for theoretical courses or theoretical teaching contents

Teaching method / Teaching hours / Course content	Theory teaching	exercise class	seminar	note	subtotal
Introduction	3				3
The chemical composition and aggregation state of a substance	5		1		6
The structural basis of matter	5	1			6
Chemical Reactions and Energy	7	1			8
Chemical reactions in aqueous solutions	5	1			6

Chemical reactions and material	3				3
gross	28	3	1		32

(2) Teaching methods

In the course of engineering chemistry teaching, we should take the coordinated development of students' knowledge, ability and quality as the goal, and earnestly carry out the educational idea of taking students as the main body and teachers as the leading. We should follow the cognitive law of students, attach importance to combining theory with practice, stimulate learning interest, guide independent learning, and encourage personality development. It is necessary to strengthen the research and reform of teaching methods and means, and strive to create a teaching environment conducive to cultivating students' scientific literacy and innovative consciousness.

With the teacher to teach mainly, the student self-study as the auxiliary means. Chemistry and living, water pollution and protection are interwoven into the corresponding chapters for discussion, which increases intuitive understanding and is conducive to the acceptance of knowledge.

We should give full play to the role of the main channel of classroom teaching and the teaching means should serve the teaching purpose. Multimedia teaching method is mainly used to increase the amount of teaching information and broaden the horizons of knowledge as much as possible. At the same time, the theoretical derivation and other knowledge should be supplemented by traditional blackboard writing teaching to give students space to think.

Conduct special lecture and discussion sessions. Ask students to discover the role of chemistry in food, clothing, housing and transportation, as well as the social concerns caused by chemistry, such as the treatment of major diseases, food problems, environmental problems, drug problems and so on. Discuss the two sides of chemistry and how to use chemistry correctly. Use water as the origin of all things and tell the importance of water. Use the eyes to observe the water source in our living environment, discuss the problem of water pollution, and lead to the necessity of water environment protection and treatment.

VI. Assessment

The assessment is to evaluate the degree of students achieving the course objectives

Table 5 Course objectives and assessment requirements

Score category	**Assessment requirement**	**Percentage**	**Corresponding objectives**
Usual performance	Attendance, class participation, assignment completion	30%	1,2

Score category	Assessment requirement	Percentage	Corresponding objectives
Book report, course paper	No less than 3000 words. Emphasis will be placed on students' comprehensive grasp of the course, whether they can relate to real life and present their own views.	20%	1,2,3
Exam	Close the book and score according to the scoring criteria	50%	1,2,3

VII. Recommended textbooks and reference materials

Textbook：

Chen Lingen et al. Fundamentals of Engineering Chemistry, 3nd Edition, Higher Education Press, 2018.

Reference books：

Tong Zhiping. Fundamentals of Engineering Chemistry, Higher Education Press, 2008.

Teaching group： Li Zhang, Yubing Xiong, Benxia Li, Jiadan Xue, Peng Ye, Huagang Ni, Xiaoqing Yan, Xiaoting Hong, Yunnan Guo, Kun Zhang, Qinghua Tian, Cuiyun Zhang, Yun Tong

Written by: Cuiyun Zhang Reviewed by: Li Zhang

Approved by: Faculty of Science Teaching Committee

Date: May 6, 2021

《机械原理课程设计*》教学大纲

Syllabus of《Curriculum Design with Principles of Machinery》

Course Name/Title：Curriculum Design with Principles of Machinery

Course code：31928

Course Type：Specialized Course, Compulsory Course

Total Teaching Hours：40 (Classroom Hours: 40)

Course Credit：2.0

I Course Introduction

This course is mainly about the kinematics and dynamics analysis and design of mechanism of the machine. This course provides students opportunities to further deepen the theoretical knowledge, which enable students to not only have general concept of mechanical kinematics and dynamics analysis and design, but also take practice on calculation, drawing and technical data analyzation. Students are trained to have the ability of choosing and using appropriate technical tools and modern engineering methods to solve engineering problems, and at the same time cultivate the sense of self-discipline, the perseverance of overcoming difficulties, the spirit and ability of practical innovation and solidarity and cooperation.

II Course Objective

Objective 1: Through curriculum design practice, cultivate students' sense of self-discipline, perseverance in overcoming difficulties, as well as the spirit and ability of practical innovation and unity and cooperation.

Objective 2: Establish more complete concept for the analysis and design of mechanical structure, kinematics and dynamics. Use the theoretical knowledge to make motion analysis and dynamic static analysis of main mechanism of a machine. For example, by given the working requirements of a machine, students should have the ability to calculate moment of inertia of the flywheel and design motion of the cam and gear mechanism and draw necessary drawings and write instructions.

Objective 3: Develop the ability to apply modern engineering tools on design the kinematics of the mechanism. Fully understand the analytical method of dynamics. Practice on the procedure of design and verification by the analytical method with cam mechanism.

Objective 4: Use the basic theories and methods to discover, analyze and solve practical engineering problems. Improve students’ ability to analyze, judge, and make decisions. Cultivate the habit of comprehensive analysis and comprehensive consideration of problems, and a good scientific attitude and innovative spirit. More importantly, cultivate the ability to develop and innovate machinery.

III Correlations between Course Objectives and Graduation Requirements

Graduation Requirements	Graduation Requirements Index Point	Course Objectives
Graduation Requirement 3.2	Complete teaching links such as course exercises, course design, experiments, scientific and technological training, production practice and graduation design. Have the ability to apply the basic principles and technical methods of natural sciences and engineering sciences to the design of mechanical engineering systems, complex units and technological processes with specific needs.	Course Objective 2,3
Graduation Requirement 10.1	Able to clearly express the solutions, processes and results of complex engineering problems in the field of mechanical engineering through written reports and oral statements, and understand the doubts and suggestions of industry colleagues and the public.	Course Objective 1,4

IV Correlations between Course Content and Course Objectives

Num.	Course Content	Teaching Requirement	Period	Teaching modes	Course Objectives
1	Design of linkage mechanism and its motion analysis and verification	1. Design the linkage mechanism according to the design conditions given in the task book. 2. Make a motion diagram of the linkage mechanism according to the requirements,	2 days	Teaching in class with books, handwriti	1,2,3,4

Num.	Course Content	Teaching Requirement	Period	Teaching modes	Course Objectives
		and determine the positions of the two or three mechanisms required by the mission statement. 3. Use relative motion graphic method to make velocity and acceleration polygons. 4. Use kinematics analysis method to solve the motion of linkage mechanism and compare with the results by graphic method. 5. Collect the movement of each position of the slider obtained by analytical method within the same student group, and draw the line graph of the slider displacement, velocity, and acceleration. 6. Carry out analysis and verification of linkage mechanism movement. 7. Organize the design instruction. 8. Get familiar with the development of China's super industrial equipment. Learn from the spirit of the Chinese women's volleyball team. Strengthen the understanding of the importance and arduousness of this subject.		ng on the board and videos	
2	Dynamic static analysis and verification of linkage mechanism	1. Draw the resistance line graph of a slider by the given conditions. 2. Determine the moment of inertia and inertial force of each link according to the angular acceleration and center-of-mass acceleration of each link and combine them into the total force. 3. Decompose the force group according to the rod group. Determine the reaction force in each kinematic pair. Add the balance moment to the crank.	2 days	Teaching in class with books, handwriting on the board and videos	1,2,3,4

Num.	Course Content	Teaching Requirement	Period	Teaching modes	Course Objectives
		4. Solve the forces by analytical method. 5. Perform dynamic static analysis and verification of the linkage mechanism. 6. Organize the design instruction.			
3	Design of flywheel mechanism	1. Gather the balance moments of each mechanism from dynamic static analysis obtained carried out by the students in the same group. Draw diagram of the resistance moment of the motion cycle. 2. Draw diagram of the resistance torque and the driving work in one motion cycle. 3. Find the maximum increment/decrement work. 4. Determine the moment of inertia of the flywheel according to the maximum increment/decrement work. 5. Organize the design instruction.	2 days	Teaching in class with books, handwriting on the board and discussions	1,2,3,4
4	Design, drawing and verification of cam mechanism	1. According to the movement profile of the follower, make the diagram of displacement, velocity and acceleration of the follower. 2. Determine the geometrical size of the cam mechanism according to the given conditions, and draw the actual profile of the cam. 3. Apply analytical method on cam mechanism design 4. Perform cam profile verification by graphical method and analytical method. 5. Organize the design instruction.	2 days	Teaching in class with books, handwriting on the board and discussions	1,2,3,4
5	Gear mechanism design	1. Select the offset coefficient according to the given design parameters. 2. Calculate geometrical size of gears.	2 days	Teaching in class with	1,2,3,4,5

Num.	**Course Content**	**Teaching Requirement**	**Period**	**Teaching modes**	**Course Objectives**
		3. Draw the gear transmission meshing diagrams. 4. Organize the design instruction. 5. By understanding the application of non-circular gear transmission in transplanting machine, enhance the sense of innovation for further study.		books, handwriting on the board and discussions	

V Period Distribution and Teaching Modes

Period Distribution: 17th -18th academic weeks

Teaching modes:

1. Teaching in class: the teaching mainly relies on the in-class teaching, assisted by handwriting on board, videos and discussions.

2. After class study: lead students do online reference searching and explore modern tools used for mechanism design.

VI Assessment

Assessment Methods or Approaches	Assessment Requirements	Assessment Weighting	Evaluation of Course Objectives
Oral defense	Evaluate from the performance of the defense (such as whether the expression is clear, whether student understands the relevant knowledge points of the curriculum, can answer the teacher's questions correctly, actively participate in the defense, etc.).	30%	1,4
Project design	The drawings and instructions of four types of mechanisms will be evaluated according to the quality of correctness, completeness, expression and	70%	2,3

	format standardization of the content etc.		

Note: 1. Assessment methods or approaches mainly include classroom performance, conventional assignments, unit tests, mid-term exam, final exam, big assignments, course paper, project design and works, etc.

2. Assessment requirements include frequencies of assignments, assessment methods (open-book, close-book), and project design requirements, etc.

3. Assessment Weighting refers to the percentage that assessment methods or approaches take up in the total score.

VII Textbooks and References

Textbooks:

[4] 罗洪田主编：《机械原理课程设计指导书》（第二版），高等教育出版社，2002 年

[5] 张颖、张春林主编：机械原理（英汉双语）（第二版），机械工业出版社，2016 年

[6] Teaching and Research Office of Mechanical Principle and Mechanical department of Northwest Polytechnic University, Mechanical principle (9th Edition), Higher Education Press, 2018

Network resources:

[3] https://www.icourse163.org/course/NWPU-20007?from=searchPage

[4] https://www.icourse163.org/course/BIT-47016?from=searchPage

Written by：Jianxin Hu **Reviewed by: Wei Ye**

Date：2021/5/31

《大数据分析基础*》教学大纲

Basis of Big data Analysis

Course name： Basis of Big data Analysis **Course code：** 31947

Course type： Specialized courses, electives

Total teaching hours： 32 (Classroom Hours: 24, Experiment Hours: 8)

Credit： 2

Prerequisites: Basics of Computer Application

Major： Bachelor degree in mechanical design and manufacturing

Department: Department of Mechanical Design and Manufacturing

I. Course Introduction

"Fundamentals of Big Data Analysis" is an important professional basic course for the direction of mechanical design and manufacturing major. It is a comprehensive and practical course. According to the needs of cultivating application-oriented talents, the purpose and task of this course is to enable students to understand the basic concepts, basic technologies and application scenarios of big data, understand the basic principles and methods of big data analysis, and apply big data thinking and analysis methods to solve problems related to their major. It lays a good foundation for further study and future work related to big data.

The features of this course are as follows: strive to deepen students' understanding of the concept and application of big data in programming methods, and let students first understand, then understand, and finally master each knowledge point gradually through relevant examples; The whole process in harmony "teaching, learning and practice" at an organic whole, strengthen students maintain national data security, bear the social responsibility consciousness and individual purpose and a sense of pride, improve the practice ability, independent thinking and problem solving skills, so as to use operating system correctly and flexibly various knowledge to solve the problems related to the target, And for the follow-up professional basic courses, professional courses to lay a solid foundation for learning.

II. Course Objectives

Course Objective 1： Mining the ideological and political elements behind the knowledge of data science, and based on this, shaping the thinking system of data science from three aspects of "heart", "brain" and "body", and cultivate students to become outstanding data scientist at the same time, pay attention to training students' faith and stick to the spirit, to fulfill the social responsibility consciousness, dialectical thinking ability, analysis and reasoning abilities, "insight" type and critical thinking ability, etc.

Course Objective 2： Understand the basic concepts of big data, big data collection methods and pretreatment technologies, and understand the basic principles of distributed big data processing architecture Hadoop; Master the storage and management technology of big data, understand the basic concept and structure of distributed file system, the principle and usage of distributed file system HDFS; Understand big data calculation mode and analysis method, master the principle and application method of typical algorithm; Have a preliminary grasp of the basic methods and common tools of data visualization.

Course Objective 3： Able to build experimental environment or download virtual machine environment, understand the concepts and basic technologies related to big data; Able to use the basic tools and methods of big data analysis to process and analyze case data, and cultivate the ability of hands-on, independent thinking and problem solving.

Course Objective 4： Have the thinking consciousness to combine professional knowledge and industry knowledge to conduct big data analysis, develop data-driven decision-making habits, and improve the scientific insight and decision-making ability towards things.

III. Graduation requirements supported by course objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the course objectives and the index points of graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Basis of Big data Analysis*

Index points of graduation requirements	**Content**
1.3	Ability to apply mathematics, science, engineering fundamentals and expertise to solve complex engineering problems.
3.3	Able to conduct research on complex engineering problems based on scientific principles and using scientific methods, including designing experiments, analyzing and interpreting data, and drawing reasonable and effective conclusions through information synthesis.
6.1	Have the consciousness of independent learning and lifelong learning, and have the ability to continuously learn and adapt to development.

Table 2. The supporting relationship between the course objectives and the index points of graduation requirements

Index points of graduation requirements	**1.3**	**3.3**	**6.1**
Course objectives	1，2	3	1,4
Intensity of support	M	M	M

IV. Basic course content and teaching arrangement

Table 3 Relationship between course objectives and teaching content

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
1	1. Definition of big data 2. The source, characteristics and significance of big data 3. Data types of big data 4. Various application scenarios of big data	1. Understand the concept of big data 2. Understand the source, characteristics and value of big data, and inspire students' sense of pride in The Times. 3. Know what big data looks like 4. Understand various application scenarios of big data, and inspire students' sense of social responsibility.	2	Lecture	1、2
2	1. Big data collection: collection concepts, collection tools and collection methods 2. Big data pre-processing: data cleaning, integration, conversion 3. Feature extraction, feature selection and dimension reduction of big data	1. Master the concepts, tools and methods of big data collection 2. Master the concepts of data cleaning, data integration and data transformation 3. Understand the big data pre-processing process 4. Understand big data feature processing methods 5. Souse students' dialectical thinking and social responsibility for data science by understanding big data collection and pretreatment and feature technology.	6	Lecture	1、2、3
3	1. Big data processing platforms: Hadoop and Spark 2. non-relational databases: NoSQL 3. Distributed database: HDFS, HBase, Hive	1. Understand the big data processing platform 2. Understand how big data is stored 3. Understand distributed data warehouses 4. Understand non-relational databases 5. Cultivate students' big data thinking and seeking truth spirit.	8	Lecture	1、2、3、4

Chapter	Course content	Teaching requirements	Teaching hours	Teaching type	course objectives
4	1. Big data computing platform (MapReduce) 2. Stream computing: data characteristics, key technologies 3. Graph calculation: Overview, Pgel framework, Spark GraphX 4. Structured data analysis model: regression analysis, correlation analysis, classification analysis, clustering analysis 5. Semi-structured data analysis model: structural analysis model 6. Unstructured data analysis model: text analysis Big Data Mining: Concepts, Methods, and Tools	1. Master big data analysis methods 2. Understand the concepts and methods of data mining 3. Understand the big data computing model 4. Stimulate students' spirit of honesty and respect in data calculation and analysis.	8	Lecture	1、2、3、4
5	1. Overview of big data visualization 2. Big data visualization methods: text visualization, network visualization, and multi-dimensional data visualization 3. Big data visualization tools: such as Excel, Processing, Echarts, Tableau, etc	1. Understand the development of big data visualization technology; 2. Understand data visualization methods; 3. Master and initially apply visualization tools. 4. Stimulate students' pride in data science through visualization techniques.	4	Lecture	1、2、3、4

Table 4 Distribution table of teaching content of experimental class

experimental project	Content	The main equipment	Experimental hour	Each group of Number	Experimental attribute	requirement	course objectives
Experiment 1 big data	Build Linux VIRTUAL machine in Windows	Windows XP	2	5	fundamental	compulsory	1、2、3

processing platform	environment; And set up the Hadoop environment						
Experiment 2 Big data storage	Familiar with distributed database HDFS; Use apis to read and write HDFS data	Windows XP	2	5	fundamental	compulsory	2、3
Experiment 3 big data calculation	Application of MapReduce programming thinking to write big data applications	Windows XP	2	5	fundamental	compulsory	2、3
Experiment 4 big data visualization	Display application case data through data visualization tools; Perform a simple analysis using the chart shown.	Windows XP	2	5	fundamental	compulsory	1、3、4

V. Teaching method

This course is recommended to use multimedia teaching methods and blackboard writing methods combined, teachers can choose the appropriate software and network equipment for teaching.

VI. Assessment

This course assessment is to evaluate the degree to which students achieve the course teaching objectives and reflect the degree to which students achieve the ability training objectives. The specific assessment methods, contents and corresponding teaching objectives of the course are shown in Table 5.

Table 5 Course objectives and assessment methods

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
Usual performance	In class performance	10%	It mainly assesses students' understanding and mastery of basic concepts and theories, and focuses on whether students can put forward their own opinions from them.	1、4
	Routine homework	20%	It mainly evaluates students' ability to apply the basic methods and theories they have learned to solve practical problems.	1、2、3

Score category	Assessment methods	Percentage	Assessment details	Corresponding objectives
The experimental results	Experiment report	20%	Examine the students' understanding and mastery of the relevant basic knowledge, and their practical ability in the actual experiment.	1、2、3
Exam	Exam score	50%	Assess the students' understanding and mastery of the relevant basic knowledge.	2、3、4

The grading criteria of this course for each assessment method are presented in Table 6.

Table 6 The grading criteria for each assessment method

Assessment methods	Standard for evaluation
In class performance	According to the students' usual class participation degree, according to the students' understanding and mastery of the basic knowledge to give a percentage of the evaluation.
Routine homework	Single homework grade: according to the amount of completion and correct rate according to the percentage of evaluation. The overall grade of the assignment: a weighted average of all the individual assignments is obtained and evaluated on a hundredth scale.
Experiment report	According to the experiment report submitted by the students, the students will be graded according to the detailed record of the experiment process and the reasonable degree of the experiment results.
Exam	The final exam will be 100 percent based on standard answers and grading rules prepared by the course leader.

The score distribution matrix of this course assessment method and course objectives is shown in Table 7

Table 7 Assessment method and course objective score distribution matrix

		Assessment 1（In class performance）（K1）	Assessment 2（Routine homework）（K2）	Assessment 3（Experiment report）（K3）	Assessment 4（Exam）（K4）
Percentage		0.1	0.2	0.2	0.5
Score percentage of course objective for each assessment	Objective 1（M1）	0.5	0.2	0.2	0
	Objective 2（M2）	0	0.4	0.4	0.3
	Objective 3（M3）	0	0.4	0.4	0.3
	Objective 3（M4）	0.5	0	0	0.4

		Assessment 1 （In class performance）（K1）	**Assessment 2 （Routine homework）（K2）**	**Assessment 3 （Experiment report） （K3）**	**Assessment 4 （Exam） （K4）**
method					

According to the average value analysis of the achievement of course objectives, the evaluation criteria for the achievement of course teaching objectives are determined as follows:

Table 8 Achievement of course objectives evaluation criteria

Course objectives	**Evaluation standard**				
	90-100	**80-89**	**70-79**	**60-69**	**0-59**
	excellence	**good**	**medium**	**Pass**	**fail**
1. Understand the basic concepts of big data, big data collection methods and pretreatment technologies, and understand the basic principles of distributed big data processing architecture Hadoop;	Be able to fully and accurately understand the basic concepts of big data, big data collection methods and pretreatment technologies, and understand the basic principles of distributed big data processing architecture Hadoop;	Can correctly understand and master the basic concepts of big data, big data collection methods and pretreatment technologies, and understand the basic principles of distributed big data processing architecture Hadoop;	Can correctly understand and master the basic concepts of big data, big data collection methods and pretreatment technologies, and understand the basic principles of distributed big data processing architecture Hadoop;	Be able to correctly understand and master the basic concepts of big data, big data collection methods and pretreatment technologies, and understand the basic principles of distributed big data processing architecture Hadoop;	Can not correctly understand and master the basic concepts of big data, big data collection methods and pretreatment technologies, and understand the basic principles of distributed big data processing architecture Hadoop;
2. Master the storage and management technology of big data, understand the basic concept and structure of distributed file system, the principle and use method of distributed file system HDFS;	Can fully grasp the storage and management technology of big data, understand the basic concept and structure of distributed file system, the principle and use method of distributed file system	Can accurately master the storage and management technology of big data, understand the basic concept and structure of distributed file system, the principle and use of distributed file system	Can accurately master the storage and management technology of big data, understand the basic concept and structure of distributed file system, the principle and use method of distributed	Be able to master the storage and management technology of big data, understand the basic concept and structure of distributed file system, the principle and use method of distributed file system	Can not accurately master the storage and management technology of big data, understand the basic concept and structure of distributed file system, distributed file system HDFS principle and

Course objectives	Evaluation standard				
	90-100	80-89	70-79	60-69	0-59
	excellence	good	medium	Pass	fail
	HDFS;	HDFS;	file system HDFS;	HDFS.	use method;
3. Understand the calculation mode and analysis method of big data, master the principle and application method of typical algorithms; Have a preliminary grasp of the basic methods and common tools of data visualization.	Be able to fully and accurately understand the big data calculation mode and analysis method, master the principle and application method of typical algorithms; Have a preliminary grasp of the basic methods and common tools of data visualization.	Able to accurately understand big data calculation mode and analysis method, master the principle and application method of typical algorithms; Have a preliminary grasp of the basic methods and common tools of data visualization.	Able to accurately understand the big data calculation mode and analysis method, master the principle and application method of typical algorithms; Have a preliminary grasp of the basic methods and common tools of data visualization.	Be able to basically correctly understand the big data calculation mode and analysis method, master the principle and application method of typical algorithms; Have a preliminary grasp of the basic methods and common tools of data visualization.	Unable to correctly understand the calculation mode and analysis method of big data, master the principle and application method of typical algorithms; Have a preliminary grasp of the basic methods and common tools of data visualization.

VII. Recommended textbooks and reference materials

Textbook：

[1] Yaoxue Zhang. Introduction to Big Data, China Machine Press, 2018.9

[2] Reference books：

[1] Victor Meyer-Schonberg, Big Data Era, Zhejiang People's Publishing House, 2013.1.

[2] Li Jie, Ni Jun, Wang Anzheng. From Big Data to Intelligent Manufacturing, Shanghai Jiao Tong University Press, 2016.5.

Teaching group： Fanghua Ning , Jiangming Jia   Course administrator：Fanghua Ning

Written by: Fanghua Ning   Reviewed by: Wei Ye

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May 17, 2021

《机构分析与综合*》教学大纲

《Analysis and Synthesis of Mechanism》

Course name：Analysis and Synthesis of Mechanism **course code**：31921

Course type：Specialized course (Optional course)

Total teaching hours：32（Classroom teaching：32）

Credits：2.0

Preparation course：Mechanical Design、Mechanical principle、Mechanical Drawing、Linear algebra

Applicable professional：Mechanical design and manufacturing and its automation

Department of Courses：Department of Mechanical Design and Manufacturing

I.Course Introduction

This course is an enhanced elective course based on courses such as engineering mathematics, computer basics and skills, and mechanical principles. Taking non-standard parameter mechanisms commonly used in mechanical engineering, like linkage mechanisms, cam mechanisms, combined mechanisms, parallel mechanisms, etc., as objects, the modern design calculation methods are deeply studied. Through the study of this course, students will be trained to further improve the ability of applying computer-aided mechanism analysis and design and the ability to innovate in mechanical technology work. At the same time, the introduction of mechanical development related character stories, practical cases, principal extensions, and other methods through the teaching process can cultivate students' noble thinking, sense of unity and cooperation, as well as a rigorous work attitude and a spirit of innovation.

II.Course objectives

Course Objective 1：Realize value guidance and quality training. Possess the scientific spirit and professionalism of seeking truth from facts and striving for perfection, teamwork spirit and communication skills, strong independent learning ability.

Course Objective 2：Preliminarily establish modern organization analysis and comprehensive design ideas, and master the content, process, methods, design procedures and principles of modern organization analysis and integration. Grasp the thinking methods and design types of mechanism analysis and synthesis, and master certain mechanism optimization design methods, configuration synthesis methods, and innovative scheme design methods.

Course Objective 3：Master the methods of literature retrieval and data collection related to mechanical analysis and comprehensive methods, and be able to summarize the background, content, research status and development trends of key technologies related to engineering issues through literature analysis.

III.Graduation requirements supported by curriculum teaching goals

The graduation requirements index points supported by this course are shown in Table 1, Table 2 shows the support relationship between the curriculum teaching objectives and the index points that support graduation requirements.

Table 1《**Analysis and Synthesis of Mechanism**》The index points of graduation requirements supported

Graduation Requirements indicators point	Graduation requirement index point content
2.2	Able to correctly identify the diversity of solutions to complex engineering problems, and seek solutions to complex engineering problems in mechanical engineering and their alternatives through literature research.
3.1	Understand the frontier status and development trends of mechanical engineering, be familiar with the basic process of research and development of new products, new processes, new technologies and new equipment, and have the attitude and awareness of pursuing innovation in solving complex engineering problems in the field of mechanical engineering.
8.2	Understand the core values of socialism, understand national conditions, safeguard national interests, and have a sense of responsibility to promote national rejuvenation and social progress.

Table 2《**Analysis and Synthesis of Mechanism**》The supporting relationship between the curriculum goal and the index points supporting graduation requirements

Graduation Requirements indicators point	**2.2**	**3.1**	**8.2**
Course objectives	2	3	1
Support strength	M	L	L

IV.Basic teaching content and class time arrangement

Table 3 The relationship between curriculum objectives and teaching content

chapter	**Teaching content**	**Teaching requirements**	**period**	**Teaching methods**	**Course objective**
1	Topic 1 （1）Innovative and optimized design of planting mechanism （2）Motion analysis and optimization of typical textile mechanism （3）Brief introduction of	1. Combine the teacher's research case in the planting institution, stimulate students' interest in learning and enthusiasm for innovation, and cultivate students' love for this major. 2. Master the consideration methods, design types, design procedures, design procedures, criteria and laws	8	Classroom teaching	1、2

chapter	Teaching content	Teaching requirements	period	Teaching methods	Course objective
	mechanism performance synthesis and evaluation method	of the comprehensive design of the organization; 3. Understand modern design methods.			
2	Topic 2 （1）Optimal design method of gear linkage （2）Analysis of the Innovative Design Process of Typical Institutions (Take the rice transplanting institution as an example)	1. Understand the motion analysis and optimization design method of combined mechanism 2. Master and understand the innovative design methods of mechanism configuration oriented to engineering problems, etc. 3. From the structure of the organization principle and the coordination between the components, students are guided to learn the spirit of self-discipline and collaboration.	8	Classroom teaching	1、2
3	Topic 3 （1）Introduction to Parallel Mechanism （2）Spiral theory foundation （3）Analysis of Degree of Freedom of Parallel Mechanism（4）Analysis of Degree of Freedom of Parallel Mechanism （5）Application Analysis of Parallel Mechanism	1. Combining current affairs hotspots to introduce excellent mechanical products around and in major projects to inspire students' home country feelings, pride and sense of mission. For example, our school’s alumni Wang xingxing at the 2021 Spring Festival Gala, "Ben Ben" robot cow. 2. Understand the composition of the parallel robot system. 3. Understand the basic methods of parallel robot design. 4. Understand the industrial applications of parallel robots.	8	Classroom teaching	1、2
4	Topic 4 （1）Mechanism process action and structure selection （2）Mechanism dynamic balance analysis and design （3）Dynamic design of mechanism	1. Understand the relationship between process action and mechanism selection 2. Understand mechanism dynamic balance analysis and design method 3. Understand the concept of mechanism dynamic design	8	Classroom teaching	1、2

V.Teaching Methods

The teaching method is based on classroom lectures, supplemented by reports and exams.

VI.Assessment Methods

《**Analysis and Synthesis of Mechanism**》Assessment is to evaluate the degree to which students achieve the teaching objectives of the course, reflecting the degree to which students' ability training objectives are achieved. The assessment methods are shown in Table 4

Table 4 Course objectives and assessment methods

Grade composition	Evaluation	Points	Evaluation Rules	Corresponding teaching goals
Usual grades	Classroom performance	10%	Mainly assess students' understanding and mastery of knowledge. Evaluate students' participation in answering questions and class discussions. Each time it is graded on a hundred-point system, and finally 10% of the average grade is counted into the total course grade.	1
	Report 1	20%	It mainly assesses the students' ability in institutional analysis and comprehensive frontier related professional literature retrieval and data collection, analysis, induction, and summary. The report about the application background and basic knowledge of modern organization optimization and synthesis related key technologies is 35 points, the research status is 30 points, the development trend is 20 points, and the content format is 15 points, corresponding to the course goal 3. The total score is calculated as 20% of the total score of the course.	3
	Report 2	20%	It mainly assesses students' abilities in literature retrieval and data collection, analysis, induction and summarization of parallel robot-related majors. The report is about 35 points for the application background and basic knowledge of key technologies related to parallel robots, 30 points for research status, 20 points for development trends, 15 points for content format, corresponding to course objective 3. The total score is calculated as 20% of the total score of the course.	3
	Report 3	20%	It mainly assesses the students' ability to retrieve, analyze, summarize and summarize the professional literature related to the dynamic balance and design of the organization. The report has 35 points for the application background and basic knowledge of the key technologies of the dynamic balance and design of the organization, 30 points for the research status, 20 points for the development trend, 15 points for the content format, corresponding to the course objective 3. The total score is calculated as 20% of the total score of the course.	3
Final exam	Final exam paper results	30%	It mainly assesses students' mastery of institutional analysis and basic knowledge and related design and analysis methods. The test paper structure and score distribution are as follows: 1. Short answer questions or drawing questions: 45 points, corresponding to course objective 2 2. Calculation questions or analysis questions: 55 points, corresponding to course objective 2 The total score is calculated as 30% of the total score of the course.	2

《**Analysis and Synthesis of Mechanism**》The grading standards for each assessment link of the course are shown in Table 5.

Table 5 Course assessment method grading standard

Evaluation	Evaluation Rules
Classroom performance	Participation in teaching activities and understanding of ideological and political activities

Review Report	The review report is mainly evaluated from the aspects of the orderliness and completeness of the review content, and the standardization of format expression	Key technology application background and basic knowledge (35 points)：To be able to reflect the concept of the production of the key technology and related basic knowledge.
		Summary of research status (30 points)：Summarize the scientific issues and methods involved in the technology, and cite the documents properly.
		Development trend (20 points)：It mainly reflects new directions, new theories and new methods in related fields, and it is best to be able to present your own opinions.
		Content format (15 points): Abstract (5 points), keywords (5 points), and references (5 points) According to the requirements of current journals, the report shall be edited and typeset in a standardized manner.
Final exam	The final exam adopts a 100-point system and is graded according to the standard answers and grading rules drawn up by the person in charge of the course.	

Refer to Table 6 for the score distribution matrix of assessment methods and course objectives.

Table 6 Assessment Method and Course Target Score Distribution Matrix

		Classroom performance（K0）	Assessment 1（report 1）（K1）	Assessment 2（report 2）（K2）	Assessment 3（report 3）（K3）	Assessment 4 (Final exam)（K4）
The proportion of assessment methods in the total score		0.1	0.2	0.2	0.2	0.30
The proportion of course objectives in each assessment	Course objectives 1（M0）	1	0	0	0	0
	Course objectives 2（M1）	0	0	0	0	1
	Course objectives 3（M2）	0	1	1	1	0

According to the《**Institutional Analysis and Synthesis**》assessment method, grading standard and the course target distribution matrix, the evaluation standard of the course teaching target can be determined as shown in Table 7.

Table 7 Evaluation Criteria for Curriculum Objectives

Course objectives	evaluation standard				
	Course objectives to reach the average value 0.9-1	**Course objectives to reach the average value 0.8-0.9**	**Course objectives to reach the average value 0.7-0.79**	**Course objectives to reach the average value 0.6-0.69**	**Course objectives to reach the average value 0-0.59**
	excellent	**good**	**medium**	**Pass**	**Fail**
Realize value guidance and quality training. Have the scientific spirit and professionalism of seeking truth from facts and striving for perfection; have the spirit of teamwork and communication; have strong independent learning ability.	The value guidance and quality training have been completely realized. Possess the scientific spirit and professionalism of seeking truth from facts and excellence; Possess excellent teamwork spirit and communication skills; Possess strong independent learning ability	Better realization of value guidance and quality training. Possess the scientific spirit and professionalism of seeking truth from facts and excellence; Possess good teamwork spirit and communication skills; Possess strong independent learning ability	Better realize value guidance and quality training. Have a good scientific spirit and professionalism of seeking truth from facts and excellence; have a good teamwork spirit and communication skills; have a certain ability to learn independently	Basically, realize value guidance and quality training. Basically, possess the scientific spirit and professionalism of seeking truth from facts and striving for perfection; possess a certain teamwork spirit and communication ability; possess certain autonomous learning ability	Failure to achieve value guidance and quality training. Does not have the scientific spirit and professionalism of seeking truth from facts and excellence; does not have the spirit of teamwork, communication and independent learning
Preliminarily establish modern organization analysis and comprehensive design ideas, and master the content, process, methods, design procedures and principles of modern organization analysis and integration. Grasp the thinking methods and design types of mechanism analysis and synthesis, and master certain mechanism optimization design methods, configuration synthesis methods, and innovative scheme synthesis methods.	Fully understand the ideas and processes of modern design methods to solve specific engineering problems, and determine the direction of structural analysis and synthesis to solve actual engineering problems.	A more comprehensive understanding of the ideas and processes of modern design methods to solve specific engineering problems, and roughly determine the direction of structural analysis and synthesis for solving actual engineering problems.	Understand the ideas and processes of modern design methods to solve specific engineering problems, and basically be able to clarify the direction of structural analysis and synthesis to solve actual engineering problems.	Basically, understand the ideas and processes of modern design methods to solve specific engineering problems, and partly clarify the direction of structural analysis and synthesis to solve actual engineering problems.	Cannot understand the ideas and processes of modern design methods to solve specific engineering problems, and have not determined the direction of structural analysis and synthesis to solve actual engineering problems.

Course objectives	evaluation standard				
	Course objectives to reach the average value 0.9-1	Course objectives to reach the average value 0.8-0.9	Course objectives to reach the average value 0.7-0.79	Course objectives to reach the average value 0.6-0.69	Course objectives to reach the average value 0-0.59
	excellent	good	medium	Pass	Fail
Master the methods of literature retrieval and data collection related to mechanical analysis and comprehensive methods, and be able to summarize the background, content, research status and development trends of key technologies related to engineering issues through literature analysis.	Familiar with the literature retrieval method, check the report with clear structure, smooth writing, complete content, correct literature citation, standard format expression	Have a good command of literature retrieval methods, read the report sentences fluently, the content is basically complete, and the format expression is basic standard	Have a good grasp of the literature retrieval method, read the report sentence basically smoothly, the content is basically complete, the format expression is basic standard	Basically, master the literature retrieval method, read the report sentence basically smoothly, the content is basically complete, the format expression is basic standard	Inability to master the literature retrieval method, the sentence of the retrieval report is chaotic and unorganized, the content is incomplete, and the format is not standardized

VII.Recommended textbooks and reference materials

Recommended reference books:

Robert L.Norton: Design of Machinery An Introduction to the Synthesis and Analysis of Mechanisms and Machines, ISBN: 9787111112471, China Machine Press, 2004.

Teaching team：Yu Gaohong、Zhao Xiong、Sun Liang、Ye Wei

Course leader：Yu Gaohong

Writing：Zhao Xiong

Reviewers：Yu Gaohong

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May. 07, 2021

《模具设计与制造技术*》教学大纲

Syllabus of《Mould Design and Manufacturing Technology》

Course Name(Chinese)：模具设计与制造技术*　　　Course Code：31961

Course Name(English)： Mould Design and Manufacturing Technology

Category of this Course：Specialized course(limited optional course）

Total credit hours：32 lessons（including lectures：28 lessons, experiment: 4 lessons）

Credits：3.0

Prerequisite courses：Engineering materials and heat treatment, Mechanical manufacturing basis, Interchangeability and technical measurement, Principles of metal cutting and machine tools, Mechanical Manufacturing Technology.

Applicable major：Mechanical design and manufacturing and its automation, Mechanical and electronic engineering, etc.

Department：Institute of mechanical design and manufacture

I. Course introduction

This course is an important professional elective course for students majoring in mechanical design, manufacturing and automation. Through the learning of this course, students will understand the basic principles of mold design, understand the structure and design methods of typical molds such as stamping molds and plastic molds, and have the ability to formulate manufacturing process regulations for important mold parts. Introduce the achievements in the field of mold manufacturing in China, integrate the spirit of great craftsman into the teaching content, carry out classroom teaching, enhance students' sense of identity with the implementation of the socialist system and national science and technology policy, enhance students' cohesion and centripetal force, and lay a solid professional foundation for further theoretical study, and finally achieve the unity of professional education and talent education.

II. Course objectives

Objective 1：To cultivate students' ability to analyze and solve problems, rigorous and meticulous craftsmanship spirit, selfless dedication spirit, integrity spirit of words and deeds, collective consciousness of unity and cooperation, dedication spirit of arduous struggle, spirit of fearing hard work, and set up lofty ideals and aspirations.

Objective 2： Understand the basic principles of material forming, be familiar with the structural characteristics of stamping molds and plastic molds, and be able to understand the basic knowledge required for the formulation of mold parts processing and assembly process regulations

Objective 3: Have the ability to analyze the molding process and mold design, understand the new process, new technology and new equipment of mold manufacturing, and have the ability to optimize mold design and mold manufacturing processes on the basis of process and economic analysis

Objective 4: Based on the analysis of the material forming process, select and use appropriate technical means and modern engineering tools to model, predict and simulate the mold design and manufacturing process.

III. Graduation requirements supported by teaching objectives

The index points of graduation requirements supported by this course are shown in Table 1, and the supporting relationship between the teaching objectives of this course and the index points supporting graduation requirements is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Mould Design and Manufacturing Technology*

Index points of graduation requirements	Content of the index points of graduation requirements
1-3	Ability to use relevant knowledge and mathematical models of design, manufacturing, control, etc. to compare and synthesize solutions to complex engineering problems in the field of mechanical engineering.
3-1	Understand the current status and development trends of mechanical engineering, be familiar with the basic process of research and development of new products, new processes, new technologies and new equipment, and have the attitude and awareness of pursuing innovation in solving complex mechanical engineering problems.
5-2	Be able to select and use appropriate technical means and modern engineering tools for modeling, prediction and simulation of complex engineering problems in the field of mechanical engineering.
8-2	To understand the socialist core values, to understand the national conditions, to safeguard national interests, has the sense of responsibility to promote national rejuvenation and social progress.

Table 2 The supporting relationship between the course objectives of *Mould Design and Manufacturing Technology* and the index points supporting graduation requirements

Index points of graduation requirements	**1-3**	**3-1**	**5-2**	**8-2**
Objectives	2	3	4	1

Intensity of support	M	M	M	M

IV. Basic teaching content and class arrangement

Table 3 Relationship between course objectives and teaching content

Chapters	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
1	Basic knowledge of stamping (1) Stamping process and stamping die (2) Stamping equipment and stamping materials Blanking die design (1) Typical structure of blanking die (2) Design of the main parts of the blanking die (3) Process calculation related to blanking die design	(1) Understand the basic theory of stamping forming process (2) Familiar with common stamping forming methods (3) Master the key points of blanking die design （4）Through group discussion on the achievements and core technologies of China's science and technology in mold manufacturing, students' feelings of home and country, sense of pride and sense of mission are stimulated.	4	Teaching in class	1、2、3
2	Bending die design (1) Typical structure of bending die (2) Process calculation related to bending die design Drawing die design (1) Typical structure of drawing die (2) Process calculation related to drawing die design	(1) Understand the theory of bending deformation and master the key points of bending die design (2) Understand the principle of deep drawing process and master the key points of drawing die design	4	Teaching in class	2、3
3	Other stamping die design Basic knowledge of plastic molding (1) Plastic properties and plastic parts design (2) Injection molding equipment and injection mold (3) Injection molding process	(1) Learn about the characteristics and application ranges of other stamping molds (2) Learn about the molding process for commonly used plastics (3) Master the design points of the injection molding process	2	Teaching in class	2、3、4
4	Single-parted face injection mold design Double-parted surface and side pumping core injection mold	(1) Be familiar with the structure of the single-parted face injection mold (2) Master the design points of the single-parted face injection mold (3) Learn about the double-parted surface and side-pump injection molds	4	Teaching in class	2、3、4

Chapters	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
5	Other plastic molding mold design (1) Compression mode design (2) Press mold design (3) Hot flowway injection mold design	Learn about the application range and characteristics of other plastic molding processes and molds	2	Teaching in class	2、3
6	Mold manufacturing process procedures (1) Process analysis of mold part diagrams (2) Benchmark selection and installation of parts (3) The formulation of the route Machining of mold parts (1) Process analysis of mold part diagrams (2) Benchmark selection and installation of parts (3) Forming grinding of convex and concave collage surfaces	(1) Familiar with mold parts diagram, master mold manufacturing process procedures (2) Master the benchmark selection and installation of parts and be able to develop routes (3) Be familiar with mold guidance and the machining of template-type parts (4) Be familiar with the mold grinding of convex and concave tile faces （5）Cultivate students' spirit of craftsmanship	4	Teaching in class	1、2、3、4
7	Mold parts are machined with electric sparks The basics of electric spark processing Electric spark forming processing CNC electric spark wire cutting processing	Learn the basics of electric spark processing Be familiar with the forming of electric sparks Be familiar with CNC electric spark wire cutting and processing	3	Teaching in class	1、2、3
8	Grinding and polishing of molds (1) Grinding of the mold (2) Mold polishing Fast molding and rapid molding technology (1) The basic principles and characteristics of fast molding manufacturing technology (2) A method of rapid molding and processing (3) Application of fast molding technology in mold manufacturing	(1) Be familiar with the grinding of the mold (2) Familiar with mold polishing Familiar with the basic principles and characteristics of rapid molding manufacturing technology (3) Learn how to quickly mold and process (4) Learn about the application of fast molding technology in mold manufacturing （5）Cultivate students' spirit of craftsmanship	3	Teaching in class	1、2、3
9	Mold assembly process (1) Stamping mold assembly (2) Heat treatment and surface	(1) Learn about the assembly of stamped molds (2) Learn about the assembly of	2	Teaching in class	1、2

Chapters	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
	reinforcement technology for the assembly mold of plastic molding molds (3) Heat treatment of the mold (4) Chemical heat treatment of the surface of the mold	plastic molds (3) Learn about mold heat treatment and surface reinforcement techniques			

Table 4: Experimental teaching content class hour distribution table

Name of experimental project	Synopsis	Main equipment or experimental environment used	Experimental hours	Number of people in each group	Experimental properties	Course requirements	Corresponding course objectives
Mold disassembly experiment	Familiarize yourself with and master the dismantling of the mold	Mold	2	30	Elective course	Basic experiment	1、2
The preparation and test mold of convex mold	Be familiar with the preparation processing and test mold of convex mold	Mold	2	30	Elective course	Basic experiment	2

V. Teaching method

Teaching methods are mainly lectured in the classroom, supplemented by course reports, in-class experiments and after-school assignments.

VI. Evaluation method

The assessment of *Engineering Materials and Heat treatment* is to evaluate the degree of students achieving the teaching objectives of the course, which reflects the degree of students achieving the objectives of ability cultivation. The assessment methods are shown in Table 4 below.

Table 4 Course objectives and assessment methods

Scores	Evaluation parts	percentage	Evaluation details	Related objectives

Scores	Evaluation parts	percentage	Evaluation details	Related objectives
Usual performance	In-class performance	10%	The main assessment of students' understanding and mastery of basic knowledge; Score each time by percentage. The average score for each session is 10% of the total results of the course.	1、2、3
	Course report	20%	The main assessment of students on mold design, mold manufacturing and its related professional literature search and data collection, analysis, induction, summary of the ability, the total score is included in the course score of 20%.	2、3
Experiment	Experimental report	20%	Complete 2 experiments, experiment 1 is to let students form an understanding of mold structure, experiment 2 is to strengthen students' perceptic understanding of matching processing, and finally according to the experimental report and experimental performance to score, according to the results of 20% into the course total score.	2、3、4
Final Exam	Exam result	50%	It mainly assesses students' mastery of software and their ability of using software to design and analyze complex mechanical system simulation.	2、3、4

The grading standards of this course for each assessment link of the course are shown in Table 5.

Table 5 The grading standards of this course

<table>
<tr><th>Evaluation parts</th><th colspan="2">Grading standards</th></tr>
<tr><td>Usual performance</td><td colspan="2">According to the situation of answering questions, there are five grades: excellent (90-100), good (80-89), middle (70-79), passed (60-69), failed (below 60 points), on the basis of grades combined with class performance as appropriate to give points.</td></tr>
<tr><td>Experiment</td><td>课程实验（10%）</td><td>According to the completion of the experiment report and result, there are five grades: Excellent (90-100), good (80-89), middle (70-79), passed (60-69), failed (below 60).</td></tr>
<tr><td>Final Exam</td><td colspan="2">According to the completion of the test, according to the scoring rules will be graded.</td></tr>
</table>

The score distribution matrix of assessment methods and course objectives is shown in Table 6.

Table 6 Assessment methods and course target score distribution matrix

		Part 1（in-class performance）（K1）	Part 2（Course report）（K2）	Part 3（ Experimental report ）（K3）	Part 3（exam）（K3）
Percentage		0.10	0.20	0.20	0.50
Percentage of the objectives	Objective 1（M1）	0.50	0.30	0.30	0.30
	Objective 2（M2）	0.50	0.30	0.30	0.30
	Objective 3（M3）	0	0.40	0.40	0.40

VII. Recommended teaching materials and reference materials

Textbook:

[1] 杨志立，欧阳德祥 著，《模具设计基础》，机械工业出版社，2020.07

[2] 成虹 编，《模具制造技术》，机械工业出版社，2016.01

参考书：

[1] 宋建丽 编，《模具制造技术》，机械工业出版社，2012.03

[2] 王广春，赵国群编，《快速成型与快速模具制造技术及其应用》，机械工业出版社，2013.06

[3] 熊志卿编，《冲压工艺与模具设计》，高等教育出版社，2011.05

[4] 黄虹编，《塑料成型加工与模具》，化学工业出版社，2015.06

[5] 刘朝福编，《模具制造实用手册》，机械工业出版社，2012.07

Teaching group： Xiangsheng Li, etc.　　Course administrator：Jian Zhou

Written by: Jian Zhou　　Reviewed by: Xiangsheng Li

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May. 07, 2021

《模具设计制造综合实践*》教学大纲

Syllabus of《Mold design and manufacture comprehensive practice》

Course Name(Chinese)：模具设计制造综合实践　　　Course Code：31962

Course Name(English)： Mold design and manufacture comprehensive practice

Category of this Course：Professional Education (Practical Electives)

Total credit hours：40 lessons

Credits：2.0

Prerequisite courses：Engineering Materials and Heat Treatment, Fundamentals of Mechanical Manufacturing, Interchangeability and Technical Measurement, Metal Cutting Principles and Machine Tools, Mechanical Manufacturing Technology, Mold Design and Manufacturing Technology

Applicable major：Mechanical design and manufacture and automation

Department：Institute of mechanical design and manufacture

I. Course introduction

Mould design and manufacture of integrated practice is a comprehensive very strong practicality course, by analyzing from the parts to the mold design and manufacturing processes of comprehensive training to let the student to the mold design and manufacturing process completely, master the stamping die and plastic mould design and manufacture method, knowledge of common mould processing technology and related equipment,Have the ability of simple parts molding process design, mold design and mold manufacturing process. Introduce the achievements in the field of mold manufacturing in China, integrate the spirit of great craftsman into the teaching content, carry out classroom teaching, enhance students' sense of identity with the implementation of the socialist system and national science and technology policy, enhance students' cohesion and centripetal force, and lay a solid professional foundation for further theoretical study, and finally achieve the unity of professional education and talent education.

II. Course objectives

Objective 1：To cultivate students' ability to analyze and solve problems, rigorous and meticulous craftsmanship spirit, selfless dedication spirit, integrity spirit of words and deeds, collective consciousness of unity and cooperation, dedication spirit of arduous struggle, spirit of fearing hard work, and set up lofty ideals and aspirations.

Objective 2： Master of typical parts molding process and mold manufacturing process of the basic theory and knowledge, with analysis of mold design and make mould manufacturing process capability, understanding of mold design and manufacturing of new methods, new techniques and new equipment, have in the product design based on the analysis of the requirements and production conditions or to optimize the molding process,And the ability to analyze the reasonableness of product design from the point of view of process.

Objective 3: Mastering the economic analysis method of mold manufacturing process can improve the economic efficiency of mold manufacturing products through reasonable mold design, mold manufacturing process and molding equipment selection.

III. Graduation requirements supported by teaching objectives

The graduation requirement indicator points supported by this course are shown in Table 1, and the supporting relationship between the teaching objectives of the course and the graduation requirement indicator points is shown in Table 2.

Table 1 Index points of graduation requirements supported by *Comprehensive Practice of Mold Design and Manufacturing*

3.1	Understand the current situation and development trend of mechanical engineering frontier, familiar with the basic process of research and development of new products, new processes, new technologies and new equipment, and have the attitude and consciousness of pursuing innovation in solving complex engineering problems in the field of mechanical engineering.
8.2	To understand the socialist core values, to understand the national conditions, to safeguard national interests, has the sense of responsibility to promote national rejuvenation and social progress.
11.1	Master the knowledge of economic analysis and decision-making methods of technical schemes, economic evaluation methods of environmental protection and theories and methods of technological innovation.

Table 2 The supporting relationship between the course objectives of *Comprehensive Practice of Mold Design and Manufacture* and the index points supporting graduation requirements

Index points of graduation requirements	**3.1**	**8.2**	**11.1**
Objectives	2	1	3
Intensity of support	M	M	M

IV. Basic teaching content and class arrangement

Table 3 Relationship between course objectives and teaching content

Chapters	Teaching content	Teaching requirement	Lesson	Teaching style	objectives
1	1. Designed to prepare （1）Design specification （2）Design instruction	1. Define design tasks 2. Master the general design process 3. Through group discussion on the achievements and core technologies of China's science and technology in mold manufacturing, students' feelings of home and country, sense of pride and sense of mission are stimulated.	2	Teaching in class	1、2
2	2. Mold design (1) Forming process analysis of parts (2) Determination of molding method and equipment selection (3) Mold design	1. Parts of the molding process analysis 2. Determine the tooling process of the parts 3. Mold design 4. Cultivate students' spirit of craftsmanship	10	Teaching in class and practice	1、2、3
3	3. Mold manufacturing process design (1) The manufacturing process analysis of the main working parts of the mold (2) Manufacturing process procedures (3) Parts processing and mold assembly	1. Analysis of the manufacturing process of mold parts 2. Determine manufacturing process procedures 3. Trial mold parts and mold assembly test molds	12	Teaching in class and practice	2、3
4	4. drawing design (1) The main working part parts parts diagram (2) Mold assembly drawing	1. Complete the drawing of the main working parts of the mold 2. Complete the mold assembly drawing 3. Cultivate students' spirit of craftsmanship	10	practice	1、2
5	5. Group defense (1) Mold design and manufacturing process design report (2) Reply to PPT	1. Prepare course design reports as required 2. Course design on-site defense, combined with PPT preparation five minutes report	6	practice	2、3

V. Teaching method

Teaching methods using classroom teaching, student practice design-based, supplemented by curriculum design guidance, offline group discussion and communication.

VI. Evaluation method

The assessment of the comprehensive practice of mold design and manufacturing is carried out by means of the combination of usual results, mold design and manufacturing process design report, group defense, in order to assess the student's ability training goal to become the main purpose, in order to check the students' mastery of each knowledge point as an important content, in which the mold design and manufacturing process design report requires a detailed description of the mold molding process analysis and design process of selected parts, mold manufacturing process design process, and to be able to use professional knowledge for reasonable analysis.

Assessment results include: usual performance accounted for 10%, design report accounted for 60%, defense score accounted for 30% (calculation results according to the grade of the score assessment).

Table 4 Course objectives and assessment methods

Scores	**Evaluation parts**	**percentage**	**Evaluation details**	**Related objectives**
Usual performance	Usual performance	10%	The performance in the design process, node check and other comprehensive performance.	1
Mold design and manufacturing process design report results	Design report	60%	More than 5000 words of design report (including data access, analysis of the calculation process, mold design drawings), according to the completeness of the report, the main content includes molding process analysis, economic analysis, molding of the main working parts of the process procedures, molding methods and equipment selection, mold design drawings. Also see if the design process takes into account non-technical factors such as safety and environmental protection. Requires at least 3 mold design drawings (including main working parts drawings and mold assembly drawings).	2、3
Group defense	The performance of the defense	30%	The quality of the PPT production of the defense, the clarity of the oral statement in the reply, the performance of the answer to the question.	2、3

Table 5 The grading standards of this course

Evaluation parts	**Grading standards**	
Usual performance	According to the situation of answering questions, there are five grades: excellent (90-100), good (80-89), middle (70-79), passed (60-69), failed (below 60 points), on the basis of grades combined with class performance as appropriate to give points.	
Mold design and manufacturing process design report	Design report is the summary of students' design process and achievements, mainly from the content integrity, design rationality, drawing specification, description expression and format specification and other aspects of assessment and evaluation	Content integrity (30 points): Whether the design report is more than 5000 words (including the calculation analysis process). Whether combined with the theoretical knowledge of mold molding and production practice around the molding process, mold manufacturing process, molding equipment, technological advanced, environmentally friendly and other content, on the design process of key technologies, product economic analysis, mold manufacturing process, advanced technology and other aspects of the elaboration or analysis.
		Design rationality (30 points): whether the mold process and manufacturing process design is reasonable, whether the basis is adequate, whether to take into account the impact of non-technical factors.
		Drawing specification (30 points): whether the drawing is complete, whether the expression is correct and clear, whether the label is complete specification, etc.
		Description expression and format specification (10 points): whether the report description is accurate, whether the level is clear, whether the language is smooth, whether the structure is reasonable, whether in accordance with the format requirements of the task, whether it meets the school's design report specifications, whether it meets the requirements of the instructor.
Group defense	On-site or online video defenses need to be combined with PPT to report design processes and results. According to the reported performance (e.g. PPT production quality, clear expression, whether non-technical factors are taken into account, whether the answer questions are correct, etc.), there are four levels: excellent (90-100), good (75-89), medium (60-74), failure (less than 60 points).	

The score distribution matrix of assessment methods and course objectives is shown in Table 6.

Table 6 Assessment methods and course target score distribution matrix

	Part 1 （in-class performance）（K1）	Part 2 （Design report）（K2）	Part 3 （Group defense）（K3）

<table>
<tr><th colspan="2"></th><th>Part 1（in-class performance）（K1）</th><th>Part 2（Design report）（K2）</th><th>Part 3（Group defense）（K3）</th></tr>
<tr><td colspan="2">Percentage</td><td>0.30</td><td>0.30</td><td>0.40</td></tr>
<tr><td rowspan="3">Percentage of the objectives</td><td>Objective 1（M1）</td><td>0.50</td><td>0.30</td><td>0.30</td></tr>
<tr><td>Objective 2（M2）</td><td>0.50</td><td>0.30</td><td>0.30</td></tr>
<tr><td>Objective 3（M3）</td><td>0</td><td>0.40</td><td>0.40</td></tr>
</table>

VII. Recommended teaching materials and reference materials

Textbook:

[1] 冯炳尧等. 模具设计与制造简明手册（第4版）. 上海：上海科学技术出版社，2015.

参考书：

[1] 郑修本. 机械制造工艺学(第三版). 北京：机械工业出版社, 2017.

[1] 许发樾. 实用模具设计与制造手册. 北京：机械工业出版社，2001.

[2] 王鹏驹，成虹. 冲压模具设计师手册. 北京：机械工业出版社，2009.

[3] 张维合. 注塑模具设计实用手册. 北京：化学工业出版社，2011.

Teaching group： Xiangsheng Li, etc.　　　　Course administrator：Jian Zhou

Written by: Jian Zhou　　　　Reviewed by: Xiangsheng Li

Approved by: Teaching Committee of Faculty of Mechanical Engineering and Automation

Date: May. 07, 2021

《毕业设计（论文）》教学大纲

课程中文名称：毕业设计（论文）　　　　**课程代码：**31672

课程英文名称：　Graduation Design (Thesis)

课程性质与类别：实践课程、专业课、必修课

总学时：16 周

学分：8 学分

先修课程：机械设计制造及其自动化专业所要求的全部课程

适用专业：机械设计制造及其自动化专业

开课系(室)：　机械设计与制造系

一、课程简介

本课程是机械设计制造及其自动化专业学生最后一门综合性实践教学课程、必修课。通过本课程学习，使学生具备以下能力：

1、在学生已完成专业基础课和专业课学习后，通过专题研究、论文综述、工程设计等方式，综合应用和深化本专业所学理论知识和专业技能，培养学生分析和解决实际问题的能力。使学生得到从事本专业相关的生产或科研工作所必需的基本训练和进行科学研究工作的初步能力。

2、通过毕业设计教学，使学生学会依据课题任务进行中外资料数据的调研、收集、加工与整理，并完成文献综述和外文翻译，培养学生理论分析、制定设计或试验方案的能力，训练学生正确使用各种设计资料、手册、图册、国家标准和技术规范的基本技能，培养学生掌握工程设计的程序、方法和基本原则，培养学生掌握科学实验和数据测试、处理与分析等从事科学研究的基本方法，提高学生工程计算、图纸绘制、编写技术文件的能力。

3、通过毕业设计，在实践中培养学生勇于探索的创新精神，应使学生树立正确的设计思想，培养学生严肃认真的科学态度、严谨求实的工作作风、正确的技术经济观点和工程全局意识。

4、通过毕业设计，应使学生受到现代机械工程师的基本训练，进一步培养学生严谨的科学态度、创新能力、实践能力和创业精神，增加学生的社会责任感，为毕业后更好地遵守职业道德和行为规范，适应工程设计，科学研究及其它技术工作奠定必要的基础。

二、课程目标

课程目标 1：通过让学生参加毕业设计的学习和锻炼，培养学生严肃认真的学习态度，增强学生的责任感，引导学生遵守职业道德、遵守行为规范，培养合格的社会主义建设者和接班人。

课程目标 2：在学生已完成专业基础课和专业课学习后，通过专题研究、论文综述、工程设计等方式，综合应用和深化本专业所学理论知识和专业技能，培养学生分析和解决实际问题的能力。使学生得到从事本专业相关的生产或科研工作所必需的基本训练和进行科学研究工作的初步能力。

课程目标 3：通过毕业设计教学，使学生学会依据课题任务进行中外资料数据的调研、收集、

加工与整理，并完成文献综述和外文翻译，培养学生理论分析、制定设计或试验方案的能力，训练学生正确使用各种设计资料、手册、图册、国家标准和技术规范的基本技能，培养学生掌握工程设计的程序、方法和基本原则，培养学生掌握科学实验和数据测试、处理与分析等从事科学研究的基本方法，提高学生工程计算、图纸绘制、编写技术文件的能力。

课程目标 4：通过毕业设计教学，使学生学会依据课题任务，根据所学到的理论知识完成方案设计，并对方案的可行性进行分析，培养学生的分析动手以及处理复杂工程问题的能力。

课程目标 5：通过毕业设计教学，使学生学会利用多种手段处理复杂工程问题的能力，包括计算机辅助设计、仿真分析等方面的能力，理解每种工具的长处，提高学生工程计算、图纸绘制、编写技术等方面的综合能力。

课程目标 6：通过毕业设计，在实践中培养学生勇于探索的创新精神，应使学生树立正确的设计思想，培养学生严肃认真的科学态度，分析设计的最优化方案，培养长远的经济观点和工程全局设计意识。

课程目标 7：通过毕业设计，培养学生的逻辑思维能力和口头表达能力，能够利用工程语言表述自己的方案，能够采用思辨的方式正确分析工程实际问题。

课程目标 8：通过毕业设计，应使学生受到现代机械工程师的基本训练，进一步培养学生系统全局观念、严谨的科学态度、创新能力、实践能力和创业精神，为毕业后更好地适应工程设计，科学研究及其它技术工作奠定必要的基础。

三、课程教学目标支撑的毕业要求

本课程职称的毕业要求指标点如表 1 所示，课程教学目标对职称毕业要求指标点的职称关系如表 2 所示。

表 1 《毕业设计（论文）》支撑的毕业要求指标点

毕业要求指标点	毕业要求指标点内容
2-3	能够正确表述一个机械工程中的复杂工程问题的解决方案，并能运用基本原理分析方案的合理性。
3-3	完成课程练习、课程设计、实验、科技训练、生产实习和毕业设计等教学环节，能将自然科学、工程科学的基本原理和技术手段用于特定需求的机械工程系统、复杂单元及工艺流程设计。
5-3	理解利用现代工程工具解决机械工程中的复杂工程问题的局限性。
7-2	树立绿色制造的理念，正确评估机械工程领域的复杂工程问题的工程实践对环境和社会可持续发展的影响。
8-3	理解工程伦理的核心理念及机械工程师的社会责任，在工程实践中能够自觉遵守机械工程师职业道德和行为规范。

10-1	能够通过书面报告和口头陈述清晰地表达机械工程领域的复杂工程问题的解决方案、过程和结果，并能理解业界同行及社会公众的质疑和建议。
10-2	通过阅读国内外技术文献、参加学术讲座、学生互访等环节，理解不同文化、技术行为之间的差异，能够在跨文化背景下进行沟通和交流，具有一定的国际视野。
11-2	能运用系统工程的观点、理论和方法，对项目涉及的全部工作进行管理，并应用于多学科环境中机械工程领域的复杂工程问题的解决。

表 2 《毕业设计（论文）》课程目标对支撑毕业要求指标点的支撑关系

毕业要求指标点	2-3	3-3	5-3	7-2	8-3	10-1	10-2	11-2
课程目标	4	2	5	6	1	7	3	8
支撑强度	H	H	H	H	L	H	H	H

四、教学内容与学时安排

表 3 课程目标与教学内容的关系

	教学内容	教学要求	学时	教学方式	课程目标
1	完成开题报告、文献综述	（1）根据指导教师的安排，参与某项具体任务，了解任务的基本情况；从整体上介绍工程设计的重要性以及工程师的社会责任等。 （2）商定毕业设计任务，撰写毕业设计开题报告。	2周	指导老师指导	1、2
2	制定具体计划	（1）调研、查阅文献，拟定方案，进行可行性分析，撰写论证报告； （2）编写报告中的项目摘要、项目研究的目的和意义、项目要达到的目标及考核指标、项目的关键技术、主要研究内容、拟采取的技术工艺路线；在技术路线设计中，注重考虑绿色、环保的技术方案的选择。 （3）制定具体实施方案、具体的仪器设备和测试仪器及进度节点、计划进度、现有条件与工作基础等。 （以上相关工作由导师检查记录）	2周	指导老师指导	2、3
3	制定设计、仿真或者实验方案等	（1）完成项目的前期准备工作，包括实验所需原材料、实验仪器设备、检测手段、方法及地点、实验辅助人员； （2）完成图纸、设备选型及材料采购、技改人员安排； （3）完成仿真分析相关软件的准备、软件方案等。 （以上相关工作由导师检查记录）	3周	指导老师指导	2、3

	教学内容	教学要求	学时	教学方式	课程目标
4	具体设计或实验	开展设计或仿真分析或实验研究等毕业设计工作，包括：实验室研究、工程化分析、试验及考核方式、工业运行数据记录与分析，工程化试验初步结论等。试验过程中，要求学生如实严谨记录试验过程、试验结果，不能篡改数据，培养学生认真仔细的态度和作风，培养学生的工程师担当。 （中期答辩/导师检查记录）	5周	指导老师指导	4、5
5	设计方案、数据整理	进一步完善设计或仿真分析以及试验，并完成设计资料或工程化试验数据整理。 （以上相关工作由导师检查记录）	2周	指导老师指导	4、5、6
6	论文整理及答辩	（1）完成设计或实验报告； （2）毕业论文答辩。 （导师检查记录/评阅教师评语 答辩记录/答辩小组评语）	2周	指导老师指导	5、6、7、8

五、教学方法

指导老师指导为主，结合中期检查以及开展答辩。

六、课程考核及评价标准

表 4 课程考核目标与考核方式

成绩组成	考核/评价环节	分值	考核/评价内容	对应的教学目标
指导教师评分	文献综述、毕业论文、外文翻译、工作表现等	30%	指导教师评价学生的文献综述、开题报告、毕业论文、外文翻译、工作表现等情况。	1、2、3、4、5、6、7、8
评阅教师评分	选题、文献综述、毕业论文、外文翻译等	30%	评阅老师对学生论文选题、文献综述、外文翻译、毕业论文等情况进行评价。	1、2、3、4、5、6、7、8
答辩小组评分	毕业论文、答辩表现等	40%	答辩小组根据学生答辩时的表现，对毕业论文质量、答辩表现进行现场打分。	1、2、3、4、5、6、7、8

表 5 课程考核方式评分标准

考核/评价环节	评分标准
指导教师评分	指导教师按学生的文献综述开题报告 15%、毕业论文 50%、外文翻译撰写能力 15%、工作表现 20%的比例打分。该项成绩按 30%计入总成绩。
评阅教师评分	按照论文选题 10%、文献综述 10%、外文翻译 10%、毕业论文 70%的比例打分。该项成绩按 30%计入总成绩。
答辩小组评分	答辩小组根据学生答辩时的表现，按照毕业论文质量 40%、答辩表现 60%的比例现场打分，占学生总评成绩的 40%。

表 6 考核方式与课程目标分值分配矩阵

		考核 1 （指导老师评分） （K1）	考核 2 （评阅老师评分） （K2）	考核 3 （答辩小组评分） （K3）
考核方式在总成绩中的占比		0.3	0.3	0.4
课程目标在各考核中的占比	课程目标 1（M1）	0.1	0.1	0.1
	课程目标 2（M2）	0.2	0.2	0.2
	课程目标 3（M3）	0.2	0.2	0.2
	课程目标 4（M4）	0.1	0.1	0.1
	课程目标 5（M4）	0.1	0.1	0.1
	课程目标 6（M4）	0.1	0.1	0.1
	课程目标 7（M4）	0.1	0.1	0.1
	课程目标 8（M4）	0.1	0.1	0.1

七、推荐教材及参考资料

教材：

无。

参考书：

各类与机械设计制造自动化相关及与研究领域相关的专业类书籍、工具书、中外文期刊。

课程教学团队：机械系全体教师　　　　　　　　课程负责人：魏义敏

执笔：魏义敏　　　审稿：李剑敏　　　　　　　　　审定：机械与自动控制学院教学委员会

制（修）订时间：2021 年 5 月 17 日

《工程前沿讲座》教学大纲

课程中文名称：工程前沿讲座　　　　　　　**课程代码：**31677

课程英文名称：Lectures on Engineering Frontier

课程性质与类别：专业教育（选修）

总学时：16 学时

学分：1.0

先修课程：机械学科导论、机械制造基础、机械原理、机械设计、金属切削原理与机床

适用专业：机械设计制造及其自动化

开课系(室)：机械设计制造系

一、课程简介

工程前沿讲座是一门专业性很强的专业选修课程。主要针对机械工程各研究和应用领域的前沿热点方向和突出问题，邀请国内外研究机构和行业龙头企业的研究人员或资深工程师开展专题讲座。其主要作用是拓宽学生知识面和专业视野，了解机械工程各研究方向的最新进展，启发科研思路；培养学生把握大势、抢占先机，直面问题、迎难而上的开拓创新精神，瞄准世界科技前沿，引领科技发展方向，肩负起历史赋予的重任，树立勇做新时代科技创新的排头兵，努力建设世界科技强国的志向。

二、课程教学目标

课程目标1：塑造爱国敬业，忠于职守的社会主义核心价值观，树立肩负历史重任，勇做新时代科技创新的排头兵，努力建设世界科技强国的志向。

课程目标2：知晓机械工程领域新兴的新产品、新工艺、新技术和新设备，了解机械工程前沿现状和发展趋势，开拓学术视野，培育创新精神和意识。

课程目标3：掌握专业技术文献的检索方法，培养初步的科研和专业交流能力，理解不同文化、技术行为之间的差异，培养初步的国际视野。

三、课程教学目标支撑的毕业要求

本课程支撑的毕业要求指标点如表1所示，课程教学目标对支撑毕业要求指标点的支撑关系如表2所示。

表 1《工程前沿讲座》支撑的毕业要求指标点

毕业要求指标点	毕业要求指标点内容
3.1	了解机械工程前沿现状和发展趋势，熟悉新产品、新工艺、新技术和新设备研究、开发的基本流程，在解决机械工程领域的复杂工程问题中具有追求创新的态度和意识。

8.2	理解社会主义核心价值观，了解国情，维护国家利益，具有推动民族复兴和社会进步的责任感。
10.2	通过阅读国内外技术文献、参加学术讲座、学生互访等环节，理解不同文化、技术行为之间的差异，能够在跨文化背景下进行沟通和交流，具有一定的国际视野。

表 2《工程前沿讲座》课程教学目标对支撑毕业要求指标点的支撑关系

毕业要求指标点	3.1	8.2	10.2
课程教学目标	2	1	3
支撑强度	H	M	H

四、基本教学内容与学时安排

表 3 课程目标与教学内容的关系

序号	教学内容	教学要求	学时	教学方式	对应的教学目标
1	1. 课前准备 （1）发布讲座主题 （2）资料检索	1. 根据发布主题进行资料检索 2. 撰写文献综述，做好知识准备 3. 了解中国研究人员在工程前沿领域取得的成就和贡献	4	讲授	1、2
2	2. 系列讲座 （1）机械工程前沿系列讲座	1. 按时参加讲座，现场积极参与交流和讨论 2. 按要求撰写课程报告 3. 通过现场讨论中国学者开展工程前沿技术的事迹和意义，激发学生的家国情怀、自豪感和使命感。	12	讲授	1、2

五、教学方法

教学方式采用课堂讲授为主，辅以线上学习，线下讨论交流。

六、考核方式

工程前沿讲座的考核采用平时成绩、课程报告相结合的方式进行考核，以考核学生对机械工程最新研究和应用进展的了解程度，文献检索和归纳总结能力。

考核成绩包括：平时表现占20%，课程报告占80%（计算结果按照等级式进行成绩评定）。

表 4 课程目标与考核方式

成绩组成	考核/评价环节	分值	考核/评价细则	对应的教学目标
平时成绩	平时表现	20%	参与讲座和学习过程中的综合表现。	1、2

课程报告成绩	课程报告	80%	3000 字以上的课程报告，根据报告的完整程度打分，主要内容包括文献研读、讲座内容简介、心得体会和思考等。	1、2、3

表 5 课程考核方式评分标准

考核/评价环节	评分标准
平时表现	根据听取讲座期间的表现情况（如是否遵守安排、是否严格遵守纪律与规范、是否积极参与讨论和交流等），分为四个等级：优（90-100）、良（75-89）、中（60-74）、不及格（60 分以下）。
课程报告	参加讲座前需要根据发布的报告主题进行文献检索和研读；讲座后需要撰写课程报告，根据课程报告的质量（如内容是否完整、表达是否清楚、是否有自己的心得和思考等），分为四个等级：优（90-100）、良（75-89）、中（60-74）、不及格（60 分以下）。

表 6 考核方式与课程目标分值分配矩阵

		考核 1（平时表现）（K1）	考核 2（课程报告）（K2）
考核方式在总成绩中的占比		0.2	0.8
课程目标在各考核中的占比	课程目标 1（M1）	0.3	0.2
	课程目标 1（M2）	0.7	0.3
	课程目标 2（M3）	0	0.5

七、推荐教材及参考资料

教材：

本课程为前沿讲座，讲授内容随着本学科各研究方向的发展动态而不断调整，无固定教材。

参考书：

[1] 机械工程前沿著作系列. 北京：高等教育出版社, 2013.

课程教学团队：周健、魏义敏　　　　课程负责人：周健

执笔：周健　　　审稿：叶伟　　　审定：机械与自动控制学院教学委员会

制（修）订时间：2021 年 05 月 21 日

《生产企业管理与运作》教学大纲

课程中文名称：生产企业管理与运作　　　**课程代码：**31667

课程英文名称：Management and Operation of Production Enterprise

课程类别与性质：专业基础教育（选修）

总学时：32 学时（其中讲课 32 学时）

学　分：2.0

先修课程：高等数学、线性代数

面向对象：机械工程本科生

开课系(室)：机械设计与制造系

一、课程简介

本课程是工业工程专业的一门类别选修课。本课程主要介绍企业现场管理所涉及到的材料管理、人员管理、作业方法管理、设备管理和环境管理等方面的问题，主要内容包括：管理的基本理念、明确现场管理的主要工作（品质、降低成本、确保交货期、确保人生安全、提高士气、认识七种浪费）、现场人员管理、现场物料管理、现场设备管理、现场品质管理、现场环境管理（推进5s活动：整理、整顿、清扫、清洁、素养）、现场工序管理、现场信息管理、现场改善手法（问题解决七步法）和管理改善的系统工具等；培养学生把握大势、抢占先机，直面问题、迎难而上的开拓创新精神，瞄准世界科技前沿，引领科技发展方向，肩负起历史赋予的重任，树立勇做新时代科技创新的排头兵，努力建设世界科技强国的志向。

二、课程目标

课程目标 1：塑造爱国敬业，忠于职守的社会主义核心价值观，树立肩负历史重任，勇做新时代科技创新的排头兵，努力建设世界科技强国的志向。

课程目标 2：通过生产现场管理理论学习和实践环节的学习，使学生从理论的角度掌握生产现场管理方法及改善的工具。通过实践环节的学习以达到提高运用知识的能力，并为学习相关课程提供必要的基础知识。

课程目标 3：通过本课程的学习，学生应获得如下能力：能对生产现场管理有初步认识；通过案例教学及实践环节训练，培养学生善于发现问题，并能综合运用所学理论分析、解决实际问题的能力和创新能力。

三、课程教学目标支撑的毕业要求

本课程支撑的毕业要求指标点如表1所示，课程教学目标对支撑毕业要求指标点的支撑关系如表2所示。

表1《生产企业管理与运作》支撑的毕业要求指标点

毕业要求指标点	毕业要求指标点内容

2.3	能够正确表述一个机械工程中的复杂工程问题的解决方案，并能运用基本原理分析方案的合理性。
5.3	理解利用现代工程工具解决机械工程中的复杂工程问题的局限性。
8.3	理解工程伦理的核心理念及机械工程师的社会责任，在工程实践中能够自觉遵守机械工程师职业道德和行为规范。

表 2 《生产企业管理与运作》课程目标对支撑毕业要求指标点的支撑关系

毕业要求指标点	**2.3**	**5.3**	**8.3**
课程教学目标	2	3	1
支撑强度	L	L	L

四、基本教学内容与学时安排

表 3 课程目标与教学内容的关系

章节	**教学内容**	**教学要求**	**学时**	**教学方式**	**课程目标**
1	1. 现场管理基础 (1) 生产现场管理内涵 (2) 管理循环（PDCA） (3) 现场管理者的责任	了解管理的起源、管理的意义、工厂中常见的管理活动、管理的基本理念、PDCA 管理循环、成为管理者的五个必要条件等内容。通过案例说明培养敬业精神和职业精神的意义和重要性。	4	课堂讲授	1、2
2	2. 整体工作的推进方法 (1) 管理项目 (2) 有效推进工作的方法 (3) 如何编写改善计划及改善报告	了解何为管理项目、结果型及可量化的管理项目、管理目标、工作成绩的评价、如何编写改善计划、如何编写改善报告等内容。	4	课堂讲授	1、2、3
3	3. 如何发掘全员智慧 (1) 企业最大的浪费概念 (2) 如何建立一般提案制度	了解企业最大的浪费是什么、7 大浪费、建立员工提案制度的意义、员工提案制度等	4	课堂讲授	1、2、3
4	4. 目视管理及看板管理 (1) 何为目视管理：目视管理的定义、目视管理的要点、目视管理之用途和目视管理之对象及常用工具。 (2) 目视管理的分类和管理要点：目视管理的物品管理、目视管理的作业管理、案例六 目视管理的作业管理案例、目视管理的设备管理、目视管理的品质管理、目视管理的安全管理和目视管理之看板管理 (3) 目视管理水准及评价基准。	了解目视管理的定义、目视管理的要点、目视管理之用途、目视管理之对象及常用工具、目视管理的物品管理、作业管理、设备管理、品质管理、安全管理、看板管理、目视管理水准及评价基准和现场管理水平的标志等内容。结合看板的实例讨论分析企业和管理者是如何将精益求精落到实处，以及产生的效果。	4	课堂讲授	1、2、3

章节	教学内容	教学要求	学时	教学方式	课程目标
5	5. 现场改善手法 (1) 现场改善概述 (2) 改善的意识 (3) 改善手法：问题解决七步法 (4) 改善四阶法 (5) 如何营造现场改善气氛	了解现场的概念、管理与改善的关系、现场改善的内容、主要分析工具、改善的意识、改善的手法（问题解决七步法）和作业改善四阶法等内容。	6	课堂讲授	1、2
6	6. 管理改善的系统工具 (1) TPM 活动 (2) 人 TCI 全面改善活动 (3) 新 TQM 活动 (4) 经营可视化的工具 TPI (5) 6Sigma 管理法	了解 TPM 的定义、TPM 活动的内容、TCI 活动的核心内容、开展新 TQM 活动的基本方法和 TPI 方法的出发点和所期待的效果等内容。	6	课堂讲授	1、2
7	7. 现场改善纪实 (1) 6S 推动企业管理上档升级 (2) 工厂、车间、班组全面提升 (3) 改善案例分析	了解 6S 推动企业管理上档升级、集团公司水泥三厂“6S”管理经验（四个案例）和达标与改善的区别等内容。通过现场实地分析工匠精神对于企业发展的意义，激发学生的家国情怀、自豪感和使命感。	4	课堂讲授	1、2、3

五、教学方法

教学方式以课堂讲授为主。为了提高教学质量，理论教学采用多媒体课件进行，用多媒体手段把相关的优秀教材中的文字内容，相关的声像和图片资料收录在内，使学生在课堂上能看到内容丰富、图表俱全的专业知识。多媒体教室还配备网络设置，可以随时链接有关工业工程系列的网站，获取广泛的信息。

六、考核方式

《生产企业管理与运作》课程的考核是对学生达到课程教学目标的程度进行评价，体现学生能力培养目标的达成度，考核方式如下表 4。

表 4 课程目标与考核方式

成绩组成	考核/评价环节	分值	考核/评价细则	对应的教学目标
平时成绩	课堂表现	40%	主要考核学生对基础知识的理解和掌握程度。评价学生回答问题、课堂讨论参与度。	1、2、3
期末考查	学习报告	60%	主要考核学生对生产企业管理与运作基本知识和相关生产现场管理方法及改善的工具掌握情况。	1、2、3

《生产企业管理与运作》课程各考核环节评分标准如下表 5。

表 5 课程考核方式评分标准

考核/评价环节	评分标准

课堂表现	根据回答问题情况，分为四个等级，优（90-100）、良（80-89）、中（70-79）、及格（60-69）、不及格（60 分以下），在等级基础上结合上课表现酌情给分。
期末考查	根据学习报告完成情况和质量，分为四个等级：优（90-100）、良（80-89）、中（70-79）、及格（60-69）、不及格（60 分以下）。

考核方式与课程目标的分值分配矩阵见表6。

表 6 考核方式与课程目标分值分配矩阵

		考核 1（课堂表现）（K1）	考核 2（期末考查）（K2）
考核方式在总成绩中的占比		0.4	0.6
课程目标在各考核中的占比	课程目标 1（M1）	0.3	0.2
	课程目标 2（M2）	0.4	0.4
	课程目标 3（M3）	0.3	0.4

七、推荐教材及参考资料

教材：

[1] 潘尔顺 主编：《生产计划与控制》，上海交通大学出版社，2003 年出版。

参考书：

[1] 王丽亚主编：《生产计划与控制》，清华大学出版社，2007 年出版。

[2] 叶春明主编：《生产计划与控制》，高等教育出版社，2005 年出版。

网络资源：

1、http://course.cugnc.com/security_people_machine/06-3.htm

2、http://www.hfes.org/

课程教学团队：董宝力、贾江鸣　　　　课程负责人：董宝力

执笔：董宝力　　审稿：叶伟　　审定：机械与自动控制学院教学委员会

制（修）订时间：2021 年 5 月 10 日

《企业综合实践》教学大纲

课程中文名称：企业综合实践　　　　　　　　**课程代码：**31689

课程英文名称：Comprehensive Practice of Corporate Internship

课程性质与类别：专业教育（实践选修）

总学时：80 学时

学分：4.0

先修课程：机械设计制造及其自动化专业所要求的全部课程

适用专业：机械设计制造及其自动化专业（卓越计划项目）学生

开课系(室)：机械设计制造系

一、课程简介

"卓越工程师教育培养计划"是直接面向企业需求的校企联合培养模式，企业综合实践即深入到生产、科研第一线，全面了解并熟悉实习单位的产品开发过程、生产流程、企业运作管理方式等，获取现代制造企业的综合管理基本知识。

企业综合实践在学生实习企业内实施，由聘请的企业指导教师指导，学校教师监督，期间主要完成企业认识、顶岗实习、职业培训等任务。通过企业综合实践使学生具备在行业相关企业从事实际设计、生产、运营及管理工作的能力；在实践中塑造学生的职业道德，培养学生敬业、精益、专注、创新的"工匠精神"。

二、课程教学目标

课程目标1：塑造爱国敬业，忠于职守的社会主义核心价值观，培养追求卓越的创造精神、精益求精的"工匠精神"。

课程目标2：了解并掌握实践所在企业主体产品的生产流程和关键技术，运用所学专业理论知识、结合生产现场调研和在岗实践对企业生产技术特点进行深度评价，培养学生理论联系实际，提高其在生产实际中调查研究、观察问题、提炼问题、分析问题以及解决问题的能力和方法，巩固、深化和扩大学生所学基本理论、基本知识和基本技能，为以后的工作和继续深造学习积累实际经验。

课程目标3：通过学生参加企业产品开发或机械项目实施，接受企业员工一样的管理，培养学生的创新能力和团队精神，形成良好的职业素养和意识，为毕业就业后快速融入企业，加速成才打下坚实的基础。

三、课程教学目标支撑的毕业要求

本课程支撑的毕业要求指标点如表1所示，课程教学目标对支撑毕业要求指标点的支撑关系如表2所示。

表 1《企业综合实践》支撑的毕业要求指标点

毕业要求指标点	毕业要求指标点内容
6.3	能够评价机械工程实践和机械工程领域的复杂工程问题解决方案对社会、健康、安全、法律以及文化的影响，并理解应承担的责任。
8.3	理解工程伦理的核心理念及机械工程师的社会责任，在工程实践中能够自觉遵守机械工程师职业道德和行为规范。
11.2	能运用系统工程的观点、理论和方法，对项目涉及的全部工作进行管理，并应用于多学科环境中机械工程领域的复杂工程问题的解决。

表 2《企业综合实践》课程教学目标对支撑毕业要求指标点的支撑关系

毕业要求指标点	6.3	8.3	11.2
课程教学目标	2	1	3
支撑强度	M	L	M

四、基本教学内容与学时安排

表 3 课程目标与教学内容的关系

序号	教学内容	教学要求	学时	教学方式	对应的教学目标
1	1. 上岗培训 （1）安全教育 （2）企业培训	1. 形成安全意识 2. 了解企业情况和主要产品 3. 了解“工匠精神”是在企业发展中的作用和体现	10	讲授	1、2
2	2. 顶岗实习 （1）岗位工作学习 （2）岗位工作实践	1. 了解岗位工作的内容 2. 熟悉实习岗位的相关设备、软件、工装、工艺以及生产管理等生产环节 3. 了解实习企业是如何开展个性化定制、柔性化生产，培育精益求精的工匠精神	60	实践	1、2、3
3	3. 综合设计 （1）分析实习过程中发现或存在的技术问题 （2）结合专业所学知识，检索文献，提出解决或优化方案	1. 结合实习工作，从机械工程专业角度出发分析和解决问题 2. 分析实习企业行业发展情况，撰写实习报告 3. 汇报在企业实习过程中对制造强国战略和“工匠精神”对于中华民族伟大复兴的作用和意义的理解	10	实践、汇报	1、2、3

五、教学方法

教学方式以学生实践和设计为主，辅以企业指导教师现场讲授，校内指导教师线下交流指导的方式进行。

六、考核方式

企业综合实践的考核采用实习日志、实践报告、实习企业和指导教师评价相结合的方式进行考核，以考核学生能力培养目标的达成为主要目的，以检查学生对实习岗位相关知识的理解和掌握程度为重要内容，其中实践报告要求详细描述实习岗位涉及的工作任务和要求，以及相关设备、软件、工艺、工装以及生产管理等生产环节，要在实践过程发现存在的问题，能够运用专业知识进行合理的分析，并且结合实际情况提出解决方案。

考核成绩包括：实习日志占10%，实践报告占60%，实习企业和指导教师评价占30%（计算结果按照等级式进行成绩评定）。

表 4 课程目标与考核方式

成绩组成	考核/评价环节	分值	考核/评价细则	对应的教学目标
实习日志	平时表现	10%	实践心得体会，发现的问题及可能解决方法。	1、2
实践报告	实践报告	60%	5000 字以上的实践报告，根据报告的完整度打分，主要内容包括实习工作介绍、企业的行业发展情况分析、实习工作中发现的与机械工程相关的专业性问题、查阅的文献资料、分析计算过程、提出的解决或优化方案等。此外看提出的方案是否考虑安全、环保等非技术因素。	1、2、3
实习企业和指导教师评价	实习表现	30%	实习企业对学生实习期间的表现（包括出勤情况，遵守纪律，工作作风等），企业指导教师对学生实习工作的表现（包括专业知识的掌握程度，学习和应用能力等）做出评价。	1、2、3

表 5 课程考核方式评分标准

<table>
<tr><th>考核/评价环节</th><th colspan="2">评分标准</th></tr>
<tr><td>实习日志</td><td colspan="2">根据实习期间的日志的完成情况（如是否记录完整、是否积极按节点要求完成任务等），分为四个等级：优（90-100）、良（75-89）、中（60-74）、不及格（60 分以下）。</td></tr>
<tr><td rowspan="3">实践报告</td><td rowspan="3">实践报告是学生实践过程的总结，主要从内容完整性、专业相关性、分析合理性、描述表达及格式规范性等环节方面进</td><td>内容完整性（30 分）：实践报告是否在 5000 字以上。是否完整描述了生产实际，围绕实习工作所使用的设备、工艺、软件、产品装备、技术先进性、环境友好性等内容展开，就生产过程中的关键技术、产品的经济性分析、制造工艺、生产管理等方面进行阐述或分析。</td></tr>
<tr><td>分析合理性（30 分）：对技术问题的分析和解决方案的设计是否合理，依据是否充分，是否考虑到非技术因素的影响。</td></tr>
<tr><td>专业相关性（30 分）：观察、分析问题和提出的解决方案是否从专业的角度出发，有深度，逻辑性强。</td></tr>
</table>

	行考核评价。	语言描述表达（10分）：报告描述是否准确、层次是否分明，语言是否流畅，结构是否合理，是否符合指导老师的要求。
实习企业和指导教师评价	由实习企业的人事部分和企业指导教师对学生在企业实习的总体情况进行评价，分为四个等级：优（90-100）、良（75-89）、中（60-74）、不及格（60分以下）。	

表6 考核方式与课程目标分值分配矩阵

		考核1 **（实习日志）（K1）**	**考核2** **（实践报告）（K2）**	**考核3** **（企业和教师评价）** **（K3）**
考核方式在总成绩中的占比		0.1	0.6	0.3
课程目标在各考核中的占比	课程目标1（M1）	0.3	0.2	0.2
	课程目标2（M2）	0.7	0.4	0.3
	课程目标3（M2）	0	0.4	0.5

七、推荐教材及参考资料

教材：

无指定教材

课程教学团队：周健、李红军、周海丽、程晓、吕利叶　　　　课程负责人：周健

执笔：周健　　审稿：李红军　　审定：机械与自动控制学院教学委员会

制（修）订时间：2021年05月21日