Appendix B1

# MODULE HANDBOOK OF PROCESS EQUIPMENT AND CONTROL ENGINEERING PROGRAM

# Contents

***Note: the contents with mark (**) are the key points, the contents with mark (*) must be mastered and the contents without mark are the points required to be understood.***

# Mathematics, Physics and Chemistry

## Calculus(1)

| | |
|---|---|
| Competence field | Mathematics, Physics and Chemistry |
| Module designation | Calculus (1) |
| Code, if applicable | 22000210 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 1st semesters |
| Person responsible for the module | Professor ZHANG Weiguo |
| Lecturer | Professor JIA Gao<br>Professor YUAN Sanling<br>Associate Professor YU Zhixian<br>Associate Professor LIU Xiaojun<br>Associate Professor WEI Gongming<br>Lecturer ZHANG Tiansi<br>Lecturer LIU Ling etc. |
| Language | Chinese |
| Relation to curriculum | Fundamental course for students related to science and engineering majors. Calculus (1) and Calculus (2) forming complete Calculus course. Calculus is a deductive science and a branch of pure mathematics. At the same time, it has strong roots in physical problem and it derives a strong theoretical development with sound training in technique. Thus, as a basic course for university students majored in engineering related, it provides an important foundation for the subsequent mathematics, physics and professional courses, and provides the necessary mathematical tools for the Innovation and Entrepreneurship Project Training, Bachelor Thesis. |
| Type of teaching, contact hours | Target students: students of science and engineering programs related<br>Type of teaching: Most of the time is for lectures, and some time is for classroom discussions<br>Contact hours: 96 hours<br>Of which,<br>Theoretical teaching: 96 hours<br>Experiment / practice teaching: 0 hour<br>Computer practice: 0 hour |

| | |
|---|---|
| | Size of class: 60-90 students |
| Workload | Workload = 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points(ECTS) | 6.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | None |
| Module objectives/intended learning outcomes | Module objectives:<br>● **Knowledge:** This course aims to introduce a fundamental knowledge of Calculus. It mainly includes function and limit, derivatives and differentials, mean value theorem and its applications, indefinite integral, definite integral, application of definite integral, introduction to differential equations.<br>● **Skills:** Understand the theory and methods of derivative and integral for functions of several variables. Skillfully compute partial derivatives and multiple integrals.<br>● **Competences:** Providing students with an in-depth applied mathematics training in their capability of both analyzing and solving problems in the field. This course will also provide the foundation for students' studies in other following course to apply the theory to and skills to practice, e.g. problems in geometry and physics. |
| Content | **Part A. Theoretical teaching (96 contact hours, 84 self-study hours)**<br>**Calculus (1)**<br>**Chapter 1**. Functions and Limits (12 contact hours and 12 self-study hours)<br>● Understand the definition of a function; *<br>● Establish a simple practical model with functional relationship;*<br>● Understand the definition of a limit and master rules for working with limits; *<br>● Use properties of infinitesimal to calculate the limit;<br>● Understand the concept of the continuity function;*<br>● Grasp clearly rules and properties of continuous functions on closed interval. **<br>**Chapter 2**. Derivatives and Differentials (14 contact |

| | |
|---|---|
| | hours and 12 self-study hours)<br>● Deeply understand definition of derivative at a point and derivative functions;**<br>● Understand geometric significance of derivatives ;*<br>● Skillfully grasp rules for derivatives, higher-order derivatives, and derivatives of functions defined by parametric functions and implicit functions;**<br>● Understand the concept of differential for a function.*<br>**Chapter 3**. Mean Value Theorem and Its Applications (14 contact hours and 12 self-study hours)<br>● Grasp Rolle's theorem, Lagrange's mean value theorem and Cauchy's mean value theorem; **<br>● Be familiar with applications of L'Hospital's rule;*<br>● Clear the monotonicity and concavity of curves and points of inflection;*<br>● Sketch the graph of functions;*<br>● Be able to find extremum, maximum and minimum, and their applications.*<br>**Chapter 4**. Indefinite Integrals (14 contact hours and 12 self-study hours)<br>● Understand the concept of indefinite integral and its properties; *<br>● Skillfully grasp integration by substitution and some basic integral formula;**<br>● Skillfully master integration by parts;**<br>● Be able to calculate integrations of Trigonometric functions and Rational functions.*<br>**Chapter 5**. Definite Integrals (14 contact hours and 12 self-study hours)<br>● Understand the definition of definite integral, its properties and the fundamental theorem, some geometric explanatory remarks;**<br>● Be familiar with the Newtonian - Leibniz formula; *<br>● Skillfully Master integration by substitution and integration by parts;**<br>● Calculate two kinds of improper integral.*<br>**Chapter 6**. Geometric and Physical Application of Definite Integral. (14 contact hours and 12 self-study hours)<br>● Apply the definite integrals to calculate Areas of more complicated plane regions, Volume, the arc length of curves and Area in terms of polar |

| | |
|---|---|
| | coordinates; **<br>● Be able to calculate Work, Pressure and Gravity by using definite integral.<br>**Chapter 7**. Introduction to Differential Equations (14 contact hours and 12 self-study hours)<br>● Understand the basic concept of differential equations;*<br>● Be able to find complete solutions and the particular solution for some special differential equations;*<br>● Be able to formulate and solve differential equations according to some geometrical and various physical problems.*<br>**Part B. Experiment / practice teaching: 0 hour.** |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class. Usual performance accounts for 30%, consisted of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 70%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] Higher mathematics2, Department of mathematics, Tongji University, higher education press, sixth edition, 2007.<br>2. Reference books<br>[1] Guidance to higher mathematics, laboratory of higher mathematics, University of Shanghai for Science and Technology, 2005. |

## Calculus(2)

| | |
|---|---|
| Competence field | Mathematics, Physics and Chemistry |
| Module designation | Calculus (2) |
| Code, if applicable | 22000220 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 2nd semesters |
| Person responsible for the module | Professor ZHANG Weiguo |
| Lecturer | Professor JIA Gao<br>Professor YUAN Sanling<br>Associate Professor YU Zhixian<br>Associate Professor LIU Xiaojun<br>Associate Professor WEI Gongming<br>Lecturer ZHANG Tiansi<br>Lecturer LIU Ling etc. |
| Language | Chinese |
| Relation to curriculum | Fundamental course for students related to science and engineering majors. Calculus (1) and Calculus (2) forming complete Calculus course. Calculus is a deductive science and a branch of pure mathematics. At the same time, it has strong roots in physical problem and it derives a strong theoretical development with sound training in technique. Thus, as a basic course for university students majored in engineering related, it provides an important foundation for the subsequent mathematics, physics and professional courses, and provides the necessary mathematical tools for the Innovation and Entrepreneurship Project Training, Bachelor Thesis. |
| Type of teaching, contact hours | Target students: students of science and engineering majors related<br>Type of teaching: Most of the time is for lectures, and some time is for classroom discussions<br>Contact hours: 96 hours<br>Of which,<br>Theoretical teaching: 96 hours<br>Experiment / practice teaching: 0 hour<br>Computer practice: 0 hour<br>Size of class: 60-90 students |
| Workload | Workload = 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points(ECTS) | 6.0 |
| Requirements according to the | Students with class attendance rate over 2/3 and |

| | |
|---|---|
| examination regulations | assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | None |
| Module objectives/intended learning outcomes | Module objectives:<br>● **Knowledge:** This course aims to introduce a fundamental knowledge of Calculus. It mainly includes function and limit, derivatives and differentials, mean value theorem and its applications, indefinite integral, definite integral, application of definite integral, introduction to differential equations.<br>● **Skills:** Understand the theory and methods of derivative and integral for functions of several variables. Skillfully compute partial derivatives and multiple integrals.<br>● **Competences:** Providing students with an in-depth applied mathematics training in their capability of both analyzing and solving problems in the field. This course will also provide the foundation for students' studies in other following course to apply the theory to and skills to practice, e.g. problems in geometry and physics. |
| Content | **Part A. Theoretical teaching (96 contact hours, 84 self-study hours)**<br>**Chapter 8**. Space Analytic Geometry and Vector Algebra (24 contact hours and 21 self-study hours)<br>● Definition of vector; *<br>● Scalar and vector product; *<br>● Surface and its equation; *<br>● Line and its equation; **<br>● Plane and its equation. **<br>**Chapter 9**. Derivatives of Functions of Several Variables and Applications (24 contact hours and 21 self-study hours)<br>● Definition of function of several variables; *<br>● Partial derivatives; **<br>● The differentials of functions; **<br>● The chain rule for compound functions; **<br>● Partial derivative of implicit functions; **<br>● Directional derivatives and gradients; **<br>● Maximum and minimum: the method of Lagrange multiplier.*<br>**Chapter 10**. Multiple Integrals (24contact hours and 21 |

| | |
|---|---|
| | self-study hours)<br>● Double integrals. **<br>● Definition and properties; *<br>● Computation: right angled and polar coordinates.**<br>● Triple integrals. Definition and properties; *<br>● Computation: right angled, cylindrical and spherical surface coordinates.**<br>● Applications: geometry and physics.<br>**Chapter 11**. Curve Integrals and Surface Integrals<br>(24contact hours and 21 self-study hours)<br>● Curve integral for arc length; *<br>● Curve integral for coordinates; *<br>● Green's formula and applications; **<br>● Surface integral for area; **<br>● Surface integral for coordinate; **<br>● Gauss's formula: applications to geometry and physics.*<br>**Part B. Experiment / practice teaching: 0 hour.** |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class. Usual performance accounts for 30%, consisted of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 70%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] Higher mathematics2, Department of mathematics, Tongji University, higher education press, sixth edition, 2007.<br>2. Reference books<br>[1] Guidance to higher mathematics, laboratory of higher mathematics, University of Shanghai for Science and Technology, 2005. |

## Linear Algebra

| | |
|---|---|
| Competence field | Mathematics, Physics and Chemistry |
| Module designation | Linear Algebra |
| Code, if applicable | 2200621 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 2nd semester |
| Person responsible for the module | Professor LIU Xiping |
| Lecturer | Professor LIU Xiping<br>Associate Professor HE Changxiang<br>Associate Professor FAN Hongfu<br>Lecturer Dr. HU Jianhua<br>Lecturer Dr. WEI Lianxin<br>Lecturer Dr. WU Baofeng |
| Language | Chinese |
| Relation to curriculum | Linear Algebra is an important branch of Mathematics which mainly study the vectors, vector spaces (or linear spaces), linear equations and linear transformations. The theory of the vector spaces is an important subject of modern Mathematics. Through the analytic geometry, Linear Algebra isdescribed concretely and specifically. Therefore, Linear Algebra is widely used in abstract algebras, functional analysis and computational Mathematics. Its theory is generalized into operator theory. For the nonlinear model in scientific research can usually be approximated by a linear model, the Linear Algebra is widely used in natural science and social science. As a common fundamental course of engineering, the theory of Linear Algebra helps students train the ability to solve problems and improve the ability of logical thinking and reasoning ability. It is necessary for the subsequent courses and the related professional courses for students of engineering. |
| Type of teaching, contact hours | Target students: students of engineering and related programs<br>Type of teaching: Most of the time is for lectures, and some time is for classroom discussions<br>Contact hours: 32 hours<br>Of which,<br>Theoretical teaching:32 hours<br>Experiment / practice teaching: 0 hour<br>Computer practice: 0 hour |

| | |
|---|---|
| | Size of class: 40-60 students |
| Workload | Workload = 60 hours<br>Contact hours = 32 hours<br>Self-study hours = 28 hours |
| Credit points | 2.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | None |
| Module objectives/ intended learning outcomes<br>/ | Module objectives:<br>Linear algebra is a common fundamental course of engineering. It is widely used in modern mathematics. It plays an important role in the related subjects.<br>● **Knowledge:** The theory of linear algebras mainly includes the theory of matrices, determinant, system of linear equations, vector spaces, eigenvalues and eigenvectors, quadric forms.<br>● **Skills:** Through learning the course, students are able to understand the definition and properties of determinant and calculate the determinant; master the operations between matrices; be familiar with some special matrices, such as diagonal matrices, symmetrical matrices, antisymmetric matrices, invertible matrices, orthogonal matrices, positively definite matrices; understand the linear dependence and linear independence of vectors; master the structure of all the solutions of linear equations and find all solutions of system of linear equations; computing eigenvalues and eigenvectors of square matrices; master the method of diagonalization of matrices; give the normal orthogonal basis in n-dimensional linear space; familiar with quadric forms and their representations by matrices; transform the quadratic forms to their standard forms.<br>● **Competences:** On successful learning of this course, students will master the basic theory and method of linear algebra, and improve the abilities to solve the practical problems. |
| Content | **Part A. Theoretical teaching (32 contact hours, 28 self-study hours)**<br>**Chapter 1:** Determinant (6 contact hours and 6 self-study hours)<br>● The concept of determinant; *<br>● The properties of determinant; ** |

| | |
|---|---|
| | ● The expansion of determinant; **<br>● Cramer theorem.<br>**Chapter 2:** Matrices and Their Operations (6 contact hours and 5 self-study hours)<br>● The concept of matrices;<br>● Matrices and their operations; **<br>● Inverse of matrices;**<br>● Elementary matrices and the elementary transformation of matrices;<br>● The rank of matrices; **<br>● Block matrices.<br>**Chapter 3:** N-dimensional Vector (8 contact hours and 6 self-study hours)<br>● N-dimensional vector and their operations;*<br>● Vector groups and their linear dependence; **<br>● The rank of the vector groups;**<br>● The concept of vector space;<br>● The inner product of the vector space $R^n$ and the standard orthogonal basis of the vector space $R^n$ ; *<br>**Chapter 4:** System of Linear Equations (4 contact hours and 3 self-study hours)<br>● Method of the elimination to solve the linear equations;<br>● The structure of the solutions of homogeneous linear equations; **<br>● The structure of the solutions of non-homogeneous linear equations. **<br>**Chapter 5:** Eigenvalues and Eigenvectors of Matrices (4 contact hours and 4 self-study hours)<br>● Eigenvalues and eigenvectors of matrices n;**<br>● Similar matrices; *<br>● Diagonalization of symmetric real matrices;*<br>**Chapter 6:** Quadratic Form (4 contact hours and 4 self-study hours)<br>● Quadratic form and its matrix; Congruence of matrices;<br>● The standard form of quadratic form; **<br>● Law of inertia and positively definite matrices .**<br>**Part B. Experiment / practice teaching: 0 hour.** |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 30%, consisted of assignments, attendance and discussion after class; final |

| | |
|---|---|
| | exam (closed book written examination) accounts for 70%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] Liu Xiping, Cao Weili and Yu Zhengsheng, *Linear algebras*, Science Press, 2013.9<br>2. Reference books<br>[1] Department of Applied Mathematics of Usst, *Learning guidance of Linear Algebras*, Science Press, 2014.2<br>[2] Cao Weili etc, *Linear Algebras*, Hunan Science and Technology Press,2010.1<br>[3] Department of mathematics of Tongji University, *Linear Algebras*, High education press, 2007.5 |

## Probability Theory and Mathematical Statistics

| | |
|---|---|
| Competence field | Mathematics, Physics and Chemistry |
| Module designation | Probability Theory and Mathematical Statistics |
| Code, if applicable | 22000172 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 3rd semester |
| Person responsible for the module | Professor LIU Xiping |
| Lecturer | Associate Professor: ZHANG HaiQiang<br>Associate Professor: FAN Hongfu<br>Associate Professor: CAO Weili<br>Associate Professor: HE Changxiang<br>etc. |
| Language | Chinese |
| Relation to curriculum | The goal of the course is to extend students' knowledge of probability and statistical methods from the bachelor branch and to provide theoretical background for studying and applying advanced statistical methods. Probability Theory and Mathematical Statistics is the required course for Engineering program. The emphasis of this course is on basic probability and distribution theory, which are the foundation of mathematical statistics. This course provides an excellent preparation for undergraduate students who are preparing for study in statistically based areas such as engineering experiments, psychometrics, or biostatistics. |
| Type of teaching, contact hours | Target students: sophomores of science and engineering and related programs<br>Type of teaching: Most of the time is for lectures, and some time is for classroom discussions<br>Contact hours: 48 hours<br>Experiment / practice teaching: 0 hour<br>Computer practice: 0 hour<br>Size of class: 40-60 students |
| Workload | Workload = 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam.<br>Final examination : written examination |
| Recommended prerequisites | Calculus and Linear Algebra |
| Module objectives/intended learning | Module objectives: |

| | |
|---|---|
| outcomes | A prime objective of the course sequence is to present techniques and basic results of probability and mathematical statistics at a rigorous and advanced calculus level. To develop the probabilistic tools and language of mathematical statistics, this course describes probabilistic models for and properties of random variables and vectors, moments and common probability distributions. The theory of estimation, confidence sets and hypothesis testing for common parametric models are investigated.<br>● Knowledge: Understand the axiomatic approach to probability, counting and combinatorial methods, and Bayes' Theorem. Understand random variables and their properties, including marginal and conditional distributions, expectation, conditional expectation, covariance and correlation, moment generating functions, and distributions of functions of one or more random variables. Recognize and learn the properties of important probability distributions.<br>● Skills: Gain the ability to prove results in probability. Use statistical software to simulate random phenomena and to carry out probability computations for standard distributions.<br>● Competences: Upon successful completion of this course, students will be able to study, correctly apply and interpret different statistical multivariate methods, which can be helpful to solve related problems in subsequent professional courses and projects. |
| Content | **Part A. Theoretical teaching (48 contact hours; 42 self-study hours)**<br>**Chapter 1**: Random Events and Probability (6 contact hours and 5 self-study hours)<br>Outline: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence, problems.<br>● Introduction to probability;<br>● Conditional probability;*<br>● Independence of random events;*<br>**Chapter 2**: Random Variables and Distribution (8 contact hours and 6 self-study hours)<br>Outline:<br>Discrete and continuous random variables, probability mass, probability density and cumulative distribution |

| | |
|---|---|
| | functions, Special distributions: Discrete uniform, binomial, geometric, Poisson, continuous uniform, exponential, gamma, normal<br>● Introduction to random variables and distributions;*<br>● Discrete random variables;*<br>● Continuous random variables;*<br>● Distribution of random variables function;**<br>**Chapter 3:** Expectation and Variance (4 contact hours and 4 self-study hours)<br>Outline: mathematical expectation and variance, median and quantiles.<br>● Expectation and variance;**<br>● Median and quantiles;**<br>**Chapter 4:** Multi-dimensional Random Variables and Distribution (8 contact hours and 8 self-study hours)<br>Outline: Joint, marginal and conditional distributions, product moments, independence of random variables, bivariate normal distribution, problems. Multi-dimensional random variables and joint and marginal.<br>● Distributions: Sections;*<br>● Conditional distributions;*<br>● Independence of random variables;*<br>● Distribution of multi-dimensional random variables;*<br>● Bivariate expectation and variance;*<br>● Moment, covariable and correlation coefficient;*<br>**Chapter 5:** Law of Large Numbers and Central Limit Theorem (6 contact hours and 5 self-study hours)<br>Outline: Chebyshev's inequality, Law of large numbers the central limit theorem, problems.<br>● Chebyshev's inequality;*<br>● Law of large numbers;**<br>● Central Limit Theorem;*<br>**Chapter 6:** Basic Conceptions of Statistics (4 contact hours and 4 self-study hours)<br>Outline: distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems.<br>● Basic conceptions of statistics;**<br>● Sample variance and sample distributions;**<br>**Chapter 7**: Estimation Problems (6 contact hours and 5 self-study hours)<br>Outline: Unbiasedness, consistency, the method of moments and the method of maximum likelihood |

| | |
|---|---|
| | estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions, problems.<br>● The method of point estimation problems;*<br>● The evalution criterion of point estimation;**<br>● Confidence intervals;**<br>**Chapter 8**: Testing Hypothesis (6 contact hours and 5 self-study hours)<br>Outline: Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Neyman-Pearson Fundamental Lemma, tests for one sample and two sample problems for normal populations, tests for proportions, problems.<br>● Basic conceptions of testing hypothesis;*<br>● Testing hypothesis of expectation of normal populations;**<br>● Testing hypothesis of variance of normal populations;*<br>**Part B. Experiment / practice teaching(0 hour).** |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 30%, consisted of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 70%. |
| Media employed | Beamer and board/whiteboard, electronic scripts, ppt projection, computer practising center, and working documents |
| Reading list | 1. Recommended book<br>[1] Ci-Nan Ye and Xi-Ping Liu, Probability Theory and Mathematical Statistics, Science Press, 2010.<br>[2] Office of Engineering Mathematics, USST, The study guide to probability theory and mathematical statistics.<br>[3] Zhou Sheng, Shi-Qian Xian and Cheng-Yi Pan Probability Theory and Mathematical Statistics, Zhejiang University Press, 2008.<br>2. Reference books<br>[1] Shu-Yuan He, Probability Theory and Mathematical Statistics, Higher Education Press, 2006. |

## College Chemistry

| | |
|---|---|
| Competence field | Mathematics, Physics and Chemistry |
| Module designation | College Chemistry |
| Code, if applicable | 22000761 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 1st semester |
| Person responsible for the module | Professor CHANG Haizhou |
| Lecturer | Associate Professor Dr. MA Jie<br>Associate Professor Dr. OUYANG Ruizhuo<br>Lecturer Dr. GU Yingying<br>Lecturer Dr. QU Song<br>Lecturer Dr. JI Yajun<br>Lecturer Dr. AN Yarui<br>Lecturer Dr. GUO Ning<br>Lecturer LI Jing<br>Lecturer ZHAO Yuefeng<br>Lecturer JIA Chengzheng<br>Lecturer YU Zhihao |
| Language | Chinese |
| Relation to curriculum | College Chemistry is a compulsory basic course for undergraduates of science and engineering majors. It mainly introduces the basic principles of chemistry and the skills of chemistry. The course mainly includes aggregation state, dispersion system, and basic law of chemical reaction, four major equilibria and related analytical methods in aqueous solution, material structure, element compound and instrumental analysis method. Experiments in this course can develop students' skills including inquiry, abstract and logical thinking and critical analysis of the scientific issues. The understanding of basic principles and skills of chemistry can lay the foundation for the study of further professional courses. |
| Type of teaching, contact hours | Target students: students of science and engineering majors related.<br>Type of teaching: theoretical teaching, experiment teaching<br>Contact hours: 96 hours<br>Of which,<br>Theoretical teaching: 76 hours<br>Experiment / practice teaching: 20 hour<br>Computer practice: 0 hour<br>Size of class: 60-100 students |
| Workload | Workload = 180 hours |

| | |
|---|---|
| | Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 and performing required experiments are allowed to take the exam. |
| Recommended prerequisites | None. |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>● **Knowledge:** Understand basic principles of chemistry with emphasis on thermodynamics, kinetics, equilibria, bonding, and electrochemistry. A brief introduction to inorganic, organic and polymer chemistry.<br>● **Skills:** Display mastery of those concepts of chemistry needed to succeed in chemistry-based courses, corresponding skills of solving problems. Master basic measurement skills in chemistry experiments.<br>● **Competences:** Have a perspective of the scope of modern chemistry and its implications for society. Develop students' ability of inquiry, abstract and logical thinking and critical analysis of scientific issues. |
| Content | **Part A. Theoretical teaching (76 contact hours, 68 self-study hours)**<br>Chapter 1: Thermochemistry (12 contact hours and 10 self-study hours)<br>● Concepts of thermochemistry;<br>● The First Law of Thermodynamics;**<br>● The concept of enthalpy;*<br>● Standard enthalpies of formation;*<br>● Evaluating enthalpy and entropy changes;*<br>● Fuels, sources of energy and the utilizations.<br>Chapter 2: Principles of Chemical Reactions (12 contact hours and 12 self-study hours)<br>● The concept of entropy;*<br>● Evaluating enthalpy and entropy changes;**<br>● The Second Law of Thermodynamics;**<br>● Standard free energy change;*<br>● Chemical equilibrium;**<br>● The rate of a chemical reaction;*<br>● Environmental chemistry and green chemistry.<br>Chapter 3: Solutions and Their Properties (12 contact hours and 10 self-study hours) |

| | |
|---|---|
| | ● Types of solutions and solution concentration;*<br>● Freezing-point depression, boiling point elevation and osmotic pressure of solutions;*<br>● Theories of acids and bases;*<br>● Ionization equilibrium;*<br>● Buffer and pH control;**<br>● Precipitation and Dissolution Equilibrium;**<br>● Water purification and wastewater treatment.*<br>Chapter 4: Electrochemistry (12 contact hours and 10 self-study hours)<br>● Galvanic cell;*<br>● Ecell, ΔGo, and Keq;*<br>● Standard electrode potentials;**<br>● Ecell as a function of concentrations;*<br>● Batteries: producing electricity through chemical reactions;*<br>● Electrolysis: causing nonspontaneous reactions to occur;*<br>● Corrosion and the protections.*<br>Chapter 5: Atomic, Molecular and Crystal Structures (12 contact hours and 10 self-study hours)<br>● Atomic structure;**<br>● The Periodic Law and the Periodic Table;**<br>● Periodic properties of the elements;**<br>● Chemical bonding;*<br>● Molecular orbitals;*<br>● The crystalline solid state.*<br>Chapter 6: Inorganic Chemistry (8 contact hours and 8 self-study hours)<br>● Properties of oxides and halides;*<br>● Coordination compounds;*<br>● Inorganic materials: alloy and inorganic nonmetallic materials.*<br>Chapter 7: Organic Chemistry (8 contact hours and 8 self-study hours)<br>● Organic compounds and structures: an overview;<br>● Polymerization reactions;**<br>● Structures and properties of polymer;**<br>● Applications and molecular design.*<br>**Part B. Experiment / practice teaching (20 contact hours and 16 self-study hours)**<br>1) Determination of acetic acid dissociation constant (4 contact hours and 4 self-study hours)* |

| | |
|---|---|
| | 2) Electrogalvanization (4 contact hours and 2 self-study hours)*<br>3) Determination of iron content by spectrophotometry (4 contact hours and 4 self-study hours)**<br>4) Determination of water quality by chemical analysis (4 contact hours and 2 self-study hours)**<br>5) Iodine clock reaction- Hydrogen peroxide variation (4contact hours and 4 self-study hours)* |
| Study and examination requirements and forms of examination | Final score includes: usual performance (20%); experiment (10%), final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate, and computer practice<br>Experiment score includes: experiment report (50%); and experiment exam (50%) |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] XU Duanjun etc., General Chemistry (6th edition), Higher Education Press, 2012<br>[2] ZHOU Shilin etc., Experiments in General Chemistry, Science Press, 2013<br>2. Reference books<br>[1] Ralfh H. Petrucci etc., General Chemistry: Principles and Modern Applications (10th edition), Prentice Hall, 2010<br>[2] HUA Tongwen etc., Principles of General Chemistry, Peking University Press, 2013<br>[3] ZHOU Xuguang etc., General Chemistry, Tsinghua University Press, 2011 |

## College Physics (1)

| | |
|---|---|
| Competence field | Mathematics, Physics and Chemistry |
| Module designation | College Physics (1) |
| Code, if applicable | 20000050 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 2nd semester |
| Person responsible for the module | Professor GU Zhengtian |
| Lecturer | Associate Professor CHEN Jun<br>Associate Professor Dr. TONG Yuanwei<br>Associate Professor Dr. YAO Lanfang<br>Associate Professor WANG Lijun<br>Lecturer MA Shanshan<br>Lecturer YAN Feinan<br>Lecturer Dr. LIU Yuan<br>Lecturer HUANGFU Quansheng<br>Lecturer LIANG Liping<br>Lecturer NI Weixin<br>Lecturer XU Chunyan<br>Lecturer Dr. LI Yuqiong<br>Lecturer Dr. DING Yaqiong<br>Experimentalist ZHOU Qun<br>Experimentalist Tang Meng<br>Experimentalist Ma Shanshan<br>Experimentalist Cai Xiongxiang<br>Experimentalist Guo Li |
| Language | Chinese |
| Relation to curriculum | Fundamental course for engineering major students. College Physics (1) and College Physics (2) forming complete College Physics course. Physics is a science to research the basic structure and the interaction between matters. It also investigates the most basic and most common form of movement and their mutual transformations. The research strategy of physics is the foundation of natural science and engineering technology. |
| Type of teaching, contact hours | Target students: students of science and engineering related programs<br>Type of teaching: theoretical teaching, experiment teaching<br>Contact hours: 80 hours<br>Of which,<br>Theoretical teaching: 64 hours<br>Experiment / practice teaching: 16 hours<br>Computer practice: 0 hour |

| | |
|---|---|
| | Size of class: 60-90 students |
| Workload | Workload = 150 hours<br>Contact hours = 80 hours<br>Self-study hours = 70 hours |
| Credit points | 5.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 and performing required experiments are allowed to take the exam. |
| Recommended prerequisites | Calculus |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>With emphasis on College Physics course, students will be familiar with basic ideas of physics methods, students will gain a professional and improved ability to analyze and solve physical problems.<br>On successful learning of this course module, the student should be able to demonstrate the following learning outcomes:<br>● **Knowledge:** students are required to master the basic concepts and principles in mechanics, thermophysics and electrostatics.<br>● **Skills:** Acquire the ability of abstract thinking. Improve self-study ability. Acquire the ability to analyze and solve problems. Capable of computing and judging. Use mathematical tools to solve general problems in physics, calculation and estimation are included.<br>● **Competences:** Analyze engineering problems from a viewpoint of physics, and solve problems using knowledge and skills mentioned above. |
| Content | **Part A. Theoretical teaching (64 contact hours; 58 self-study hours)**<br>Part One Mechanics<br>**Chapter 1:** Kinematics (6 contact hours and 6 self-study hours)<br>● Frame of reference, particle *<br>● Position vector and displacement, velocity and acceleration **<br>● Circular motion, relative motion *<br>**Chapter 2:** Newton's Law of Motion (4 contact hours and 4 self-study hours)<br>● Newton's law, force, inertial reference frame *<br>● General properties of forces in mechanics<br>● Fundamental forces in nature, units and dimensions * |

| | |
|---|---|
| | ● Application of Newton's law of motion**<br>**Chapter 3:** Momentum and Angular Momentum (6 contact hours and 6 self-study hours)<br>● Momentum, impulse, momentum theorem*<br>● Conservation of momentum**<br>● Collision<br>● Angular momentum of a particle and conservation of angular momentum**<br>**Chapter 4:** Work and Energy (4 contact hours and 4 self-study hours)<br>● Work<br>● Kinetic energy and law of kinetic energy**<br>● Conservative force and potential energy**<br>● Conservation of mechanical energy**<br>● Conservation of energy<br>**Chapter 5:** Rotation of A Rigid Body (8 contact hours and 8 self-study hours)<br>● Motion of rigid body<br>● Torque, law of rotation, rotational inertia*<br>● Application of the law of rotation **<br>● Kinetic energy and work in rotational motion *<br>● Angular momentum of a rigid body, conservation of angular momentum in rotation*<br>**Chapter 6:** Fundamentals of Special Relativity (8 contact hours and 6 self-study hours)<br>● The relativity postulate in mechanics<br>● The postulates of special relativity, Lorentz transformation**<br>● Some consequences of the Lorentz transformation**<br>● The Lorentz transformation of velocities *<br>● The relativistic dynamic theory<br>Part Two Thermodynamics<br>**Chapter 7:** The Kinetic Theory of Gases (6 contact hours and 6 self-study hours)<br>● Essential concept of the kinetic theory of gases *<br>● State parameters, equilibrium state, ideal gas law *<br>● Representation of pressure for ideal gas **<br>● Average translational kinetic energy, temperature**<br>● Equipartition theory of energy, internal energy*<br>● Maxwell speed distribution**<br>● Mean free path and average collision rate Boltzmann distribution<br>**Chapter 8:** Fundamentals of Thermodynamics (6 contact |

| | |
|---|---|
| | hours and 6 self-study hours)<br>● Internal energy, heat and work *<br>● The first law of thermodynamics**<br>● Application of the first law of thermodynamics**<br>● The heat capacities of an ideal gas*<br>● Application of the first law to adiabatic processes**<br>● Cyclical processes, thermal efficiency, Carnot cycle, reverse cycle *<br>● The second law of thermodynamics**<br>● Reversible and irreversible process<br>● Statistical meaning of the second law<br>● Entropy<br>Part Three Electromagnetic theory<br>**Chapter 9:** Electrostatic Field in Vacuum (8 contact hours and 6 self-study hours)<br>● Electric charges, Coulomb's law*<br>● Electric field, electric field line and flux**<br>● Gauss' law**<br>● Electric potential**<br>● Equipotential surface and potential gradient*<br>**Chapter 10:** Conductors and Dielectrics in Electrostatic Field (8 contact hours and 6 self-study hours)<br>● Elecrostatic induction**<br>● Capacitance and dielectrics*<br>● Gauss' law in dielectric, electric displacement*<br>● Energy in electric field*<br>**Part B. Experiment / practice teaching (16 contact hours and 12 self-study hours)**<br>● Methods and steps to produce basic knowledge of physical experiment (2 contact hours and 2 self-study hours); **<br>● The use and principle of oscilloscope. Guide students to master frequency measurement by the pattern of Li Saru and to learn how to use the oscilloscope measurement signals with the same frequency phase difference (2 contact hours and 2 self-study hours); **<br>● The adjustment and the use of Michelson Interferometer. Guide students to Understand the basic structure, the principle of optics Michelson interferometer, learn adjustment method (2 contact hours and 2 self-study hours); **<br>● Double bridge measuring low resistance. Guide students to understand the significance and principle |

| | |
|---|---|
| | of low resistance measurement method of double bridge four end of the lead wire, learn to use the double bridge measuring low resistance, resistivity and calculate the conductor (2 contact hours and 2 self-study hours); *<br>● Torsion pendulum method measuring moment of inertia. Guide students to determine moment of inertia and torsional spring constant of the object, verify the parallel axis theorem (2 contact hours and 2 self-study hours); *<br>● Light intensity distribution and width measurement of single slit diffraction. Guide students to observe single slit diffraction phenomena, to deepen the understanding of the diffraction theory, measure using photoelectric element, master its distribution law (2 contact hours and 2 self-study hours); *<br>● Franck Hertz experiment. Guide students to learn the principle and method of knowing Franck - Hertz experiment, verify the existence of atomic energy level, the first excitation potential and determination of argon atoms, understand the method of computer data acquisition, data processing (2 contact hours and 2 self-study hours);<br>● Adjustment of the spectrometer. Guide students to understand the structure of spectrometer, learn to adjust the spectrometer and use the spectrometer to angle measuring accuracy (2 contact hours);<br>● Optical lever measuring linear expansion coefficient of metal. Guide students to measure linear expansion coefficient of metal tube, study the application of light lever to measure the length of tiny change (2 contact hours). |
| Study and examination requirements and forms of examination | Final score includes: usual performance (20%); experiment (10%), final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate, and computer practice<br>Experiment score includes: experiment report (50%); and experiment exam (50%) |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] Cheng Shouzhu, Jiang Zhiyong, General Physics, |

| | |
|---|---|
| | Higher Education Press ,2006.12(sixth edition)<br>[2] WANG Xiaoping, College Physics Experiment (1st edision), Machinery Industry Press,2009<br>2. Reference books<br>[1] Zhang Sanhui, College Physics, Tsinghua University Press,1999 (second edition)<br>[2] Ma Wenwei, Physics, Higher Education Press, 2006 (fifth edition)<br>[3] Gu Zhengtian, Chen Jun, College Physics Synchronous Tutorship Review and Self-testing, China Machine Press, 2009<br>[4] Francis W.Sears, Mark W.Zemansky, College Physics, Addison-Wesley Publishing Company, 1991 |

## College Physics (2)

| | |
|---|---|
| Competence field | Mathematics, Physics and Chemistry |
| Module designation | College Physics (2) |
| Code, if applicable | 20000060 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 3rd semester |
| Person responsible for the module | Professor GU Zhengtian |
| Lecturer | Associate Professor CHEN Jun<br>Associate Professor Dr. TONG Yuanwei<br>Associate Professor Dr. YAO Lanfang<br>Associate Professor WANG Lijun<br>Lecturer YAN Feinan<br>Lecturer Dr. LIU Yuan<br>Lecturer HUANGFU Quansheng<br>Lecturer LIANG Liping<br>Lecturer NI Weixin<br>Lecturer XU Chunyan<br>Lecturer Dr. LI Yuqiong<br>Lecturer Dr. DING Yaqiong<br>Experimentalist ZHOU Qun<br>Experimentalist Tang Meng<br>Experimentalist Ma Shanshan<br>Experimentalist Cai Xiongxiang<br>Experimentalist Guo Li |
| Language | Chinese |
| Relation to curriculum | Fundamental course for engineering major students. College Physics (1) and College Physics (2) forming complete College Physics course. Physics is a science to research the basic structure and the interaction between matters. It also investigates the most basic and most common form of movement and their mutual transformations. The research strategy of physics is the foundation of natural science and engineering technology. |
| Type of teaching, contact hours | Target students: students of science and engineering related programs<br>Type of teaching: theoretical teaching, experiment teaching<br>Contact hours: 80 hours<br>Of which,<br>Theoretical teaching: 64 hours<br>Experiment / practice teaching: 16 hours<br>Computer practice: 0 hour<br>Size of class: 60-90 students |

| | |
|---|---|
| Workload | Workload = 150 hours<br>Contact hours = 80 hours<br>Self-study hours = 70 hours |
| Credit points | 5.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 and performing required experiments are allowed to take the exam. |
| Recommended prerequisites | Calculus |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>With emphasis on College Physics course, students will be familiar with basic ideas of physics methods, students will gain a professional and improved ability to analyze and solve physical problems.<br>Intended learning outcomes:<br>On successful learning of this course module, the student should be able to demonstrate the following learning outcomes:<br>● **Knowledge:** students are required to master the basic concepts and principles in magnetism, vibration and waves, wave optics and modern physics.<br>● **Skills:** Acquire the ability of abstract thinking. Improve self-study ability. Acquire the ability to analyze and solve problems. Capable of computing and judging. Use mathematical tools to solve general problems in physics, calculation and estimation are included.<br>● **Competences:** Analyze engineering problems from a viewpoint of physics, and solve problems using knowledge and skills mentioned above. |
| Content | **Part A. Theoretical teaching (64 contact hours and 58 self-study hours)**<br>Part Three Electromagnetic theory<br>**Chapter 11** Magnetic Field of Steady Current (12 contact hours and 12 self-study hours)<br>● Magnetic phenomena, Ampere's pypothesis*<br>● Magnetic field, Gauss'law in magnetic field**<br>● Boit-Savart law and its application**<br>● Ampere's law and its application**<br>● Motion of charged particles in magnetic field*<br>● Magnetic force on current-carrying conductors*<br>● Magnetic torque on a current loop*<br>**Chapter 12** Magnetic Field in Media (4 contact hours and 2 self-study hours) |

| | |
|---|---|
| | ● Classifications of media, magnetic permeability<br>● Micro theory of paramagnetism and diamagnetism<br>● Ampere's law in the magnetic medium and magnetic intensity H*<br>● Ferromagnetism<br>**Chapter 13** Electromagnetic Introduction (8 contact hours and 8 self-study hours)<br>● Nonelectrostatic force, Electromotive force, Faraday's law of induction<br>● Motional electromotive force**<br>● Induced electric field*<br>● Self-induction and mutual-induction*<br>● Energy of the magnetic field**<br>● Displacement current<br>● Maxwell's equation*<br>Part Four Oscillation and waves<br>**Chapter 14** Oscillation (6 contact hours and 6 self-study hours)<br>● Simple harmonic motion (SHM) *<br>● Amplitude, period, frequency, phase<br>● The Energy of SHM**<br>● Damped Vibration and Forced Vibration Resonance<br>● Superposition of two parallel SHM**<br>● Superposition of two perpendicular SHM<br>**Chapter 15** Waves (6 contact hours and 6 self-study hours)<br>● Formation and Propagation of mechanical wave<br>● Wave speed and elasticity of the medium<br>● Wave function of a plane SHW**<br>● Energy, energy flow, wave intensity<br>● Superposition principle of waves, interference of waves, standing waves **<br>● Doppler effect<br>● Properties and energy of electromagnetic waves*<br>Part Five Wave optics<br>**Chapter 16** Interference of Light (6 contact hours and 6 self-study hours)<br>● The coherence of light<br>● Double slit interference**<br>● Optical path and optical path difference<br>● Interference by division of amplitude**<br>● Michelson' interferometer<br>**Chapter 17** Diffraction of Light (6 contact hours and 6 |

| | |
|---|---|
| | self-study hours)<br>● Diffraction of light ,Huygens-Fresnel's principle*<br>● Fraunhofer single slit diffraction **<br>● Diffraction Grating **<br>● Resolving power of optical instrument<br>● X-ray diffraction<br>**Chapter 18** Polarization of Light (4 contact hours and 2 self-study hours)<br>● Nature light and polarized light, polarization of light, Malus law<br>● Polarization by reflection**<br>Part Six Fundamentals of modern physics<br>**Chapter 19** Fundamentals of Quantum Theory (12 contact hours and 10 self-study hours)<br>● Thermal radiation and Plank's theory of radiation<br>● Photoelectric effect and Einstein's quantum theory**<br>● Compton effect*<br>● Atomic spectra, Bohr model of hydrogen atom**<br>● De Broglie's postulate and matter waves **<br>● The uncertainty principle *<br>● The wave function and Schrodinger equation<br>**Part B. Experiment / practice teaching (16 contact hours and 12 self-study hours)**<br>● Capacitance Tests. Guide students to understand the structure, working principle and method of using a ballistic galvanometer，learn to use DQ - 3 digital impulse current measuring capacitance (2 contact hours and 2 self-study hours); **<br>● Optical Fiber Communication. Guide students to Understand the working principle of composition, optical fiber transmission system， learn and be familiar with the test methods of basic properties of photoelectric devices and main characteristics of semiconductor electro-optic ， learn debugging technique of optical fiber transmission system (2 contact hours and 2 self-study hours);**<br>● Hall effect experiment. Guide students to understand the principle of low resistance significance and double bridge measuring four end lead method, learn to use the double bridge measuring low resistance, resistivity and calculate the conductor (2 contact hours and 2 self-study hours);**<br>● The measurement of sound velocity. Guide students to |

| | |
|---|---|
| | measure sound velocity by means of resonance interference, and deepen the relevant resonance, vibration, synthesis, wave interference theory knowledge (2 contact hours and 2 self-study hours); *<br>● Measurement of H atoms Rh with spectrometer. Guide students to learn a precise determination of the optical wavelength method -- grating method, calculate H atom Rydberg constant (2 contact hours and 2 self-study hours); *<br>● Electron Work Function Experiment. Guide students to understand the basic rules of the thermal electron emission, use the Richardson linear method for the determination of electron escape potential of tungsten wire (2 contact hours and 2 self-study hours); *<br>● Millikan Oil-drop Experiment. Guide students to verify of the "quantum of charge", namely the electric quantity is not continuous change, determine charged amount of oil droplets, and calculate the electron charge value (2 contact hours);<br>● Photoemission Experiment. Guide students to understand the basic rules of the photoelectric effect, deepen the understanding of Einstein's theory of the photoelectron, verify the Einstein equation, measure Planck constant using photoelectric effect method (2 contact hours); |
| Study and examination requirements and forms of examination | Final score includes: usual performance (20%); experiment (10%), final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate, and computer practice<br>Experiment score includes: experiment report (50%); and experiment exam (50%) |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] Cheng Shouzhu, Jiang Zhiyong, General Physics, Higher Education Press ,2006.12 (sixth edition)<br>[2] WANG Xiaoping, College Physics Experiment (1st edition), Machinery Industry Press,2009<br>2. Reference books<br>[3] Zhang Sanhui, College Physics, Tsinghua University Press,1999.4 (second edition)<br>[4] Ma Wenwei, Physics, Higher Education Press, |

| | |
|---|---|
| | 2006.1(fifth edition)<br>[5] Gu Zhengtian, Chen Jun, College Physics Synchronous Tutorship Review and Self-testing, China Machine Press, 2009<br>[6] Francis W.Sears, Mark W.Zemansky, College Physics, Addison-Wesley Publishing Company, 1991<br>[7] HAO Bangyuan, College Physics Experiment (1st edition), Southwest Jiao Tong University press,2010<br>[8] LIU Jingwang, College Physics Experiment (2nd edition), Water conservancy and Hydropower Press, 2010<br>[9] Pisin Chen, Recent Advances and Cross-Century Outlooks in Physics: Interplay Between Theory and Experiment (1st edition), National University of Defense Technology press, 2000 |

# Informatics

## Information Technology

| | |
|---|---|
| Competence field | Informatics |
| Module designation | Information Technology |
| Code, if applicable | 12002970 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 1st semester |
| Person responsible for the module | Associate Professor XIA Yun |
| Lecturer | Associate Professor XIA Yun<br>Associate Professor ZANG Jinsong,<br>Lecturer HUANG Chunmei |
| Language | Chinese |
| Relation to curriculum | Information Technology is one of the informatics courses for undergraduates of engineering related programs. This course includes the knowledge of image processing, video processing, process information based on the network, web design, etc. After finishing this course, students can master the skills of how to acquire information, process information, transmit information and use information |
| Type of teaching, contact hours | Target students: students of engineering related programs.<br>Type of teaching: half of the time is for lectures, half for classroom exercises<br>Contact hours: 32 hours<br>Of which,<br>Theoretical teaching: 16 hours<br>Experiment / practice teaching: 16 hours<br>Size of class: 60-80 students |
| Workload | Workload =60 hours<br>Contact hours = 32 hours<br>Self-study hours = 28 hours |
| Credit points | 2.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | None |
| Module objectives/intended learning outcomes/ | Students will be familiar with the knowledge of multimedia, computer network and web design, be able to process the image, video and Webpage, utilize them in their subsequent professional courses.<br>● **Knowledge:** students are required to master the basic concepts and principles of information, understand the knowledge of acquisition and utilization in different |

| | |
|---|---|
| | fields.<br>● **Skills:** Acquire the ability of image and video processing. Acquire the ability to process information based on the network. Acquire the ability to carry out a basic web design.<br>● **Competences:** Analyze engineering problems from a viewpoint of infomation, and solve problems using knowledge and skills mentioned above. |
| Content | **Part A. Theoretical teaching (16 contact hours and 14 self-study hours)**<br>**Chapter 1** Introduction: the new application of modern information technology (2 contact hours and 2 self-study hours)<br>● Integration of information and industrialization<br>● Intelligence technology*<br>● Cloud computing**<br>● Next generation internet*<br>**Chapter 2** Multimedia technology (6 contact hours and 4 self-study hours)<br>● Audio signal processing technology*<br>● Image information processing technology**<br>● Animation processing technology*<br>● Video information processing technology*<br>**Chapter 3** Basis of computer network (2 contact hours and 2 self-study hours)<br>● The basic concepts of computer network<br>● LAN*<br>● Local area networking*<br>● Internet technology and application**<br>**Chapter 4** Web design (6 contact hours and 6 self-study hours)<br>● Introduction to HTML and Web design software<br>● The basic elements in the Web page: text, hyperlinks, multimedia, form*<br>● Web design and publish**<br>**Part B. Experiment / practice teaching (16 contact hours and 14 self-study hours)**<br>● Foundation of multimedia processing: audio, image & animation ((8 contact hours and 6 self-study hours) *<br>● Network applications (2 contact hours and 2 self-study hours) **<br>● Web design (6 contact hours and 6 self-study hours) ** |

| | |
|---|---|
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 30%, consisted of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 70%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | Reference books<br>[1] Xia Yun, Basic computer application (2nd Ed.), Publishing House of Electronics Industry, 2013.<br>[2] Xia Yun, The application of computer experiment guidance (2nd Ed.), Publishing House of Electronics Industry, 2013 |

## Introduction to Computer

| | |
|---|---|
| Competence field | Informatics |
| Module designation | Introduction to Computer |
| Code, if applicable | 12003010 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 2nd semester |
| Person responsible for the module | Associate Professor XIA Yun |
| Lecturer | Associate Professor XIA Yun<br>Associate Professor ZANG Jinsong<br>Lecturer LIU Lixia |
| Language | Chinese |
| Relation to curriculum | This course aims to train the students fully understand the professional knowledge, the latest development and application of the computer field. Through the studying of this course, the students have a basic understanding of the main computer in the future to learn the knowledge, construct follow-up courses. The basic framework of knowledge, for future study and master the computer professional knowledge, to lay the foundation for scientific research. |
| Type of teaching, contact hours | Target students: freshman of all programs.<br>Type of teaching: most of the time is for lectures, the rest time for classroom exercises and discussion.<br>Contact hours: 48 hours<br>Of which,<br>Theoretical teaching: 48 hours<br>Experiment / practice teaching: 0 hour<br>Size of class: 60-80 students |
| Workload | Workload = 90 hours<br>Contact hours =48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Information Technology |
| Module objectives/intended learning outcomes/ | ● **Knowledge:** Master computer basic knowledge, understanding of computer principle of work and the information processing theory. Master general knowledge and operation technology of Windows operating system. Master the use and operation of Word, Excel, PowerPoint. To understand and master |

| | |
|---|---|
| | the basic principle of the computer network. Understanding and knowledge of information retrieval technology and information security technology.<br>● **Skills:** The cultivation of students' ability of self-learning ability and acquire new knowledge, new technology of the computer, with the use of computer tools for word processing, data processing, information acquisition of three kinds of ability.<br>● **Competences:** The cultivation of students' a serious and responsible work attitude and meticulous work style; The cultivation of students' autonomous learning consciousness and the team cooperation spirit; Training the students consciousness and ability of innovation consciousness and information processing work. |
| Content | **Part A. Theoretical teaching ( 48 contact hours, 42 self-study hours)**<br>**Chapter 1:** Basic knowledge of computer* (introductory content;6 contact hours and 3 self-study hours)<br>**Chapter 2:** Experience with the application of Windows operating system* (Preliminary understanding;6 contact hours and 3 self-study hours)<br>**Chapter 3:** To master the basic operation of word processing software** (key content;10 contact hours and 10 self-study hours)<br>**Chapter 4:** To master the basic operation of electronic form processing software Excel** (key content; 10 contact hours and 10 self-study hours)<br>**Chapter 5:** Learn how to use PowerPoint to make the presentation** (key content; 10 contact hours and 10 self-study hours)<br>**Chapter 6:** Overview of computer security, the new technology of computer knowledge and Application* (introductory content; 6 contact hours and 6 self-study hours)<br>**Part B. Experiment / practice teaching: 0 hour.** |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 30%, consisted of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 70%. |

| | |
|---|---|
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] Fundamentals of Computer Application Tutorial(2011), East China Normal University press<br>[2] The application of computer experiment guidance(2011), East China Normal University press<br>2. Reference books<br>[1] Norton,Introduction to Computer Science (Sixth Edition), Tsinghua University Press |

## Program Design and Practice

| | |
|---|---|
| Competence field | Informatics |
| Module designation | Program Design and Practice |
| Code, if applicable | 12002000 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 3rd semester |
| Person responsible for the module | Associate Professor XIA Yun |
| Lecturer | Associate Professor ZANG Jinsong,<br>Lecturer HUANG Xiaoyu,<br>Lecturer YANG Zan,<br>Lecturer CHENG Guoshu |
| Language | Chinese |
| Relation to curriculum | Program Design and Practice is one of the informatics courses for all undergraduates of engineering majors. This course includes sequence structure, program design, branch structure design, cycle structure design, etc. The course focuses on training students' programming thinking, programming ability, engineering ability and innovative ability and encourages students to use their language C to solve specific problems. |
| Type of teaching, contact hours | Target students: students of engineering related programs.<br>Type of teaching: almost 2/3 of the time is for lectures, and some time is left for classroom do exercises<br>Contact hours: 48 hours<br>Of which,<br>Theoretical teaching: 32 hours<br>Experiment / practice teaching: 16 hours<br>Size of class: 60-80 students |
| Workload | Workload =90 hours<br>Contact hours =48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Information Technology; Introduction to Computer |
| Module objectives/intended learning outcomes/ | Students should have familiarity with the language C, and they should master the major features and what most of the language constructs are and be able to write small programs.<br>● **Knowledge:** Understand the basic knowledge of programming, some basic knowledge of data |

| | |
|---|---|
| | structure. and master the basic programming analysis methods, such as module method.<br>● **Skills:** be able to analyze problem and solve it by computer programming; and be able to build a whole program using the module method.<br>● **Competences:** be able to analyze basic engineering problems and solve them with programming methods, understand the concept, development and potential applications of numerical methods. Ability to learn to use a new software when needed. |
| Content | **Part A. Theoretical teaching (32 contact hours and 26 self-study hours)**<br>**Chapter 1**. Basic Knowledge for Programming Design (2 contact hours and 2 self-study hours)<br>● Program and Programming Language*<br>● Structural Programming Design Method**<br>● Introduction and representation of Algorithm*<br>● Getting start<br>**Chapter 2.** An Overview of C (6 contact hours and 4 self-study hours)<br>● Basic structure of C program*<br>● (Character set, identifiers, expressions, keywords, statements, functions)**<br>● Data types (variable Name, Data Types and Sizes, Constants, Declarations)**<br>● Operations(Arithmetic Operators, Relational and Logical Operators,Type Conversions,Increment and Decrement Operators **<br>● Sequential Logic Structure and Selective structure**<br>**Chapter 3.** Iteration Constructure (6 contact hours and 4 self-study hours)<br>● The basic concepts of loops*<br>● The use of Loop, the comparison of three kinds of loops*<br>● Nested loop**<br>● Programming examples (output graphics, exhaustive algorithm)*<br>**Chapter 4.** Combined data structure and file (6 contact hours and 6 self-study hours)<br>● The basic concept of the array*<br>● Pointer** |

| | |
|---|---|
| | ● structure data type*<br>● file**<br>**Chapter 5.** Module and interface (6 contact hours and 6 self-study hours)<br>● C program structure, function definition**<br>● Function call and data transfer between the functions**<br>● Scope Rules and variable storage**<br>● Recursive function calls*<br>**Chapter 6.** Case study(6 contact hours and 4 self-study hours)<br>● Transmission of structured data between functions*<br>● basic algorithm practice*<br>**Part B. Experiment / practice teaching (16 contact hours and 16 self-study hours)**<br>● Environment of programming(2 contact hours and 2 self-study hours)**<br>● Sequential Logic Structure and Selective structure practice(2 contact hours and 2 self-study hours)**<br>● Iterative programming(4 contact hours and 4 self-study hours)**<br>● Data process(4 contact hours and 4 self-study hours)*<br>● Module and algorithm practice(4 contact hours and 4 self-study hours)* |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 30%, consisted of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 70%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | Reference books<br>[1] "A First Book of ANSI C, (Fourth Edition)", By Gary J.Bronson<br>[2] "A Book on C : Programming in C (Fourth Edition)", By Al Kelley and Ira Pohl ,2004<br>[3] "Concise Prelude to Programming: Concepts and Design, Third Edition",Stewart Venit ， Elizabeth Drak |

# Engineering Fundamentals

## Fundamentals of Engineering Drawing

| | |
|---|---|
| Competence field | Engineering Fundamentals |
| Module designation | Fundamentals of Engineering Drawing |
| Code, if applicable | 14001900 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 1st semester |
| Person responsible for the module | Professor ZHONG Liangwei |
| Lecturer | Associate Professor QU Yuanshang<br>Associate Professor ZHU Wenbo<br>Lecturer CHEN Long<br>Lecturer JING Lulu |
| Language | Chinese |
| Relation to curriculum | Fundamentals of Engineering Drawing is an engineering fundamental course of engineering related programs. This course focuses on the introduction of geometry projection principles and engineering drawing representation methods. At the same time, it can provide a primary introduction of the principles and national standards of mechanical drawings and the representation methods of engineering drawing, and enable students to acquire the capability of drawing engineering diagrams, and get broad professional fundamental knowledge, so as to lay the foundation for the study of further mechanical courses (such as Machine Design, Mechanical Engineering Drawing, etc). |
| Type of teaching, contact hours | Target students: freshmen of engineering related programs<br>Type of teaching: most of the time is for lectures, and some time is for classroom discussions<br>Contact hours: 64 hours<br>Of which,<br>Theoretical teaching: 64 hours<br>Experiment / practice teaching: 0 hour<br>Computer practice: 0 hour<br>Size of class: 60 students |
| Workload | Workload = 120 hours<br>Contact hours = 64 hours<br>Self-study hours = 56 hours |
| Credit points | 4.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |

| | |
|---|---|
| Recommended prerequisites | None |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>Designers express their design ideas through engineering drawings, while manufacturers manufacture products according to engineering drawings; therefore, engineering drawing is the common technical language for engineers. This course is an engineering fundamental professional course for engineering realted programs.<br>● **Knowledge:** students are required to memorize the common rules of national drawing standards; grasp the basic principles of projection method, be able to correctly use various linear expression methods, and be skillful at drawing the projection of point, line, plane and body, master common expression methods of mechanical drawings, including basic views, partial views, oblique views, section views, cross-section views and partial enlarged drawings, etc., especially the in-depth learning of the drawing of various section views. Students are able to select appropriate expression methods and draw engineering drawings according to geometric structural features.<br>● **Skills:** be able to draw solid three-view drawings or section views, etc. according to given geometric models or stereogram by using orthographic projection. On the contrary, be able to imagine solid structure according to given engineering drawing, and have certain imaginable thinking capability.<br>● **Competences:** by studying the common expression methods of engineering drawings, students are expected to acquire certain imagination in 3D space and be able to make integrated application of three-views and section views to express objects, so as to lay the foundation for the study of follow-up professional courses and product design drawing. Good design and innovation capability is one of the necessary conditions required for enterprise talents. |
| Content | **Part A. Theoretical teaching ( 64 contact hours and 56 self-study hours)**<br>**Introduction:** Understand the nature, tasks and methods for learning of this course. (1 contact hour)<br>**Chapter 1:** Basic Knowledge of Engineering Drawing (brief introduction; 8 contact hours and 6 self-study hours)<br>● Drawing sheets, scale, lettering, line types, |

| | |
|---|---|
| | dimensioning and other national drawing standards;<br>● Basic skills and knowledge of instrument-aided and freehand drawing and dimensioning;<br>● Geometric construction. *<br>**Chapter 2:** Projection of Point, Line, Plane and Solid (key content; 20 contact hours and 20 self-study hours)<br>● Basic principles and methods of spatial geometric elements expression by orthogonal projection method, the projection features of spatial geometric elements (point, line, plane); **<br>● Relative position projection features of spatial geometric elements, and the graphical solution of the parallel, intersect, cross and vertical issues, etc. of geometric elements; *<br>● Seeking line length and the true graphic shape through the method of replace plane, and carrying out graphical problems of spatial geometric elements; *<br>● Orthogonal projection of planar solid and curved surface solid; **<br>● Methods for drawing the intersection line of special position plane and solid surface; **<br>● Methods for drawing the line of surface intersection of two orthogonal rotary solids. **<br>**Chapter 3:** Composite Solids (combination of lectures and exercises guidance; 15 contact hours and 14 self-study hours)<br>● Formation and projection features of solid's three-views; *<br>● Composite solid drawing, reading and dimensioning using shape analysis method and line plane analysis method. **<br>**Chapter 4:** Axonometric Projection (brief introduction; 6 contact hours and 4 self-study hours)<br>● Basic knowledge of axonometric projection, the drawing methods for the isometric projection and cabinet axonometric projection;<br>● Freehand drawing of simple solid axonometric drawings. *<br>**Chapter 5:** General Principles of Representation of Machine Parts (key content; 14 contact hours and 12 self-study hours)<br>● Drawing methods for views, section views and cross-section views; ** |

| | |
|---|---|
| | ● Other expression methods and application examples; * <br> ● Drawing composite solid by using ruler and compasses as well as various expression methods. * <br> **Part B. Experiment / practice teaching (0 hour)** |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class. <br> Usual performance accounts for 30%, consisted of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 70%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book <br> [1] QIU Wenyan and QU Yuanshang, Mechanical Drawing (2nd edition), Higher Education Press, 2009 <br> 2. Reference books <br> [1] LIU Chaoru, etc., Mechanical Drawing (5th edition), Higher Education Press, 2012 <br> [2] HE Mingxin and QIAN Keqiang, Mechanical Drawing (5th edition), Higher Education Press, 2012 <br> [3] WANG Chunhua, etc., Modern Engineering Graphics, China Petrochemical Press, 2012 <br> [4] Colin H Simmons etc. Manual of Engineering Drawing(Second edition), Elsevier Newnes, 2004 |

## Electrical Engineering and Electronics

| | |
|---|---|
| Competence field | Engineering Fundamentals |
| Module designation | Electrical Engineering and Electronics |
| Code, if applicable | 12002090 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 2nd semester |
| Person responsible for the module | Associate Professor XIN Shangzhi |
| Lecturer | Associate Professor LIU Jian<br>Associate Professor HOU Wen |
| Language | Chinese |
| Relation to curriculum | Electrical Engineering and Electronics is an engineering fundamental course for students of engineering related programs. This course includes two aspects, electrical and electronic technology, with the aim to train students to master basic theory knowledge and the skill of experiment of electrician and electronic technology, to grasp the basic theory, basic knowledge and basic skills of electronic technology, to understand the application and development situation of electronic technology, so as to lay the important foundation for the study of follow-up courses. |
| Type of teaching, contact hours | Target students: freshmen of engineering related programs<br>Type of teaching: most of the time is for lectures, and some time is left for classroom discussions and explaining exercises<br>Contact hours: 96 hours<br>Of which,<br>Theoretical teaching: 78 hours<br>Experiment / practice teaching: 18 hours<br>Computer practice: 0 hour<br>Size of class: 80-100 students |
| Workload | Workload = 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the examination regulations | Assess comprehensively by these three aspects: the scores of the usual experimental report, experimental operation and experimental attendance. |
| Recommended prerequisites | Calculus; College Physics |
| Module objectives/intended learning outcomes/ | Module objectives:<br>Electrical Engineering and Electronics is an engineering fundamental course.<br>● **Knowledge:** Understand the potential of electrical |

| | |
|---|---|
| | safety education and the test, in the DC circuit, and master the principle of superposition and Thevenin's theorem; understanding of RLC series resonant circuit and single tube amplification circuit; study the operational amplifier and gate circuits and combinational logic circuit, etc.<br>● **Skills:** Be able to automatically access components and instruments, analysis or design experimental circuit; be able to independently connect wiring, reasonable wiring and exclude general fault according to the map; be able to use the theoretical knowledge to analyze and judge the experimental phenomena; be able to correctly record and process the experimental data, indicating the experimental results, giving the qualified experiment report.<br>● **Competences:** Through the application of basic theories and analysis methods learnt from this course, students are expected to be able to independently analyze the electrical principle diagram and connect correct wiring, reasonable wiring, and independent ability to remove common faults. This course trains students connately analyzing the experimental phenomena, the ability of processing the experimental data. |
| Content | **Part A. Theoretical teaching ( 78 contact hours and 66 self-study hours)**<br>**Chapter 1:** Introduction (2 contact hours and 2 self-study hours)<br>**Chapter 2:** The basic concepts and the basic laws of circuit (4 contact hours and 4 self-study hours)<br>● Understand the basic concepts of circuit; *<br>● Master Kirchhoff's law. **<br>**Chapter 3:** Analysis the methods of circuit (6 contact hours and 6 self-study hours)<br>● Master the circuit equivalent transform method and analysis method of linear circuit; **<br>● Master the principle of superposition and Thevenin's theorem. **<br>**Chapter 4:** Sinusoidal alternating circuit (8 contact hours and 6 self-study hours)<br>● Master all representation methods of sinusoidal flow; **<br>● Master the analysis and calculation of general AC |

| | |
|---|---|
| | circuit. **<br>**Chapter 5:** Three-phase AC circuit (4 contact hours and 4 self-study hours)<br>● Understand the concept of symmetrical three-phase power supply; *<br>● Master the calculation of symmetric three-phase load circuit. **<br>**Chapter 6:** Transient analysis of circuit (4 contact hours and 4 self-study hours)<br>● Understand the causes of the transition process of circuit; *<br>● Master the law of switching and the three elements method to analysis of a first-order circuit. **<br>**Chapter 7:** Transformer and AC motor (4 contact hours and 4 self-study hours)<br>● Master three transforming functions of the transformer; **<br>● Understand the mechanical characteristics and calculation of asynchronous motor. *<br>**Chapter8:** Semi-conductor diode and transistor (6 contact hours and 4 self-study hours)<br>● Understand the conductive properties of semi-conductor and the structure of the diode and the transistor; *<br>● Understand the volt ampere characteristic of the transistor. *<br>**Chapter 9**: Basic amplifier circuit (10 contact hours and 8 self-study hours)<br>● Understand the working principle of the transistor amplifier; *<br>● Master the static and dynamic analysis of basic amplifier. Understand the relationship between distortion and the working point. **<br>**Chapter 10:** The integrated operational amplifier (8 contact hours and 6 self-study hours)<br>● Understand the basic composition of the operational amplifier; master the analysis, calculation and application of the arithmetic circuit composed of operational amplifiers; *<br>● Understand the simple applications of comparator. *<br>**Chapter 11:** Gate circuit and combinational logic circuit (10 contact hours and 8 self-study hours)<br>● Master the application method of logic algebra, the |

| | |
|---|---|
| | logic function of gate circuit and analysis and design of combinational logic circuit. **<br>**Chapter 12:** The logical circuit of the trigger and logical circuit (12 contact hours and 10 self-study hours)<br>● Understand the basic law of the bistable R-S,J-K and D trigger; *<br>● Master the analysis methods of the registers and counters. **<br>**Part B. Experiment / practice teaching (18 contact hours and 18 self-study hours)**<br>● Safety education of electrical engineering experiments and experiment of potential measuring in DC circuits (2 contact hours and 2 self-study hours) *<br>● Experiment of Superposition Principle and Thevenin's Theorem (2 contact hours and 2 self-study hours) *<br>● Experiment of improving power factor and influence of frequency on capacitance and inductance (2 contact hours and 2 self-study hours) **<br>● Experiment of RCL series resonant circuit (2 contact hours and 2 self-study hours) *<br>● Introduction of common electronic instrument (2 contact hours and 2 self-study hours) *<br>● Experiment of single transistor AC amplifier circuit (2 contact hours and 2 self-study hours) **<br>● Experiment of operational amplifier (2 contact hours and 2 self-study hours) **<br>● Experiment of gate circuit and combinational logic circuit (2 contact hours and 2 self-study hours) **<br>● Experiment of trigger and counter (2 contact hours and 2 self-study hours) ** |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 30%, consisted of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 70%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. The specified books<br>[1] “Electrical and electronic technology” edited by |

| | |
|---|---|
| | Shangzhi Xin, China metrology press, 2009 July<br>2. Reference books<br>[1] "Electrical Engineering" (volume 1) electrician technology, (volume 2) electronic technology, sixth edition,Zenghuang Qin, high Education Press,2004 July<br>[2] “Circuit’’fifth edition,edited by Guanyuan Qiu, high Education Press,2006 May<br>[3] “The Foundation of Electronic Technology” analog electronic part (fourth edition), edited by Huaguang Kang, high Education Press,1999 June<br>[4] “The Foundation of Electronic Technology” digital electronic part (fourth edition), edited by Huaguang Kang, high Education Press,2000 June |

## Mechanics of Materials

| | |
|---|---|
| Competence field | Engineering Fundamentals |
| Module designation | Mechanics of Materials |
| Code, if applicable | 14000102 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 2nd semester |
| Person responsible for the module | Professor WANG Zhonghou |
| Lecturer | Professor WANG Zhonghou<br>Associate Professor WENG Guohua<br>Lecturer YU Huijie<br>Lecturer JIAO Guyue |
| Language | Chinese |
| Relation to curriculum | Mechanics of Materials is an engineering fundamental course of engineering related programs. This course mainly analyzes rods, with focus on the introduction of the calculation of strength and stiffness of a rod under such deformations as tension, compression, shear, torsion and bending, etc. and the calculation of stability of a rod under compression, and provides necessary mechanical analysis and calculation methods for follow-up courses. In addition, this course also provides basic theoretical and computational methods for students to study mechanical courses (such as Machine Design, Fundamentals of Engineering Materials, etc.). This course and Theoretical Mechanics jointly constitute the basic mechanics system of machine subject and provides basic theoretical support for further courses. |
| Type of teaching, contact hours | Target students: freshmen of engineering related programs<br>Type of teaching: most of the time is for lectures, and some time is left for classroom discussions and explaining exercises<br>Contact hours: 96 hours<br>Of which,<br>Theoretical teaching: 96 hours<br>Experiment / practice teaching: 0 hour<br>Computer practice: 0 hour<br>Size of class: 60-80 students |
| Workload | Workload = 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the | Students with class attendance rate over 2/3 and assignment |

| | |
|---|---|
| examination regulations | completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Calculus; College Physics |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>Mechanics of Materials is an engineering fundamental course. Through the study of this course, students are expected to understand the basic concepts and fundamental theories of rod strength, stiffness and stability, be skillful at rod checking and design calculation, and have certain analysis and problem-solving capabilities.<br>● **Knowledge:** have the clear understanding of basic concepts and basic analysis methods of mechanics of materials, and be skillful at drawing the internal force diagram of a rod under such basic deformations as axial tension (or compression), torsion, bending, etc., and calculating its stress, deformation, strength and stiffness; have mastery of plane stress state theory and four commonly used basic strength theories; be able to apply the above theories into the calculation of strength under such deformations as stretch bending, compression bending, unsymmetrical bending and bending torsion deformation; and be able to apply energy method to solve static indeterminacy problems.<br>● **Skills:** be able to analyze the stress and deformation of members, and conduct checking of the members under various load in engineering according to strength, stiffness and stability theories; design economical and safe qualified members.<br>● **Competences:** Through the application of basic theories and analysis methods of this course, students are expected to be able to establish basic mechanical concepts and solve relevant practical engineering problems. This course trains students scientific thinking and improve their comprehensive analysis and calculation skills. |
| Content | **Part A. Theoretical teaching ( 96 contact hours and 84 self-study hours)**<br>**Chapter 1:** Introduction (preliminary understanding; 4 contact hours and 2 self-study hours)<br>● Tasks of Mechanics of Materials; the relation between Mechanics of Materials and productive practice;<br>● Concept of deformable body and basic assumptions;<br>● Internal force, section method; stress and strain. * |

| | |
|---|---|
| | **Chapter 2:** Axial Tension and Compression (key content; 8 contact hours and 6 self-study hours)<br>● The internal force and stress on oblique section under axial tension and compression;<br>● Strength conditions and the calculation of strength under axial tension and compression; **<br>● Calculation of deformation under axial tension and compression; **<br>● Static indeterminacy problems under tension and compression; *<br>● Practical calculation of shearing and extrusion at joint position.<br>**Chapter 3:** Torsion (key content; 8 contact hours and 8 self-study hours)<br>● Calculation of torsion couple, torque and torque diagram;<br>● Stress and strength problem under circular shaft torsion; **<br>● Deformation and stiffness problems under circular shaft torsion. **<br>**Chapter 4:** Geometric Properties of Plane Figures (introductory content; 6 contact hours and 4 self-study hours)<br>● Static moments and centroid;<br>● Moment of inertia;<br>● Parallel-axis formula. **<br>**Chapter 5:** Internal Forces in Bending (key content; 8 contact hours and 6 self-study hours)<br>● Simplification of bending rod;<br>● Shear force, bending moment, shear equation and bending moment equation; *<br>● Shear diagram and bending moment diagram; **<br>● Relationship among load intensity, shear force and bending moment. **<br>**Chapter 6:** Bending Stress (key content; 8 contact hours and 8 self-study hours)<br>● Calculation of normal stress and strength under bending; **<br>● Calculation of shear stress and strength under bending; *<br>● Measures to improve strength.<br>**Chapter 7:** Bending Deformation (key content; 6 contact hours and 6 self-study hours) |

| | |
|---|---|
| | ● Bending deformation problems in engineering practice;<br>● Approximate differential equation of deflection curve and the stiffness conditions;<br>● Solve bending deformation via the use of integral method; *<br>● Solve bending deformation via the use of superposition method; **<br>● Measures to improve the bending stiffness.<br>**Chapter 8:** Stress State and Strength Theory (key content; 10 contact hours and 10 self-study hours)<br>● The concept of stress state analysis and two-direction stress state and three-dimensional stress state instances;<br>● Two-direction stress state analytical method and graphical method; **<br>● Three-dimensional stress and maximum shear stress; *<br>● Generalized Hooke's law;<br>● Concept of strength theory and introduction of common strength theories. *<br>**Chapter 9:** Combined Deformation (key content; 8 contact hours and 8 self-study hours)<br>● Concept and examples of combined deformation;<br>● Tension (compression) and bending combined deformation (including eccentric tension); **<br>● Bending and torsional combined deformation. **<br>**Chapter 10:** Pressure Bar Stability (key content; 8 contact hours and 8 self-study hours)<br>● Pressure bar stability concept and examples;<br>● Critical force and critical stress of long and thin pressure bar; **<br>● Critical force and critical stress of pressure bar under other constraints; **<br>● Application range of Euler's formula, and calculation of medium-and-long rods and thick-and-short rods; *<br>● Pressure bar stability calculation; **<br>● Measures to improve the stability of pressure bar.<br>**Chapter 11:** Dynamic Load (introductory content; 6 contact hours and 4 self-study hours)<br>● Inertial force issues;<br>● Impact load;<br>● Measures to improve the impact resistance of |

| | |
|---|---|
| | members.<br>**Chapter 12:** Fatigue Strength of Members under Alternating Stress (introductory content; 8 contact hours and 6 self-study hours)<br>● Cycle characteristics of alternating stress;<br>● Endurance limit of materials under symmetric cycle loading;<br>● Factors affecting endurance limit of members;<br>● Strength conditions of members under symmetric cycle loading;<br>● Measures to improve endurance limit of members.<br>**Chapter 13:** Energy Method (key content; 8 contact hours and 8 self-study hours)<br>● Rod deformation energy calculation;<br>● Castigliano's theorem and mohrs theorem; **<br>● Apply Castigliano's theorem (or mohrs theorem) to solve static indeterminacy problems. **<br>**Part B. Experiment / practice teaching (0 hour)** |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 30%, consisted of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 70%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] LIU Hongwen, Concise Mechanics of Materials (2nd edition), Beijing: Higher Education Press, 2008.<br>2. Reference books<br>[1] SHAN Zuhui, Mechanics of Materials I and II (3rd edition), Beijing: Higher Education Press, 2010.<br>[2] SUN Xunfang, FANG Xiaoshu and LU Yaohong, Mechanics of Materials (3rd edition), Beijing: Higher Education Press, 2012.<br>[3] HU Zengqiang, Mechanics of Materials Study Guide, Beijing: Higher Education Press, 2006<br>[4] James M. Gere, Barry J. Goodno. Mechanics of Materials (8th edition). Nelson Engineering, 2012. |

## Theoretical Mechanics

| | |
|---|---|
| Competence field | Engineering Fundamentals |
| Module designation | Theoretical Mechanics |
| Code, if applicable | 14001022 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 3rd semester |
| Person responsible for the module | Professor WANG Zhonghou |
| Lecturer | Associate Professor WENG Guohua<br>Associate Professor LIU Jing<br>Lecturer YU Huijie<br>Lecturer ZHOU Qun |
| Language | Chinese |
| Relation to curriculum | Theoretical Mechanics is a fundamental course for students of engineering related programs. This course mainly analyzes particles and rigid bodies, with focus on the introduction of the basic law and research methods of mechanical movement (including balance) of particles, particle system and rigid bodies), and provides necessary mechanical analysis and calculation methods for follow-up courses. This course and Mechanics of Materials jointly constitute the basic mechanics system of machine subject. These two courses introduce to students the basic mechanics system, so as to lay the important foundation for the study of follow-up courses (such as Machine Design, Fundamentals of Engineering Materials, etc.). |
| Type of teaching, contact hours | Target students: sophomores of engineering related programs<br>Type of teaching: most of the time is for lectures, and some time is left for classroom discussions and explaining exercises<br>Contact hours: 96 hours<br>Of which,<br>Theoretical teaching: 96 hours<br>Experiment / practice teaching: 0 hour<br>Computer practice: 0 hour<br>Size of class: 60-80 students |
| Workload | Workload = 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |

| | |
|---|---|
| Recommended prerequisites | Calculus; College Physics |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>Theoretical Mechanics is an engineering fundamental course. The teaching objective of this course is to enable students to master the basic law and research methods of the mechanical motion of objects and the mechanical interaction between objects, so as to lay the foundation for the study of follow-up courses.<br>● **Knowledge:** Understand the basic axioms of static, and master stress analysis methods of objects; be able to solve particle motion velocity and acceleration via the use of synthetic method; be able to solve kinematics problems of rigid system, solve particle velocity via the use of basic point method, instantaneous velocity center method and velocity projection method, and solve acceleration via the use of basic point method; grasp momentum theorem, moment of momentum theorem, theorem of kinetic energy and D'Alembert's principle.<br>● **Skills:** be able to carry out system force analysis, and establish equilibrium equation to solve the unknown force of system; be able to solve the kinematics problems (including velocity and acceleration problems) of particles of rigid bodies; be able to establish the relation between rigid body system force and movement and solve it.<br>● **Competences:** Through the application of basic theories and analysis methods learnt from this course, students are expected to be able to establish basic mechanical concepts and solve relevant practical engineering problems; this course trains students scientific thinking, comprehensive computational analysis and innovation capabilities. |
| Content | **Part A. Theoretical teaching ( 96 contact hours and 84 self-study hours)**<br>**Introduction:** Main Research Content and Methods of Theoretical Mechanics (Preliminary understanding; 2 contact hours)<br>**Chapter 1:** Basic Axioms of Static and Force Analysis of Objects (introduction of basic concepts; 4 contact hours and 4 self-study hours)<br>● Get familiar with the nature of common constraints;<br>● Be able to draw the force drawings of object system |

| | |
|---|---|
| | and free-body. **<br>**Chapter 2:** Planar Concurrent Force System (key content; 4 contact hours and 4 self-study hours)<br>● Understand the synthesis result of concurrent force system; *<br>● Master the equilibrium conditions and equilibrium equations of concurrent force system. **<br>**Chapter 3:** Moment and Planar-couple Theory (introductory content; 4 contact hours and 4 self-study hours)<br>● Get familiar with the basic concepts and nature of force, moment and couple;<br>● Be able to calculate force projection and force-shaft moment; *<br>● Establish couple equilibrium equation. *<br>**Chapter 4:** Planar Arbitrary Force System (key content; 8 contact hours and 6 self-study hours)<br>● Grasp the simplified results of planar force system;<br>● Be able to calculate the principal vector and principal moment of force system; *<br>● Apply equilibrium equations to solve the equilibrium problems of object system. **<br>**Chapter 5:** Friction (introductory content; 6 contact hours and 6 self-study hours)<br>● Get familiar with the concept of sliding friction;<br>● Be able to solve the equilibrium problems of the object system with sliding friction; **<br>● Understand the concept of rolling friction.<br>**Chapter 6:** Space Force System and The Center of Gravity (introductory content; 6 contact hours and 6 self-study hours)<br>● Understand the simplified results of space force system and equilibrium equation;<br>● Be able to calculate the center of gravity of simple geometry and composite solid. *<br>**Chapter 7:** Kinematics of Particle (introductory content; 4 contact hours and 4 self-study hours)<br>● Understand vector method, method of direct coordinate and natural coordinate method to describe the motion of particles;<br>● Be able to solve the motion equation and trajectory equation of a particle; *<br>● Be able to solve the velocity and acceleration of a |

| | |
|---|---|
| | particle. *<br>**Chapter 8:** Basic Motion of Rigid Body (introductory content; 4 contact hours and 2 self-study hours)<br>● Understand rigid translational and fixed axis rotation characteristics;<br>● Be able to solve angular velocity and angular acceleration of axis rotating rigid body; *<br>● Be able to solve the velocity and acceleration of particles in translational rigid body and fixed axis rotating rigid body. **<br>**Chapter 9:** Synthetic Motion of A Particle (key content; 8 contact hours and 6 self-study hours)<br>● Grasp motion synthesis and decomposition methods; *<br>● Be able to solve particle velocity via the use of velocity synthesis theorem; **<br>● Be able to solve the acceleration of the particle with translational motion via the use of acceleration synthesis theorems; **<br>● Understand the acceleration synthesis theorem with fixed axis rotating convected motion. *<br>**Chapter 10:** Planar Motion of Rigid body (key content; 8 contact hours and 8 self-study hours)<br>● Understand the characteristics of planar motion of rigid body;<br>● Be able to solve the velocity of a particle via the use of basic point method, instantaneous velocity center method and velocity projection method; **<br>● Grasp the basic point method of solving acceleration. *<br>**Chapter 11:** The Basic Law of Dynamics (introductory content; 4 contact hours and 4 self-study hours)<br>● Be able to establish differential equation of particle motion;<br>● Be able to solve two basic problems of dynamics. *<br>**Chapter 12:** Momentum Theorem (8 contact hours and 8 self-study hours):<br>● Understand momentum theorem and theorem of motion of centre of mass in dynamics;<br>● Be able to correctly apply momentum theorem to solve the dynamics problems of particle and particle system. *<br>**Chapter 13:** Moment of Momentum Theorem (key |

| | |
|---|---|
| | content; 8 contact hours and 6 self-study hours)<br>● Understand moment of momentum theorem in dynamics and the fixed axis rotating differential equation of rigid body;<br>● Be able to correctly apply moment of momentum theorem to solve dynamics problems of particle and particle system. **<br>**Chapter 14:** Theorem of Kinetic Energy (key content; 8 contact hours and 6 self-study hours)<br>● Understand theorem of kinetic energy and associated conservation theorem in dynamics;<br>● Be able to correctly apply theorem of kinetic energy to solve dynamics problems of particle and particle system. **<br>**Chapter 15:** D' Alembert Principle (key content; 6 contact hours and 6 self-study hours)<br>● Understand D' Alembert principle;<br>● Be able to simplify the inertial forces system of translational rigid body, fixed axis rotating rigid body and plane motion rigid body; **<br>● Be able to apply D' Alembert principle to solve dynamics problems. *<br>**Chapter 16:** Principle of Virtual Displacement (introductory content; 4 contact hours and 4 self-study hours)<br>● Understand the concepts of virtual displacement and ideal constraint;<br>● Be able to apply principle of virtual displacement to solve constraint reaction.<br>**Part B. Experiment / practice teaching (0 hour)** |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 30%, consisted of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 70%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] HAO Tongsheng, Theoretical Mechanics (3rd edition), Beijing: Higher Education Press, 2003<br>2. Reference books<br>[1] Teaching and Research Office of Theoretical |

| | |
|---|---|
| | Mechanics, Harbin Institute of Technology, Theoretical Mechanics (7th edition), Beijing: Higher Education Press, 2009<br>[2] Teaching and Research Department of Fundamental Mechanics, School of Aeronautics and Astronautics and Mechanics, Tongji University, Theoretical Mechanics (2nd edition), Shanghai: Tongji University Press, 2012<br>[3] JING Rongchun, Theoretical Mechanics Counseling and Problem Solutions, Beijing: Tsinghua University Press, 2010<br>[4] Carl Jenness Coe. Theoretical Mechanics: a vectorial treatment. The Macmillan Company. 2008 |

## Fundamentals of Engineering Materials

| | |
|---|---|
| Competence field | Engineering Fundamentals |
| Module designation | Fundamentals of Engineering Materials |
| Code, if applicable | 14001930 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 3rd semester |
| Person responsible for the module | Professor WANG Shuwen |
| Lecturer | Professor WANG Yan<br>Lecturer XIONG Min<br>Lecturer ZHOU Jing |
| Language | Chinese |
| Relation to curriculum | Fundamentals of Engineering Materials is a fundamental course for engineering related programs. This course focuses on acquainting students with the fundamental theories of metal science and heat treatment and the fundamental knowledge of materials engineering, as well as enabling students to understand the composition, microstructure, properties and uses of commonly used metal materials, and the relationship between heat treatment processes. Before taking this course, students should have the basic knowledge of Mechanics of Materials. This course can help students understand heat treatment processes and application during Metalworking Practice. Through the study of this course, students are expected to be able to reasonably select mechanical engineering materials, correctly arrange heat treatment process methods of materials and properly develop the heat treatment process route for parts in further courses. |
| Type of teaching, contact hours | Target students: sophomores of engineering related programs<br>Type of teaching: Most of the time is for lectures, and some time is left for classroom discussions and explaining exercises<br>Contact hours: 64 hours<br>Of which,<br>Theoretical teaching: 56 hours<br>Experiment / practice teaching: 8 hours<br>Computer practice: 0 hour<br>Size of class: 80-100 students |
| Workload | Workload = 120 hours<br>Contact hours = 64 hours<br>Self-study hours = 56 hours |
| Credit points | 4.0 |

| | |
|---|---|
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3, who have completed required experiments, are allowed to take the exam. |
| Recommended prerequisites | College Physics; Mechanics of Materials |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>This course is an engineering fundamental course that introduces the composition, organization, performance and process technology of engineering materials (mainly metal materials). The purpose of this course is to enable students to understand and master the basic knowledge of engineering materials, so as to lay professional foundation for follow-up courses.<br>● **Knowledge:** students are required to be familiar with the main mechanical performance indicators of material and their testing principles; master the basic theories of microstructure, crystallization process, Binary Alloy Phase Diagram (focus on iron-carbon alloy phase diagram), plastic deformation and recrystallization of materials; master the basic principles and processes of heat treatment of steel materials; grasp the role of specific heat treatment process in parts machining; master the composition, microstructure, properties and uses of common carbon steel and alloy steel.<br>● **Skills:** be able to select materials for specific parts, correctly select heat treatment process methods, and reasonably arrange heat treatment process route.<br>● **Competences:** be able to make integrated analysis from many angles (including materials mechanical properties, physical properties, chemical properties and economy, etc.) according to the specific requirements on parts, select appropriate materials for designed product, and reasonably arrange heat treatment process route, so as to acquire the capability of solving practical engineering problems. |
| Content | **Part A. Theoretical teaching (56 contact hours and 46 self-study hours)**<br>**Introduction:** Introduction on the objectives, tasks and research objects of this course. (4 contact hours)<br>**Chapter 1:** Properties of Materials (6 contact hours and 4 self-study hours)<br>● Master the mechanical properties of materials, understand the test methods and corresponding property indicators; * |

| | |
|---|---|
| | ● Understand the physical and chemical property indicators of materials;<br>● Understand the process properties of materials.<br>**Chapter 2:** Structure of Materials (8 contact hours and 8 self-study hours)<br>● Understand the basic concept of crystal structure;<br>● Focus on three crystal structures and characteristics of common metal; **<br>● Master the crystal structure defects of actual metal; *<br>● Master alloy and crystal structural characteristics; *<br>● Master the concepts of phase and solid solution strengthening. *<br>**Chapter 3:** Materials Solidification (14 contact hours and 10 self-study hours)<br>● Master the concept of degree of supercooling; *<br>● Master the crystallization process of pure metals and the volume changes caused by allotropy transformations; *<br>● Master the application, distinction phase and microstructure concepts of Binary Isomorphous Diagram, Binary Eutectic Phase Diagram, Binary Eutectoid Phase Diagram and lever law; **<br>● Master iron-carbon alloy phase diagram and the crystallization process of typical iron-carbon alloy, and be able to make phase diagram analysis; **<br>● Master the concept of refined crystalline strengthening and the methods of grain refinement; *<br>● Understand the characteristics of casting ingot microstructure and its control methods.<br>**Chapter 4:** Metal Plastic Deformation and Recrystallization (6 contact hours and 6 self-study hours)<br>● Understand metal plastic deformation and its essence;<br>● Master the differences between cold machining and hot machining, the work hardening of cold-machining metal and its property changes during heating. *<br>**Chapter 5:** Steel Heat Treatment (10 contact hours and 10 self-study hours)<br>● Understand the classification and roles of heat treatment processes;<br>● Focus on cooling c curves and unbalanced microstructure of steel; *<br>● Focus on annealing, normalizing, quenching, tempering and surface heat treatment processes and applications. * |

| | |
|---|---|
| | **Chapter 6:** Industrial Steel (8 contact hours and 8 self-study hours)<br>● Understand the classification and grades of steel;<br>● Get familiar with the role of alloying elements in steel; *<br>● Focus on the grades, process methods and uses of all kinds of alloy steel. **<br>**Part B. Experiment / practice teaching (8 contact hour and 10 self-study hour)**<br>Experiment 1: Metal Hardness Test (2 contact hour and 2 self-study hour)<br>● Understand the composition and uses of Brinell hardness tester and Rockwell hardness tester;<br>● Master Brinell hardness and Rockwell hardness measurement methods. *<br>Experiment 2: Metal Impact Test (2 contact hour and 4 self-study hour)<br>● Understand the main composition and operation methods of impact tester;<br>● Preliminarily master the testing methods of toughness of metallic materials; *<br>● Preliminarily establish the relation between carbon content of carbon steel and impact toughness. *<br>Experiment 3: Carbon Steel Heat Treatment and Unbalanced Microstructure Observation (4 contact hours and 4 self-study hours)<br>● Design and develop the heat treatment processes of carbon steel with different carbon content, and master the basic operations of steel heat treatment; *<br>● Analyze the impact of cooling speed and tempering temperature on microstructure and hardness of carbon steel during its heat treatment, and analyze the impact of carbon content on the hardness after quenching;<br>● Observe the microstructure of carbon steel after common heat treatment and identify the features of its typical microstructure;<br>● Deepen the understanding of the relations among carbon steel composition, heat treatment process and its microstructure and properties. ** |
| Study and examination requirements and forms of examination | Usual performance accounts for 30%, consisted of assignments and attendance; final exam (closed book written examination) accounts for 70%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser |

| | |
|---|---|
| | pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] YU Yongsi, Mechanical Engineering Materials (9th edition), Dalian University of Technology Press, 2014<br>2. Reference books<br>[1] ZHU Zhangjiao, Materials Engineering, Tsinghua University Press, 2001<br>[2] William D. C. & David G. R.Material Science and Engineering(9th International student edition), New York: John Wiley & Sons, 2014<br>[3] HU Gengxiang, Fundamentals of Materials Science (3rd edition), Shanghai Jiaotong University Press, 2010<br>3. Experiment / computer practice instruction books<br>[1] Self-designed teaching materials<br>4. Other<br>[1] PPT assisted courseware (self-designed)<br>[2] Problem sets (self-designed) |

## Mechanical Engineering Drawing

| | |
|---|---|
| Competence field | Engineering Fundamentals |
| Module designation | Mechanical Engineering Drawing |
| Code, if applicable | 14001920 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 4th semester |
| Person responsible for the module | Professor DING Xiaohong |
| Lecturer | Associate Professor SHEN Jingfeng<br>Associate Professor HUANG Yiqing<br>Associate Professor QIAN Wei<br>Lecturer WANG Xinhua |
| Language | Chinese |
| Relation to curriculum | This course focuses on introducing the basic principles of commonly used mechanical mechanisms and the design methods of common mechanical parts. Recommended prerequisites closely related to this course are Fundamentals of Engineering Drawing, Theoretical Mechanics, and Mechanics of Materials, which provide drawing and mechanics foundation. Through the study of this course, students are expected to master the basic principles of commonly used mechanisms and the methods of calculation and selection of common parts, master the methods of structural design of mechanical drive system and other systems as well as related parts, and learn the principles of selection of standard parts. Innovative design practice project of this course is designed to strengthen students' application of the knowledge learnt, and train students' innovative mechanical thinking and innovation sense, so as to enable students to acquire innovation capability and actual product design capability as well as the theoretical basics of machine design. |
| Type of teaching, contact hours | Target students: sophomores of engineering related programs<br>Type of teaching: most of the time is for lectures, and some time is left for classroom discussions and explaining exercises<br>Contact hours: 96 hours<br>Of which,<br>Theoretical teaching: 78 hours<br>Experiment / practice teaching: 18 hour<br>Computer practice: 0 hour<br>Size of class: 40-60 students |

| | |
|---|---|
| Workload | Workload = 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Fundamentals of Engineering Drawing; Theoretical Mechanics; Mechanics of Materials |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>The purpose of this course is to enable students to master the basic principles of commonly used mechanical mechanisms and the design methods of common mechanical parts, preliminarily understand mechanical working principles, and master the design process and methods of common parts and mechanical products.<br>● **Knowledge:** get familiar with the working principles of commonly used mechanisms, and be able to correctly draw mechanism kinematics sketch; master the calculation methods of planar mechanism freedom; be familiar with the design and calculation of common parts; grasp the methods of kinematics and dynamics analysis of planar mechanisms; and master the use of basic design manual and the selection of standard parts.<br>● **Skills:** enable students to be able to correctly analyze the motion characteristics of planar mechanisms; make reasonable selection of mechanisms according to mechanical product working requirements; acquire the capability of designing general parts; master the knowledge about mechanical transmission and parts structure design in practical engineering field.<br>● **Competences:** students are expected to be able to correctly design general mechanical parts and transmission mechanisms, and acquire good comprehensive design and innovation capability, so as to lay a solid foundation for follow-up study of engineering courses. |
| Content | **Part A. Theoretical teaching (78 contact hours and 66 self-study hours)**<br>Introduction: understand the nature, tasks and methods for learning of this course, and master the strength calculation criteria of mechanical parts. (2 contact hours and 2 self-study hours)<br>**Chapter 1:** Kinematics Sketch of Planar Mechanism (to be |

| | |
|---|---|
| | highlighted; 4 contact hours and 2 self-study hours)<br>● Introduction of kinematics pair concept;<br>● Kinematics sketch of planar mechanism;*<br>● Conditions for definite motion of planar mechanism.**<br>**Chapter 2**: Planar Linkage Mechanism Design (key content; 8 contact hours and 4 self-study hours)<br>● Features of hinged four-bar linkage;*<br>● Evolution of hinged four-bar linkage;<br>● Design (graphical method) of planar four-bar linkage;**<br>● Projection drawing of planar stereoscopic and curved solid;<br>● Design (analytical method) of planar four-bar linkage.<br>**Chapter 3**: Cam Mechanism Design (combination of lectures and exercises guidance; 6 contact hours and 4 self-study hours)<br>● Cam mechanism application and classification;<br>● Law of motion of follower;**<br>● Design of disk-shaped cam profile;<br>● Precautions for cam mechanism design;*<br>● Commonly used cam materials and structural design.<br>**Chapter 4**: Intermittent Mechanism Design (brief introduction, 4 contact hours and 4 self-study hours)<br>● Intermittent mechanism characteristics and classification;<br>● Ratchet mechanism design;<br>● Geneva mechanism design;<br>● Incomplete gear mechanism design.<br>**Chapter 5**: Gear Drive Design (key content; 8 contact hours and 8 self-study hours)<br>● Basic law of gearing;<br>● The formation and characteristics of involutes profile;*<br>● Fundamental dimensions calculation of involutes profile;*<br>● Proper gearing conditions and transmission continuity conditions of straight spur gear;**<br>● Transmission and design features of helical-spur gear;<br>● Failure modes and design guidelines of gear drive; |

| | |
|---|---|
| | ● Strength calculation of gear drive;**<br>● Lubrication and efficiency of gear drive;<br>● Structural design of gear drive.<br>**Chapter 6**: Worm Transmission Design (combination of introduction and explaining exercises; 4 contact hours and 4 self-study hours)<br>● Characteristics and application of worm transmission;<br>● Selection and calculation of basic worm drive parameters;*<br>● Stress analysis and strength calculation of worm transmission;<br>● Efficiency and heat balance calculation of worm transmission.<br>**Chapter 7**: Gear Train (key content; 6 contact hours and 6 self-study hours)<br>● Characteristics and classification of gear train;<br>● Transmission ratio calculation of fixed axis gear train;**<br>● Transmission ratio calculation of epicyclical gear train;**<br>● Transmission ratio calculation of compound gear train and function of gear train.*<br>**Chapter 8**: Belt Drive and Chain Drive Design (key content; 6 contact hours and 6 self-study hours)<br>● Features and application of belt drive and chain drive;<br>● Design and calculation of belt drive;**<br>● Design and calculation of chain drive;**<br>● Tensioning and maintenance of belt drive;<br>● Lubrication and layout of chain drive.<br>**Chapter 9**: Threaded Connection Design (combination of introduction and explaining exercises; 8 contact hours and 6 self-study hours)<br>● Basic types of threaded connections;<br>● Pre-tensioning and locking of threaded connection;*<br>● Strength calculation of threaded connection;**<br>● Structural design of threaded connection.<br>**Chapter 10**: Key, Spline, Pin and Profile Connections Design (combination of introduction and explaining exercises; 4 contact hours and 4 self-study hours)<br>● Features and application of key connection; |

| | |
|---|---|
| | ● Spline connection;*<br>● Pin connection;<br>● Profile connection.<br>**Chapter 11**: Riveting, Welding and Bonding Design (combination of introduction and explaining exercises; 6 contact hours and 6 self-study hours)<br>● Features and application of riveting;<br>● Design and calculation of riveting;<br>● Design and calculation of welding and bonding.*<br>**Chapter 12**: Axis Design (key content; 6 contact hours and 4 self-study hours)<br>● Features and application of axis;<br>● Structural design of axis;**<br>● Strength calculation of axis;*<br>● Design examples OF axis.<br>**Chapter 13**: Bearing Design (combination of introduction and explaining exercises; 4 contact hours and 4 self-study hours)<br>● Characteristics and application of bearings;<br>● Design and calculation of sliding bearing ;<br>● Design and calculation of rolling bearing;**<br>● Design of bearing device.<br>**Chapter 14**: Couplers, Clutches and Brakes (combination of introduction and explaining exercises; 2 contact hours and 2 self-study hours)<br>● Characteristics and application of coupler;<br>● Design and selection of coupler;<br>● Design of clutch and brake.<br>**Part B. Experiment / practice teaching ( 18 contact hours and 18 self-study hours )**<br>● The cognitive experiment of mechanism and composition (2 contact hours and 2 self-study hours);*<br>● The drawing experiment of mechanism motion diagram(2 contact hours and 2 self-study hours);**<br>● The parameters determination experiment of the involute cylindrical gear(2 contact hours and 2 self-study hours);**<br>● The generating experiment of involute gear(2 contact hours and 2 self-study hours);**<br>● The experiment of belt transmission (2 contact hours and 2 self-study hours);** |

| | |
|---|---|
| | ● The testing experiment of gear transmission efficiency (2 contact hours and 2 self-study hours);*<br>● The liquid dynamic pressure test experiment of bearing(3 contact hours and 3 self-study hours);*<br>● The experiment of shafting structure assembly and analysis(3 contact hours and 3 self-study hours);* |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 30%, consisted of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 70%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] WANG Xinhua, *Fundamentals of Machine Design (1st edition)*, Chemical Industry Press, 2010<br>2. Reference books<br>[1] YANG Kezhen, *Machine Design (5th edition)*, Higher Education Press, 2006<br>[2] ZOU Huijun, *Machine Principles (2nd edition)*, Higher Education Press, 2006<br>[3] Robert L. MottMachine Elements in Machine design (Fourth Edition) Prentice-Hall UA, ed2003 |

## Engineering Thermodynamics

| | |
|---|---|
| Competence field | Engineering Fundamentals |
| Module designation | Engineering Thermodynamics |
| Code, if applicable | 11000230 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 4th Semester |
| Person responsible for the module | Professor LI Ling |
| Lecturer | Professor LI Ling<br>Professor LU Mei<br>Professor SHAN Yanguang<br>Associate Professor XU Hongtao<br>Associate Professor JIA Zhihai<br>Associate Professor HU Zhuohuan<br>Associate Professor Lu Wei<br>Lecturer WANG Zhiyun<br>Lecturer YAN Weigang |
| Language | Chinese / English |
| Relation to curriculum | Engineering Thermodynamics is a basic course required for undergraduates of energy and power engineering related programs. With a focus on the transformation rules between thermal energy and other types of energy, the course can help students for the further study of Heat Transfer. Engineering Thermodynamics can serve as the foundation for engineering application courses, such as Process Principle and Equipment, Design of Process Equipment, Process Fluid Machinery, Manufacturing Technology of Thermal Power Machniery, and Thermal Engineering and Thermal Power Plants, and elective courses such as Chemical Reaction Engineering, Chemical Process Technique, Process Analysis and Integration, Solar Power Generation and Thermal Utilization and Combined Cycle System. This course is a link between basic courses and specialized courses and lays a foundation for Internship and Bachelor Thesis. |
| Type of teaching, contact hours | Target students: sophomores of energy and power engineering related programs.<br>Type of teaching: theoretical teaching, classroom practice, computer practice, experiment<br>Contact hours: 96 hours<br>Of which,<br>Theoretical teaching: 62 hours<br>Classroom practice: 8 hours |

| | |
|---|---|
| | Experiment / practice teaching: 16 hours<br>Computer practice: 10 hours<br>Size of class: No more than 60 people for theoretical teaching; no more than 60 people for computer practice |
| Workload | Workload= 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3, assignment completion rate over 2/3, computer practice attendance more than twice and completed required teaching experiments are allowed to take the exam. |
| Recommended prerequisites | Calculus; College Physics; Program Design and Practice |
| Module objectives/intended learning outcomes | Module objectives:<br>With a focus on the transformation rules between thermal energy and other types of energy, Engineering Thermodynamics is a basic course for energy and power engineering related programs. It not only offers basic theoretical knowledge for study of specialized courses, but also lays a foundation for work in energy application and engineering equipment design. The objectives of this course is:<br>● **Knowledge:** Master basic concepts and rules of Engineering Thermodynamics; analyze thermodynamic process and thermodynamic cycle and solve related problems by using the basic equations of thermodynamics and thermodynamic graphs with common working substances.<br>● **Skills:** Acquire basis knowledge of thermal energy and the conversion rules of other types of energy required for specialized courses; understand basic principles and main methods for improving energy utilization rate.<br>● **Competences:** Improve students abilities in thinking and practice; enhance students comprehensive competences and abilities in analyzing and solving problems; help students cultivate abilities in solving practical problems occurring in further study and future work by using above-mentioned knowledge and skills. |
| Content | **Part A. Theoretical teaching (62 contact hours; 64 self-study hours)**<br>**Chapter 1** Basic Concepts (4 contact hours; 4 self-study hours)<br>● Thermodynamic system;* |

| | |
|---|---|
| | ● State and equilibrium state, state parameter and its characteristics;**<br>● Parametric coordinates; *<br>● Thermodynamic processes and quasi static process, thermodynamic cycle. *<br>**Chapter 2** First Law of Thermodynamics (6 contact hours; 8 self-study hours)<br>● Nature of first law of thermodynamics;*<br>● Storage energy, work and heat;*<br>● Thermodynamic energy;*<br>● Analysis formula of first law of thermodynamics (close system) ;**<br>● Application of first law of thermodynamics in opening system, steady flow energy equation, enthalpy, technical work, energy equation application. **<br>**Chapter 3** Gas and Steam Properties (4 contact hours; 4 self-study hours)<br>● State equation of ideal gas and gas constant; *<br>● Heat capacity of ideal gas, thermodynamic energy of ideal gas;**<br>● Enthalpy and entropy and their calculation; steam properties;*<br>● Steam chart and its application. **<br>**Chapter 4** Basic Thermodynamic Process of Gas and Steam (6 contact hours; 6 self-study hours)<br>● Objectives and general methods for thermal process analysis;**<br>● Constant volume, constant pressure, constant temperature and adiabatic process of ideal gas; polytropic process and polytropic index; **<br>● Comprehensive analysis of the thermodynamic process of ideal gas.*<br>● Basic thermodynamic process of steam*.<br>**Chapter 5** Second Law of Thermodynamics (8 contact hours; 8 self-study hours)<br>● Process directivity, reversible and irreversible process, nature and expression of second law of thermodynamics;**<br>● Carnot cycle and Carnot theorem;*<br>● Thermodynamic scale, entropy derivation;**<br>● Principle of entropy increase for isolated system; **<br>● Entropy equation, entropy flow and entropy production, work capacity loss.* |

| | |
|---|---|
| | **Chapter 6** Properties of Actual Gas (4 contact hours; 4 self-study hours)<br>● Properties of actual gas, Van Derwal equation; *<br>● State comparison equation, general compression factor graph.*<br>**Chapter 7** Gas and Steam Flow (6 contact hours; 6 self-study hours)<br>● Steady flow equation, basic characteristics of flow of gas and steam in nozzle and diffuser;**<br>● Flow velocity and flow rate, critical pressure ratio, critical velocity and maximum flow;*<br>● Calculation of nozzle, effect of friction on flow;**<br>● Adiabatic stagnation, adiabatic throttle. *<br>**Chapter 8** Thermodynamic Process of Compressor (4 contact hours; 4 self-study hours)<br>● Working principle of compressor, ideal compression work of gas, efficiency of compressor; **<br>● Influence of piston compressor clearance volume, multistage compression and intercooling.*<br>**Chapter 9** Gas Power Cycle (6 contact hours; 6 self-study hours)<br>● Working principle and cycle analysis of piston type internal combustion engine;**<br>● Gas turbine cycle and approches for thermal efficiency improvement. **<br>**Chapter 10** Steam Power Cycle (6 contact hours; 6 self-study hours)<br>● Rankine cycle;**<br>● Influence of steam parameters on thermal efficiency;<br>● Reheat cycle*, regenerative cycle;*<br>● Influence of fluid properties on thermal efficiency.<br>**Chapter 11** Refrigeration Cycle (4 contact hours; 4 self-study hours)<br>● Reverse Carnot cycle;**<br>● Refrigeration coefficien, refrigeration of compressed air and compression refrigeration of vapor;*<br>● Various approaches to improve refrigeration coefficient, refrigerant and its thermodynamic properties.<br>**Chapter 12** Ideal Gas Mixture and Wet Air (4 contact hours; 4 self-study hours)<br>● Concept of ideal gas mixture; **<br>● Partial pressure and partial volume, expression of |

| | |
|---|---|
| | mixed gas components, specific heat of gas mixture, thermodynamic energy;<br>● Calculation of enthalpy and entropy; *<br>● Concept of wet air, absolute humidity and relative humidity, enthalpy of wet air, thermodynamic process of wet air, enthalpy humidity chart, application of wet air. *<br>**Part B. Classroom practice (8 contact hours; 4 self-study hours)**<br>● Application of first and second law of thermodynamics;<br>● Analysis of gas power and steam power cycles;<br>● Calculation of thermodynamic system.<br>**Part C. Experiment teaching (16 experimental operation hours; 10 self-study hours)**<br>Experiment content: P-T determination of saturated water vapor; working capacity loss of heat exchanger with temperature difference; flow characteristic of nozzle; thermal performance testing of thermal equipment such as compressor, refrigeration equipment and cooling tower.<br>Requirements: grasp experiment principles; deepen understanding of theoretical knowledge; learn to how use common thermotechnical test instrument<br>**Part D. Computer practice ( 10 contact hours; 6 self-study hours)**<br>Content: Programming calculation and cycle analysis of steam power cycle by using working medium thermodynamic properties graphs, including Rankine cycle, reheat cycle and steam heat regenerative cycle<br>Requirements: With knowledge of basic concepts and calculation methods of system thermodynamic calculation, students are expected to be able to programming independently and obtain calculation results through computer operation. |
| Study and examination requirements and forms of examination | Final score includes: usual performance (20%); experiment (10%), final exam (closed book written examination) (70%)<br>Usual performance includes: assignment; attendance and computer practice<br>Practice includes: experiment process; experiment report (50%); experiment exam (50%) |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks, teachers pointer, etc. |
| Reading list | 1. Required books<br>[1] SHEN Weidao, TONG Jungeng. Engineering |

| | |
|---|---|
| | Thermodynamics (4th edition). Beijing: Higher Education Press, 2007<br>[2] YAN Jialu, YU Xiaofu, WANG Yongqing. Thermodynamic Properties Graphs of Water and Steam (2nd edition). Beijing: Higher Education Press, 2004<br>2. Reference books<br>[1] ZENG Danling, AO Yue, ZHANG Xinmin. Engineering Thermodynamics (2nd edition). Beijing: Higher Education Press, 2002<br>[2] TONG Jungeng, FAN Yunliang. Learning Guidance and Answers to Exercises for Engineering Thermodynamics Study ((2nd edition). Beijing: Higher Education Press, 2008<br>[3] HE Yaling. Brief Analysis of Engineering Thermodynamics and Detailed Explanation of Typical Questions. Xian: Xian Jiaotong University Press, 2000<br>[4] Richard E Sonntag, Claue Borgnakke. Introduction to engineering thermodynamics. New York: John Wiley and Sons, Inc, 2001<br>3. Experiment/computer practice instruction books<br>[1] Self-compiled teaching materials<br>4. Other materials<br>[1] PPT courseware (self-compiled)<br>[2] Supplementary engineering thermodynamics teaching materials (self-compiled) |

## Machine Design

| | |
|---|---|
| Competence field | Engineering Fundamentals |
| Module designation | Machine Design |
| Code, if applicable | 14002090 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 4th semester |
| Person responsible for the module | Professor DING Xiaohong |
| Lecturer | Professor DING Xiaohong<br>Associate Professor SHEN Jingfeng<br>Associate Professor HUANG Yiqing<br>Lecturer SHI Yunxia |
| Language | Chinese |
| Relation to curriculum | This course focuses on introducing the analysis theories and system integration of machine design, and the knowledge on mechanism combination and variation, etc. It provides the basic principles of common mechanisms and the design methods of general mechanical components for machine design. This course represents the improvement and integration of fundamental courses of machine design. This course enables students to master the design and planning methods of mechanical system motion program, be able to design technical motion process and coordinated motion, get familiar with the methods of kinematics and dynamics analysis of mechanisms, and make comprehensive use of machine design theories to innovate mechanism design, so as to lay the theoretical foundation for the study of follow-up specialized courses. |
| Type of teaching, contact hours | Target students: sophomores of engineering related programs<br>Type of teaching: most of the time is for lectures and practice teaching<br>Contact hours: 96 hours<br>Of which,<br>Theoretical teaching: 78 hours<br>Experiment / practice teaching: 18 hour<br>Computer practice: 0 hour<br>Size of class: 40-60 students |
| Workload | Workload = 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the | Students with class attendance rate over 2/3 and assignment |

| | |
|---|---|
| examination regulations | completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Theoretical Mechanics, Mechanics of Materials |
| Module objectives/intended learning outcomes / | Module objectives:<br>With design innovation as the principle and based on the fundamental courses of machine design, this course further introduces the kinematics analysis of planar mechanisms, the basic knowledge of machine dynamics, the innovation of combined mechanism design and the design and type-selection of typical parts. This course trains students' mechanical system design capabilities as well as mechanical innovation consciousness and ability.<br>● **Knowledge:** master the methods of design and integration of mechanical system motion program; understand the ideas of designing technical motion process and coordinated motion; master the methods of mechanical system design and innovative mechanism combination; get familiar with the methods of adjusting mechanical velocity fluctuation; understand the basic principles of mechanical equilibrium; and learn to solve design, wear and strength calculation problems of commonly used mechanical parts.<br>● **Skills:** be able to design and plan the motion program of mechanical system, correctly analyze and calculate the strength of general parts, and design and analyze simple mechanical system.<br>● **Competences:** students are expected to acquire the capability of comprehensively analyzing and designing mechanical system, making use of the knowledge learnt to expand the design and analysis of mechanical parts and produce new products, and making comprehensive application of mechanical parts design knowledge into the design of specialized products, so as to improve students capability of comprehensive design and innovation of mechanical products. |
| Content | **Part A. Theoretical teaching ( 78 contact hours and 70 self-study hours)**<br>**Introduction:** understand the nature, tasks and methods for learning of this course. (to be roughly understood; 2 contact hours)<br>**Chapter 1:** Analysis of Planar Mechanism Motion (key content; 6 contact hours and 6 self-study hours)<br>● Instantaneous velocity center method and its application in mechanism velocity analysis; |

| | |
|---|---|
| | ● Vector equation graphical method and its application in mechanism velocity analysis; **<br>● Application of analytical method in mechanism velocity analysis. *<br>**Chapter 2:** Mechanism Combination and Design Innovation (to be mastered; 6 contact hours and 8 self-study hours)<br>● Basic mechanisms and their motion characteristics;<br>● Basic mechanisms and the concept of their combinations; **<br>● Principles for various combinations of mechanisms and their innovative design. **<br>**Chapter 3:** Design of Technical Motion Process and Coordinated Motion (to be mastered; 6 contact hours and 4 self-study hours)<br>● Design of working principles and technical motion;<br>● Design of technical motion process and law of motion; **<br>● Design of coordinated motion of actuating mechanism;<br>● Design of mechanical motion cycle diagram. **<br>**Chapter 4:** Design of Mechanical Motion Program (to be roughly understood; 6 contact hours and 6 self-study hours)<br>● Type-selection of mechanisms; **<br>● Innovative design of mechanisms;<br>● Design and establishment of mechanical motion program; *<br>● Mechanical motion program evaluation system and evaluation methods.<br>**Chapter 5:** Machine Running and The Regulation of Its Velocity Fluctuation (key content, 6 contact hours and 6 self-study hours)<br>● Machine equivalent dynamics model; **<br>● Establishment and solution of mechanical motion equation;<br>● Mechanical velocity fluctuation and regulation. *<br>**Chapter 6:** Mechanical Equilibrium (key content, 6 contact hours and 6 self-study hours)<br>● Rigid rotor equilibrium; **<br>● Rigid rotor equilibrium test;<br>● Mechanism equilibrium. *<br>**Chapter 7:** Mechanical System Design Examples (to be roughly understood; 6 contact hours and 6 self-study hours)<br>**Chapter 8:** Mechanical Seal (to be mastered, 6 contact hours and 4 self-study hours) |

| | |
|---|---|
| | ● Gasket seal;<br>● Packing seal;<br>● Lubricant seal;<br>● Seal ring seal. *<br>**Chapter 9:** Riveting, Welding and Bonding Design (to be roughly understood; 6 contact hours and 4 self-study hours)<br>● Riveting;<br>● Welding;<br>● Bonding.<br>**Chapter 10:** Friction Wheel Transmission (to be mastered; 4 contact hours and 4 self-study hours)<br>● Transmission design of friction wheel with fixed transmission ratio; **<br>● Friction wheel materials and lubricants.<br>**Chapter 11:** Design of Modified Gear and Gearbox (key content; 6 contact hours and 6 self-study hours)<br>● Overview of modified gear;<br>● Geometric calculation of modified gear drive; **<br>● Type of modified gear drive;<br>● Classification of gearboxes;<br>● Gearbox transmission mechanism; **<br>● Structural forms of main parts of gearbox;<br>● Selection of main parameters of gearbox; **<br>● Gearbox control mechanism.<br>**Chapter 12:** Couplers, Clutches and Brakes (to be mastered; 6 contact hours and 6 self-study hours)<br>● Couplers; **<br>● Clutches; *<br>● Brakes.<br>**Chapter 13:** Spring Design (to be mastered; 6 contact hours and 4 self-study hours)<br>● Spring function and type; *<br>● Spring materials and manufacture; **<br>● Design and calculation of cylindrical helix compression (tension) spring.<br>**Part B. Experiment/practice teaching (18 contact hours and 14 self-study hours)**<br>● The drawing experiment of mechanism motion diagram(4 contact hours and 4 self-study hours);**<br>● The generating experiment of involute gear(6 contact hours and 4 self-study hours);**<br>● The experiment of shafting structure assembly and analysis(4 contact hours and 4 self-study hours);* |

| | |
|---|---|
| | ● The parameters determination experiment of couplers (4 contact hours and 2 self-study hours).* |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 30%, consisted of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 70%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] WANG Xinhua, Advanced Machine Design, Chemical Industry Press, 2013<br>2. Reference books<br>[1] HUANG Xikai, Principles of Machine (6th edition), Beijing: Higher Education Press, 2010<br>[2] PU Lianggui, Machine Design (7th edition), Beijing: Higher Education Press, 2001<br>[3] ZOU Huijun, Principles and Methods of Innovative Machine Design, Beijing: Higher Education Press, 2008<br>[4] Robert L. Mott, Machine Elements in Machine design (Fourth Edition), Prentice-Hall, US, ed2003 |

## Engineering Fluid Mechanics

| | |
|---|---|
| Competence field | Engineering Fundamentals |
| Module designation | Engineering Fluid Mechanics |
| Code, if applicable | 11000220 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 4th semester |
| Person responsible for the module | Professor YANG Ailing |
| Lecturer | Professor GUO Xueyan<br>Associate Professor CHEN Eryun<br>Associate Professor WANG Haimin<br>Associate Professor YANG Fan<br>Associate Professor WANG Qikun<br>Lecturer CHEN Liu |
| Language | Chinese / English |
| Relation to curriculum | Engineering Fluid Mechanics is an engineering basic course offered for undergraduates of energy and power engineering related programs. After studing of Calculus, College Physics and Theoretical Mechanics and this course, students can further study of Fluid Mechanics related courses such as Pump and Fans, Principles and Design of Heat Exchanger, Design of Process Equipment, and Process Fluid Machinery. Through this course, students will master the basic laws of fluid motion, have an intimate knowledge of basic principles of Fluid Mechanics and acquire abilities in analyzing and studying basic laws of fluid mechanics of power equipment, which will lay a solid foundation for further study and future engagement in engineering work. |
| Type of teaching, contact hours | Target students: sophomores of energy and power engineering related program<br>Type of teaching: theoretical teaching, computer practice, experiment<br>Contact hours: 96 hours<br>Of which,<br>Theoretical teaching: 64 hours<br>Experiment teaching: 20 hours<br>Computer practice: 12 hours<br>Size of class: 60 people |
| Workload | Workload= 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the | Students with class attendance rate over 2/3, assignment |

| | |
|---|---|
| examination regulations | completion rate over 2/3, and submission of complete experiment report |
| Recommended prerequisites | Calculus, College Physics, Theoretical Mechanics |
| Module objectives/intended learning outcomes | Module objectives:<br>Engineering Fluid Mechanics is an engineering basic course offered for undergraduates of energy and power engineering related programs. It mainly introduces the basic concepts and theories of Fluid Mechanics and its enginnering application. Through this course, students can acquire the abilities in analyzing and studying basic laws of mechanics of power equipment, which will lay a solid foundation for further study and future engagement in engineering work.<br>● **Knowledge:** Master basic concepts of fluid motion; describe basic laws, basic theories and calculation methods of fluid motion.<br>● **Skills:** Through this course, students can acquire the abilities in analyzing and studying basic laws of fluid mechanics of power equipment so as to be able to modify and optimize design to improve operation efficiency of power equipment.<br>● **Competences:** Through intergration of theoretical knowledge and practical work, students are able to optimize product design, organize product manufacturing, and solve thermal energy and power machinery design related problems with acquired knowledge. |
| Content | **Part A. Theoretical teaching (64 contact hours; 68 self-study hours)**<br>**Chapter 1** Fluid and Physical Properties (5 contact hours; 6 self-study hours)<br>● Subjects and Development of Fluid Mechanics Study; Study subjects, research methods and development of fluid mechanics;<br>● Continuous Medium Hypothesis, definition of fluid particles and continuous medium hypothesis;*<br>● Basic Attributes of Fluid, density, viscosity and compressibility of fluid;<br>● Newton inner friction theorem.**<br>**Chapter 2** Fluid Statics (8 contact hours; 9 self-study hours)<br>● Hydrostatic pressure and its characteristics; Characteristics of hydrostatic pressure, basic equation of fluid statics;<br>● Establishment method for fluid differential balance |

| | |
|---|---|
| | equation, basic relation formula of fluid statics, differential pressure calculation method within static fluid and pressure measuring principle of liquid column manometer;**<br>● Relative balance of fluid, pressure distribution law and calculation of relatively balanced fluid;<br>● Static Fluid Forces on Walls, basic methods and relevant calculation for static fluid surface and plane stress.*<br>**Chapter 3** Hydrokinematics (5 contact hours; 6 self-study hours)<br>● Flow field and its description method, two description methods of flow field; basic concepts of material derivative, local derivative and convective derivative;*<br>● Streamline and trace, concepts and relevant features of trace, streamline and flow tube; *<br>● Flow calculation method; **<br>● Definitions of flow field vorticity, vortex line and vortex tube;<br>● Flow pattern of viscous fluid, Reynolds experiment; basic features of laminar flow and turbulent flow, definition and functions of Reynolds number.*<br>**Chapter 4** Analysis and Application of Fluid Mechanics (12 contact hours; 12 self-study hours)<br>● Continuity equation of reynolds transport theory and integral form;<br>● Physical meaning of Reynolds transport theory, basic equation of fluid mechanics by using Reynolds transport theory; continuity equation of one dimensional steady pipe flow and its application; **<br>● Energy equation and Bernoulli Equation, energy equation of one dimensional constant adiabatic ideal flow, physical meaning of Bernoulli equation of non-compressible ideal steady flow, application of Bernoulli equation in engineering work;**<br>● Momentum equation and application, equation of steady flow; solving one dimensional steady flow problems by using continuity equation, Bernoulli equation and momentum equation; **<br>● Moment of momentum equation of steady flow and its application in impeller machinery.<br>**Chapter 5** Internal Flow of Incompressible Viscous Fluid (13 contact hours; 14 self-study hours) |

| | |
|---|---|
| | ● Energy loss of pipe flow, two types of flow loss of viscous pipe flow; causes of the loss; total flow Bernoulli equation of viscous flow;*<br>● Uncompressible laminar flow within circular section tube, stress, speed and distribution features of linear loss of fully developed laminar flow tube;<br>● Uncompressible turbulence within tube, basic features of turbulence, structure of tube turbulence and speed distribution features, concept of turbulence shear stress and calculation of liner loss; calculation of local loss;**<br>● Resistance of non-circular cross section tube,resistance comparison between non-circular cross section tube and circular cross section tube, definition of hydraulic diameter; calculation method for linear resistance of non-circular cross section tube and local resistance;<br>● Calculation of pipeline loss, calculation methods for three common pipeline problems in engineering, calculation of serial pipeline and parallel pipeline, basic concept and calculation thinking of branch pipeline and pipe network.**<br>**Chapter 6** External Flow Around Uncompressible Viscous Flow (7 contact hours; 7 self-study hours)<br>● Basic concepts and features of boundary layer; definitions of boundary layer thickness, squeezing thickness and momentum deficit thickness;<br>● Two-dimensional flat plate boundary Layer,calculation of momentum integral equation of Von-Karman boundary layer, laminar boundary layer and flat plate turbulence boundary layer;*<br>● Boundary layer separation and round flow resistance, basic concepts of boundary layer separation; familiar with resistance calculation method for uncompressible viscous round flow objects.**<br>**Chapter 7** Compressible Fluid Mechanics (7 contact hours; 7 self-study hours)<br>● Velocity of sound and Mach number transmission features of weak orbiting in moving flow;<br>● Basic equation of one-dimensional isentropic pipe flow, isentropic flow and basic equation of one-dimensional isentropic flow; *<br>● Isentropic flow in spray tube, conversion rules of parameters in spray tube such as isentropic flow speed, pressure and temperature; calculation of compressible |

| | |
|---|---|
| | flow of contraction nozzle.**<br>**Chapter 8** Similarity Principle* (7 contact hours; 7 self-study hours)<br>● Similar flow conditions, basic conditions of flow field similarity and interrelations between similar proportion constants;*<br>● Similarity principle and similarity criterion, physical meaning of commonly used similarity numbers of fluid mechanics;**<br>● Dimensional analysis, dimensional analysis method; *<br>● Approximate model calculation.<br>**Part B. Practice teaching* (12 computer practice hours; 6 self-study hours)**<br>Complete 3 calculation examples of flow around circular cylinder, cavity flow andnumerical simulation of compressor internal flow field with Phoenix Software.<br>**Part C. experiment teaching* (20 experiment operation hours; 10 self-study hours)**<br>Complete hydrostatics experiment, Reynolds experiment, non-compressible fluid momentum equation verification, non-compressible fluid energy equation verification, resistance coefficient of round tube internal path and local resistance coefficient determination experiment. |
| Study and examination requirements and forms of examination | 6 assignments and 1 final exam; usual performance accounts for 30% of final score; each assignment accounts for 5%; final exam accounts for 70%; final exam is closed book written examination |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks, teachers pointer, product model etc. |
| Reading list | 1. Required books<br>[1] GUI Ketint, WANG Jun, WANG Qiuying. Engineering Fluid Mechanics (1st edition). Beijing: Science Press, 2003<br>2. Reference books<br>[1] KONG Long. Engineering Fluid Mechanics (1st edition). Beijing: China Electric Power Press, 1992<br>[2] ZHOU Guangjong, YAN Zongyi, XU Shixiong. Fluid Mechanics (2nd edition). Beijing: Higher Education Press, 2000<br>[3] Roberson, Emeritus. Engineering Fluid Mechanics, 10th Ed, New York: Wiley, 2012.<br>3. Experiment/computer practice instruction books<br>[1] Self-compiled teaching materials<br>4. Other materials |

| | |
|---|---|
| | [1] PPT courseware (self-compiled) |

## Process Control Theroy

| | |
|---|---|
| Competence field | Engineering Fundamentals |
| Module designation | Process Control Theory |
| Code, if applicable | 11000320 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 5th semester |
| Person responsible for the module | Associate Professor HU Zhuohuan |
| Lecturer | Associate Professor XU Hongtao<br>Lecture LI Zeqiu<br>Lecturer SUN Li<br>Lecturer WANG ZHiyuan |
| Language | Chinese |
| Relation to curriculum | This course highlights the characteristics of Process Equipment and Control Engineering program. Students can not only master basic knowledge of control theories but also participate in practice and application. Main contents include basic concepts of process control systems and application schemes of typical process control system. This course contains basic concepts of automatic control, mathematical models of control system such as open and closed loop transfer functions, time domain analysis method, root locus technique, frequency domain analysis of control system, design and calibration of control system and application schemes of typical process control system such as PLC control system and PID control system. |
| Type of teaching, contact hours | Target students: juniors of Process Equipment and Control Engineering program.<br>Type of teaching: theoretical teaching, multimedia aided instruction<br>Contact hours: 96 hours<br>Of which<br>Theoretical teaching: 66 hours<br>Experiment / practice teaching: 30 hours<br>Size of class: No more than 60 people for theoretical teaching |
| Workload | Workload= 180 hours<br>Contact hours =96 hours<br>Self-study hours =84 hours |
| Credit points | 6.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |

| | |
|---|---|
| Recommended prerequisites | Calculus; College Physics; Linear Algebra; Engineering Thermodynamics. |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to understand the static and dynamic characteristics of process flow and production process. Through this course, students can acquire the abilities in analyzing and studying basic principles of process control.<br>● **Knowledge:** Master basic knowledge of process equipment control and principle of process controller; obtain a broad knowledge of process equipment measurement and control technology.<br>● **Skills:** Through this course, students can acquire the abilities in analyzing the process by using technical means, to be able to design and calibrate the control system.<br>● **Competences:** Through system intergration of computer measurement and control techniques for process equipment, students are able to build a fine foundation for future practical work and scientific research. |
| Content | **Part A. Theoretical teaching (66 contact hours; 75 self-study hours)**<br>**Chapter 1** Basic Concepts of Automatic Control (6 contact hours; 6 self-study hours)<br>● Composition of automatic control system, negative feedback principle and classification of control systems.<br>**Chapter 2** Mathematical Model of Control System (8 contact hours; 12 self-study hours)<br>● Method of building dynamic differential equation;<br>● Open and closed loop transfer function; *<br>● Error transfer function; **<br>● Rendering and simplification of block diagram signal flow; **<br>● Method of using Mason Gain Formula to get transfer function. **<br>**Chapter 3** Time Domain Analysis Method (8 contact hours; 10 self-study hours)<br>● Time domain analysis method and stability concepts and criteria; *<br>● Calculation and analysis of steady state error. **<br>**Chapter 4** Root Locus Technique (12 contact hours; 12 self- |

| | |
|---|---|
| | study hours)<br>● Principle of drawing root locus plot; **<br>**Chapter 5** Frequency Domain Analysis of Control System (12 contact hours; 13 self-study hours)<br>● Open and closed loop frequency characteristics of linear systems; **<br>● Analysis of absolute stability of system; **<br>● Calculation of relative stability index; **<br>● Relationship between frequency domain and time domain index. **<br>**Chapter 6** Design and Calibration of Control System (12 contact hours; 12 self-study hours)<br>● Basic control law of linear system;<br>● Common correction device; **<br>● Application of frequency characteristic method in system calibration; **<br>● Analytical methods for sample control system dynamic and steady-state performance;<br>● Stability criteria for sample systems.<br>**Chapter 7** Application Schemes of Typical Process Control System (8 contact hours; 10 self-study hours)<br>● PID control system;<br>● Control examples of process equipment.<br>**Part B. Experiment / practice teaching (30 experiment hours; 9 self-study hours)**<br>● Training process simulation of PLC control system in computer operation (30 experiment hours; 9 self-study hours) |
| Study and examination requirements and forms of examination | Final score includes: usual performance (30%); final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate and computer practice.<br>Experiment score includes: experiment report (50%); and experiment exam (50%) |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |

| | |
|---|---|
| Reading list | 1. Required books<br>[1] TIAN Zuohua. Foundation of Engineering Control. Beijing: Tsinghua University Press, 2010<br>2. Reference books<br>[1] ZHOU Chunhui. Principles of Chemical Process Control. Beijing: Chemical Industry Press, 1998<br>[2] HU Shousong. Automatic Control Principle ( Fourth Edition). Beijing: Science Press, 2001<br>[3] LU Jingchao. Typical Analysis and Tests on The Problems of Automatic Control Principle. Xi'an: Northwest Industrial University Press, 2001<br>[4] HUANG Zhonglin. MATLAB Calculation and Simulation of Control System (Second Edition). Beijing: National Defend Industry Press, 2006<br>[5] ZHANG Bin. Automatic Control Principle. Beijing: Beijing University of Posts and Telecommunications Press, 2002 |

## Heat Transfer

| | |
|---|---|
| Competence field | Engineering Fundamentals |
| Module designation | Heat Transfer |
| Code, if applicable | 11000050 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 5th semester |
| Person responsible for the module | Professor YANG Mo |
| Lecturer | Professor LIN Zonghu<br>Professor CHENG Ping<br>Professor LU Mei<br>Professor SHAN Yanguang<br>Professor LI Ling<br>Associate Professor JIA Zhihai<br>Associate Professor YE Li<br>Associate Professor ZHAO Ming<br>Associate processor XU Hongtao<br>Lecturer WANG Zhiyun<br>Lecturer CHEN Jian |
| Language | Chinese / English |
| Relation to curriculum | Heat Transfer is one of the main courses for undergraduates of Energy and Power Engineering related programs. It focuses on the study of heat transfer rules. The course mainly explains concepts, theory, calculation and application of conduction, convection, phase change, radiation and heat transfer processes. It also introduces some elementary knowledge of typical computer solution of heat transfer problems. As a link between theoretical study and practical work, the course is an important way of cultivating students' abilities in analyzing and solving heat transfer problems. It still lays a foundation for follow-up Professional Comprehensive Course Design, Internship and Bachelor Thesis. |
| Type of teaching, contact hours | Target students: undergraduates of energy and power engineering related programs.<br>Type of teaching: theoretical teaching, computer practice, experiment<br>Contact hours: 96 hours<br>Of which,<br>Theoretical teaching: 72 hours<br>Computer practice: 12 hours<br>Experiment: 12 hours<br>Size of class: No more than 60 people for theoretical |

| | |
|---|---|
| | teaching; no more than 60 people for computer practice; no more than 4 people in each group for experiment. |
| Workload | Workload= 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3, computer practice attendance more than twice and having completed required teaching experiments are allowed to take the exam. |
| Recommended prerequisites | College Physics; Calculus; Engineering Thermodynamics; Enginerring Fluid Mechanics. |
| Module objectives/intended learning outcomes | Module objectives:<br>Heat Transfer is one of the basic courses for undergraduates of energy and power engineering related programs before the start of specialized courses. The course helps students understand basic laws, concepts, theories, calculation and application knowledge of Heat Transfer, and lays a foundation for further study and future practical work. The course can improve students' abilities in thinking and practice as well as abilities in analyzing and solving practical problem.<br>● **Knowledge:** Heat Transfer includes four modules. 1. Basic knowledge module, including basic concepts, theories and calculation methods of conduction, convection, radiation and heat transfer processes. It helps students solve basic heat transfer problems in engineering; 2. Theoretical knowledge module, including boundary layer theory, similarity and analogy method and Numerical solution. This module focuses on methods for problem analysis and solution as well as training of mastery of method and thinking ability; 3. Application of Heat Transfer, including heat exchanger calculation and and new heat transfer technologies; 4. Computer practice of Heat Transfer. It focuses on solving three main Heat Transfer problems including one-dimensional, two-dimensional and non-steady heat transfer.<br>● **Skills:** Lay a foundation for further study and future practical work; improve students' abilities in thinking and practice.<br>● **Competences:** Improve students' ability in solving practical physical problems with basic Heat Transfer theories integrating theoretical knowledge with practice |

| | |
|---|---|
| | work. |
| Content | **Part A. Theoretical teaching (72 contact hours; 64 self-study hours)**<br>**Chapter 1** Introduction (6 contact hours; 6 self-study hours)<br>● Three ways of heat transfer: conduction, convection and radiation; *<br>● Heat resistance; heat transfer process and coefficient; development history of Heat Transfer.<br>**Chapter 2** Basic Rules of Heat Conduction and Steady Heat Conduction (10 contact hours; 8 self-study hours)<br>● Temperature field; temperature gradient; Fourier's law and heat transfer coefficient;**<br>● Differential equation of heat conduction; initial and boundary conditions; *<br>● Thermal conductivity of monolayer and multilayer flat walls, thermal conductivity of single and multi cylinder wall; fin heat conduction; fin efficiency;<br>● Variable cross-section thermal conductivity, heat source and multi dimension heat conduction.<br>**Chapter 3** Non-steady Heat Conduction (6 contact hours; 6 self-study hours)<br>● Basic concepts of non-steady heat conduction; lumped parameter method;**<br>● Analysis of one dimensional unsteady heat conduction solution;*<br>● Nomograph;<br>● Solving of two-dimensional and three-dimensional unsteady heat conduction problems;<br>● Non steady heat conduction of a semi infinite body.<br>**Chapter 4** Numerical Solution of Heat Conduction Problems (8 contact hours; 6 self-study hours)<br>● Basic ideas of numerical solution of heat conduction problems;<br>● Establishment of discrete equations; solution of algebraic equations;<br>● Numerical solution of unsteady heat conduction problems.<br>**Chapter 5** Heat Convection (12 contact hours; 10 self-study hours)<br>● Introduction of heat convection, Newton's formula; affecting factors of heat convection coefficient, concepts of velocity and temperature boundary layer;* |

| | |
|---|---|
| | ● Convective heat transfer differential equations and boundary conditions, Integral equations for laminar flow along plate heat exchanger and its solution;**<br>● Comparison between momentum transfer and heat transfer, application of similarity theory in convective heat transfer;<br>● Forced convection heat transfer tube characteristic and experimental type;**<br>● Flow around single tube and tube bundle heat release and relations, large space free convection and limited space free convection.<br>**Chapter 6** Boiling and Condensation Heat Transfer (4 contact hours; 4 self-study hours)<br>● Dropwise condensation and film condensation; film condensation heat transfer analysis and experimental correlation, affecting factors of film condensation;<br>● Large container saturated boiling curve, calculation of nucleate boiling, factors affecting boiling heat transfer.<br>**Chapter 7** Basic Law of Radiation and Object Radiation Characteristics ( 10 contact hours; 8 self-study hours)<br>● Characteristics of thermal radiation, absorptance rate, reflectance and penetration ratio, black, white, transparent body, blackness, radiation force and monochromatic radiation force, directional radiation intensity, basic law of thermal radiation; **<br>● Planck's constant law; Wien's law, Stephen Boltzmann's law, Lambert's law, radiation characteristics of solid and liquid, absorption ratio of the actual object and Kirchhoff's law. *<br>**Chapter 8** Calculation of Radiation Heat Transfer (8 contact hours; 8 self-study hours)<br>● Angular coefficient; radiation heat transfer between two solid surfaces separated by heating medium;**<br>● Calculation of radiation heat transfer surface system, network method, radiation heat hardening and weakening; heat shield plate; gas radiation.<br>**Chapter 9** Analysis of Heat Transfer Process and Calculation of Heat Exchanger (8 contact hours; 8 self-study hours)<br>● Composite heat transfer and combined heat transfer surface heat transfer coefficient;<br>● Heat transfer process and calculation of heat transfer coefficient; critical insulation diameter, average |

| | |
|---|---|
| | temperature in the pattern of the heat exchanger and logarithmic pressure;**<br>● Heat calculation of heat exchanger, -NTU method; teat transfer enhancement and insulation technology.<br>**Part B. Computer practice (12 contact hours; 10 self-study hours)**<br>Solving three steady or non-steady heat conduction problems with computer; master value solution of heat conduction problems; conduct temperature field calculation under specific boundary conditions<br>**Part C. Experiment (12 contact hours; 10 self-study hours)**<br>● Heat conduction experiment: master affecting factors of conduction process; familiar with measurement method of each parameter;<br>● Convection heat transfer experiment; master convection process; familiar with testing method of each parameter;<br>● Radiation heat transfer experiment: master affecting factors of radiation heat transfer process; familiar with testing method of each parameter. |
| Study and examination requirements and forms of examination | 8 assignments (accounting for 30% of final score with each assignment accounting for 3%), 1 mid-term exam (accounting for 30% of final score) and 1 final exam (accounting for 70% of final score)(closed book written examination). |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks, product model. |
| Reading list | 1. Required books<br>[1] YANG Shiming, TAO Wenquan. *Heat Transfer* (4th edition). Beijing: Higher Education Press, 2006.<br>2. Reference books (English reference books required)<br>[1] YANG Shiming, TAO Wenquan. *Heat Transfer* (3rd edition). Beijing: Higher Education Press, 1988.<br>[2] J.P. Holman. *Heat Transfer*, Seventh. 9th Ed McGraw-Hill New York1999.<br>[3] XIE Shuyi. *Vector Analysis and Field Theory* (2nd edition). Beijing: Higher Education Press, 1987.<br>[4] TAO Wenquan. *Numerical Heat Transfer*. Xian: Xian Jiaotong University Press, 1988.<br>3. Experiment/computer practice instruction books<br>[1] Self-compiled teaching materials<br>4. Other materials |

| | |
|---|---|
| | [1] PPT courseware (self-compiled)<br>[2] Supplementary heat transfer teaching materials (self-compiled) |

## Introduction to Process Equipement and Control Engineering

| | |
|---|---|
| Competence field | Engineering Fundamentals |
| Module designation | Introduction to Process Equipment and Control Engineering |
| Code, if applicable | 11000420 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 5th semester |
| Person responsible for the module | Professor CAI Xiaoshu |
| Lecturer | Professor CAI Xiaoshu<br>Associate Professor YE Li<br>Associate Professor XU Bo<br>Lecturer XU Jiayin<br>Lecturer WANG Zhiyuan |
| Language | Chinese & English |
| Relation to curriculum | This course is open to the junior students who have completed the usual courses in Calculus, Physics, Engineering Thermodynamics, Engineering Fluid Mechanics and Intensive English. It introduces the progress of the process industry, the basic equipment in the unit operation and the control system in the chemical engineering in English. Bilingual teaching is used to improve students' abilities of listening, speaking, reading and writing in professional English. It makes sound basis for reading the English scientific papers and communicating with the engineers or researchers from all over the world. |
| Type of teaching, contact hours | Target students: junior of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching<br>Contact hours: 64 hours<br>Of which,<br>Theoretical teaching: 64 hours<br>Size of class: No more than 60 people for theoretical teaching |
| Workload | Workload= 120 hours<br>Contact hours = 64 hours<br>Self-study hours = 56 hours |
| Credit points | 4.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required oral presentation are allowed to take the exam. |
| Recommended prerequisites | Intensive English; Reading and Writing in Technical English; College Chemistry ;Mechanics of Materials; Theoretical Mechanics ; Engineering Thermodynamics; |

| | |
|---|---|
| | Engineering Fluid Mechanics; Heat Transfer. |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to have a clear conception of Process Equipment and Control Engineering. Specific objectives include:<br>● **Knowledge:** Keep in mind a lot of professional English words on chemical engineering, unit operation and process industry; understand the definition of stress and strain in the solid mechanics; master classification of unit operations and transport phenomena in process industry; get familiar with the main components applied on pressure vessels; recognize types of heat exchangers, reactors, pumps and valves; grasp the traditional way to control a process.<br>● **Skills:** Translate English literature into a well-written Chinese one; communicate with engineers and researches in the same field.<br>● **Competences:** Get familiar with the style of English scientific papers; have a whole and clear conception of process equipment and control engineering; improve abilities of listening, speaking, reading and writing in English. |
| Content | **Part A. Theoretical teaching (64 contact hours; 56 self-study hours)**<br>**Chapter 1** Basic Knowledge of Mechanics (4 contact hours; 2 self-study hours)<br>● General equilibrium conditions of a system;<br>● Stress and Strain.<br>**Chapter 2** Metallic Materials (4 contact hours; 2 self-study hours)<br>● Properties of materials; **<br>● Manufacturing engineering processes.<br>**Chapter 3** Process Industry (16 contact hours; 16 self-study hours)<br>● Chemical engineering; *<br>● Principles of heat transfer; **<br>● Unit operation in chemical engineering; **<br>● Chemical reaction engineering; *<br>**Chapter 4** Process Equipment (16 contact hours; 16 self-study hours)<br>● Pressure vessels and their components; **<br>● Distilling equipment; *<br>● Types of heat exchangers; ** |

| | |
|---|---|
| | ● Types of reactors. *<br>**Chapter 5** Process Machinery (16 contact hours; 16 self-study hours)<br>● Pumps; **<br>● Solid liquid separation; *<br>● Valves; **<br>● Seal classification.<br>**Chapter 6** Process Control (8 contact hours; 4 self-study hours)<br>● Introduction to process control; **<br>● Process control equipment.<br>**Part B. Computer practice (0 hour)** |
| Study and examination requirements and forms of examination | Final score includes: usual performance (30%), Oral exam (70%) Usual performance includes: assignment and attendance rate.<br>Oral exam score includes: PPT preparation (30%); language organization and performance (70%). |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books<br>[1] XU Hong, DONG Qiwu, WU Dongli. Professional English on the Process Equipment and Control Engineering Combustion. Beijing: Chemical Industry Press, 2000<br>2. Reference books<br>[1] Warren McCabe, Julian Smith, Peter Harriott. Unit Operations of Chemical Engineering 4th edition. McGraw-Hill Education, 1985<br>[2] B.G. Kyle. Chemical and Process Thermodynamics. Prentice-Hall, 1984<br>[3] Meinhard Schobeiri. Fluid Mechanics for Engineering: a Graduate Textbook. Springer, 2010<br>3. References for oral presentation<br>[1] Yu.F. Maydanik. Review: Loop Heat Pipes. Applied Thermal Engineering 25 (2005) 635-657<br>[2] L.V. Biert et al. A Review of Fuel Cell Systems for Maritime Applications. Journal of Power Sources 327 (2016) 345-364<br>4. Other materials<br>[1] PPT courseware (self-compiled) |

# Engineering Applications

## Safety Technology of Process Equipment

| | |
|---|---|
| Competence field | Engineering Applications |
| Module designation | Safety Technology of Process Equipment |
| Code, if applicable | 11001510 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 3rd semester |
| Person responsible for the module | Associate Professor XU Bo |
| Lecturer | Associate Professor XU Bo<br>Associate Professor NAN Guofang<br>Associate Professor HU Zhuohuan<br>Lecturer SUN Li |
| Language | Chinese |
| Relation to curriculum | Safety Technology of Process Equipment is an engineering application course offered to undergraduates of Process Equipment and Control Engineering program. Theoretical knowledge in the curriculum is crucial for main devices applied in process equipment, such as heat exchanger, pressure vessel, and reactor. Based on the engineering practice, the course systematically introduces basic regulations and safety management methods, including standards, case analysis, materials, safety accessory and detection technology, which is useful for students to engage in related work. |
| Type of teaching, contact hours | Target students: sophomores of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching<br>Contact hours: 48 hours<br>Of which<br>Theoretical teaching: 48 hours<br>Size of class: No more than 60 people for theoretical teaching |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Mechanics of Materials; Theoretical Mechanics; |

| | |
|---|---|
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to understand safety technology of process equipment and basic engineering theories. Specific objectives include:<br>● **Knowledge:** Master basic knowledge and theories required by learning Safety Technology of Process Equipment, such as standards, design technique, manufacturing technology, and detection technology; understand the structure and the mechanism of safety device.<br>● **Skills:** Students acquire basic theoretical and specialized knowledge about Safety Technology of Process Equipment; understand engineering applications of pressure vessel and safety device; acquire deep understanding of the safe operation about pressure vessel.<br>● **Competences:** Students acquire practical abilities about the prevention, the emergency disposal and the post-mortem analysis of pressure vessel explosion accident. |
| Content | **Part A. Theoretical teaching (48 contact hours; 42 self-study hours)**<br>**Chapter 1** Pandect of pressure vessels (9 contact hours; 6 self-study hours)<br>● Safety of pressure vessels; *<br>● Operating characteristic of pressure vessels; *<br>● Definition and classification of pressure vessels. **<br>**Chapter 2** Stress and design method of pressure vessel (6 contact hours; 6 self-study hours)<br>● Load and Stress classification of pressure vessels;*<br>● Design methods of pressure vessel. **<br>**Chapter 3** Pressure vessel test technology (6 contact hours; 6 self-study hours)<br>● Test methods for pressure vessels; *<br>● Hydraulic test, pressure test and air tightness test. **<br>**Chapter 4** Nondestructive test of pressure vessels (6 contact hours; 6 self-study hours)<br>● Methods of nondestructive test; *<br>● Applications of nondestructive test. **<br>**Chapter 5** Safety device for pressure vessel (6 contact hours; 6 self-study hours)<br>● Basic structure of safety device; *<br>● Design and selection of safety device; ** |

| | |
|---|---|
| | ● Applications of safety device. **<br>**Chapter 6** Gas cylinders and mobile pressure vessels (9 contact hours; 6 self-study hours)<br>● Basic concepts of gas cylinders and mobile pressure vessels; *<br>● Safe applications of gas cylinders and mobile pressure vessels; **<br>● Methods of safety management. *<br>**Chapter 7** Inspection technology of pressure vessels (6 contact hours; 6 self-study hours)<br>● Basic requirements of inspection technology; *<br>● Applications of inspection technology. **<br>**Part B. Experiment / practice teaching (0 hours)** |
| Study and examination requirements and forms of examination | Final score includes: usual performance (30%); final exam is presentation (70%).<br>Usual performance includes: assignment and attendance rate. |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books<br>[1] TAN Wei, Safety Management Technology of Pressure Vessel. Beijing: Chemical Industrial Press, 2006<br>2. Reference books<br>[1] LI Guocheng, LIU Renhuan. Safety Assessment of Pressure Vessels. Beijing: China Petrochemical Press, 2007<br>[2] ZHANG Heguan, Safety Operation and Management of Pressure Vessel. Hefei: Anhui Science and Technology Press, 2006<br>[3] CHEN Xu. Mechanical Foundation of Process Equipment. Beijing: Chemical Industrial Press, 2011<br>3. Other materials<br>[1] PPT courseware (self-compiled) |

## Computer Modeling Practice

| | |
|---|---|
| Competence field | Engineering Applications |
| Module designation | Computer Modeling Practice |
| Code, if applicable | 11100571 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 4th semester |
| Person responsible for the module | Professor SU Mingxu |
| Lecturer | Professor SU Mingxu<br>Associate Professor WANG Zilong<br>Lecturer YANG Jie(M)<br>Lecturer CHEN Liu<br>Lecturer HAO Xiaohong<br>Lecturer WEN Zhenzhong |
| Language | Chinese |
| Relation to curriculum | This course belongs to Competence Fields of Engineering Applications. Before the start of this course, students have already taken basic programming, mathematical and engineering courses. Through this course, students can master mathematical methods, modeling methods and general data processing methods. This course is linked with previously acquired mathematical and programming knowledge and offers support for further study of data processing method and modeling. Meanwhile, with its computer practice, it also helps students complete future modules such as Professional Comprehensive Course Design, Internship and Bachelor Thesis. |
| Type of teaching, contact hours | Target students: undergraduates of energy and power engineering and related programs<br>Type of teaching: theoretical teaching, computer practice<br>Contact hours: 48 hours<br>Of which,<br>Theoretical teaching: 24 hours<br>Experiment / practice teaching: 0 hour<br>Computer practice: 24 hours<br>Size of class: No more than 60 people for theoretical teaching; no more than 60 people for computer practice |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3, having completed all computer practice and submitted practice |

| | |
|---|---|
| | report to lecturer |
| Recommended prerequisites | Calculus; Linear Algebra; Program Design and Practice |
| Module objectives/intended learning outcomes | Module objectives**:**<br>● **Knowledge:** Basic methods of MATLAB; rules and features of programming; MATLAB in calculus; matrices and linear algebra; algebra and maximum optimization; data interpolation, function approximation and basic signal processing method, etc.<br>● **Skills:** Master applications such as numerical calculation, graphic image and file operation with MATLAB; understand and master basic mathematical problems and experiment data processing methods with MATLAB.<br>● **Competences:** Be able to solve mathematics modeling and engineering data processing problems through computer software with the help of acquired computer skills. |
| Content | **Part A. Theoretical teaching (24 contact hours; 18 self-study hours)**<br>**Chapter 1** Basics of MATLAB Language (8 contact hours; 6 self-study hours)<br>● Language basics of MATLAB;**<br>● Basic arithmetical operation, process structure of MATLAB language; **<br>● Function compiling and debugging;<br>● Two-dimensional graphics plotting, data file reading and writing. **<br>**Chapter 2** Solving Calculus Problems with Computer(4 contact hours; 4 self-study hours)<br>● Analytic solution of calculus;*<br>● Numerical differential and integral.*<br>**Chapter 3** Solving Linear Algebra Problems with Computer(6 contact hours; 4 self-study hours)<br>● Special matrix input; *<br>● Basic analysis of matrix;**<br>● Solution of linear equations.**<br>**Chapter 4** Data Processing and Signal Analysis Fundamentals (6 contact hours; 4 self-study hours)<br>● Data interpolation and fitting, model fitting of known data, signal analysis fundamentals;**<br>● Statistical analysis of data.*<br>**Part B. Computer practice (24 contact hours; 24 self-study hours)** |

| | |
|---|---|
| | 1) Computer practice of MATLAB programming (8 contact hours; 6 self-study hours)<br>● A total of 12 programming exercises targeted at matrix structure, matrix operation and structure practice; **<br>● Function compiling and call, drawing and file. **<br>2) Computer practice of calculus problem solving(4 contact hours; 6 self-study hours)<br>● A total of 8 programming exercises targeted at limit, derivative, integral, numerical integration and its application in engineering calculation.<br>3) Computer practice of linear algebra problem (6 contact hours; 6 self-study hours)<br>● A total of 8 programming exercises targeted at special matrix input, matrix analysis, matrix properties, determination and solving of linear equations. *<br>4) Data processing and signal fundamentals (6 contact hours; 6 self-study hours)<br>● A total of 9 programming exercises targeted at one-dimensional and two-dimensional interpolation of data, polynomia and least-squares fitting; regression and confidence interval; time domain and frequency domain analysis. ** |
| Study and examination requirements and forms of examination | Usual performance accounts for 30%; final exam accounts for 70%; exam is carried out on computer (open book exam, students can take prescribed paper materials) |
| Media employed | Multimedia computers, projector, laser pointers |
| Reading list | 1. Required books<br>[1]. Calculus Problems MATLAB Solving (2nd edition), XUE Dinyu, Tsinghua University Press, 2008<br>2. Reference books<br>[1]. MATLAB and Scientific Calculation (2nd edition), WANG Moran, Electronic Industry Press, 2005<br>[2]. MATLAB Principle and Engineering Application, Edward B Magrab et al. GAO Huisheng trans. Electronic Industry Press, 2002<br>3. Experiment/computer practice instruction books<br>[1] Self-compiled teaching materials<br>4. Other materials<br>[1]. PPT courseware (self-compiled) |

## Measurement and Control Technology of Power Engineering

| | |
|---|---|
| Competence field | Engineering Applications |
| Module designation | Measurement and Control Technology of Power Engineering |
| Code, if applicable | 11000111 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 5th semester |
| Person responsible for the module | Professor CUI Guomin |
| Lecturer | Professor TAO Leren<br>Processor ZHANG Lixin<br>Associate processor GUAN Xin<br>Lecturer HUANG Xiuhui<br>Lecturer WANG Zhiyuan<br>Lecturer Li Zeqiu |
| Language | Chinese/English |
| Relation to curriculum | Measurement and Control Technology of Power Engineering is an engineering application course offered to undergraduates of energy and power engineering related programs. As a comprehensive course, measurement and control technology are integrated, it avoids the problem of separation between measurement and control, as measurement resorts to control as its objective and control uses measurement as its basis. The course is designed to allow students to master measurement methods for thermodynamic parameter as well as instrument/equipment and power equipment control technology. By integrating measurement and control, the course lays a foundation for further study of professional courses of Process Equipment and Control Engineering, realization of automatic operation, optimization and monitoring of thermal energy power equipments, and develop related scientific experimental research. |
| Type of teaching, contact hours | Target students: undergraduates of energy and power engineering related programs.<br>Type of teaching: theoretical teaching, experiment teaching<br>Theoretical teaching: 84 hours<br>Experiment / practice teaching: 12 hours<br>Size of class: No more than 60 people for theoretical teaching; no more than 5 people in each group for experiment. |
| Workload | Workload= 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |

| | |
|---|---|
| Credit points | 6.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | College Physics; Introduction to Computer |
| Module objectives/intended learning outcomes | Module objectives**:**<br>Measurement and Control Technology of Power Engineering is a specialized course offered to undergraduates of Process Equipment and Control Engineering program. With a focus on measurement methods of thermodynamic parameters, instrument/equipment and power equipment control technology, it is a basic course for realization of automatic operation, optimization and monitoring of thermal energy power equipment. It is also the basis of further scientific experimental research. Study of the course can help achieve the following objectives:<br>● **Knowledge:** Master basic content of engineering measurement and control technology; familiar with basic principles and methods of thermal physical parameter measurement, and automatic control principle and technology.<br>● **Skills:** Master certain experimental measurement skills and basic experimental data processing and error analysis methods; students are able to select or design a relatively proper non-electricity measurement system, use and check common instruments correctly, process and analyze measurement data, analyze and process technical problems of measurement system.<br>● **Competences:** Be able to integrate and apply the above mentioned knowledge and skills; and be able to independently solve problems concerning automatic operation, optimization and monitoring of thermal energy power equipment, and carry out related scientific experimental research. |
| Content | **Part A. Theoretical teaching (84 contact hours; 72 self-study hours)**<br>**Chapter 1** Overview (3 contact hours; 3 self-study hours)<br>**Chapter 2** Error Theory and Data Processing (21 contact hours; 18 self-study hours)<br>● Random Error; Systematic Error; Gross Error; **<br>● Error Representation;<br>● Analysis of Measurement Uncertainty (Direct and Indirect Measurement) ;* |

| | |
|---|---|
| | ● Data Processing of Combined Measurement.<br>**Chapter 3** Measurement Technology of Power Engineering Basic Quantity and Thermal Instrument (21 contact hours; 18 self-study hours)<br>● Characteristics of Measurement System; **<br>● Temperature Measurement and Instrument; *<br>● Pressure and Speed Measurement and Instrument; *<br>● Flow Measurement and Instrument. *<br>**Chapter 4** Fundamentals of Automatic Control (21 contact hours; 18 self-study hours)<br>● Automatic Control Principle; **<br>● Simple Control System; *<br>● Computer Control System;<br>**Chapter 5** Modern Measurement and Control Technology (18 contact hours; 15 self-study hours)<br>● Modern Measurement and Control System;<br>● Measurement and Control System Design; *<br>● Interference and Suppression Method for Measurement and Control System.<br>**Part B. Experiment teaching (12 contact hours; 12 self-study hours)**<br>● I/O channel interface experiment; master exchanging external signals with internal signals of computer; master concept of CAS interface address. (3 contact hours; 3 self-study hours)<br>● Automatic pressure measurement experiment; master changing real physical quantity into virtual quantity which can be detected; master detecting virtual signals with A/D conversion interface board. (3 contact hours; 3 self-study hours)<br>● Bulb brightness controlled with computer experiment; master output needed virtual signals with D/A conversion interface board; know how to control physical quantity with virtual signals. (3 contact hours; 3 self-study hours)<br>● Control experiment of wind tunnel flow; review how to control physical quantity with A/D card measurement signal and D/A card; master controlling physical quantity by forming a complete control system. (3 contact hours; 3 self-study hours) |
| Study and examination | 4 assignments and 1 final exam; usual performance and |

| | |
|---|---|
| requirements and forms of examination | attendance account for 30% of final score; final exam accounts for 70%; final exam is closed book written exam. |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks, teacher's pointer, real objects (e.g. thermal couple; platinum resistance etc.) |
| Reading list | 1. Required books<br>[1] ZHANG Yingxin et al. Fundamentals of Non-electricity Measurement Technology (1st edition), Beihang University Press, 2002.2<br>2. Reference books<br>[1] ZHAO Qingguo, CHEN Yongchang, XIA Guodong. Thermal Energy and Power Engineering Measurement Technology (1st edition), Chemistry Industry Press, 2006.6<br>[2] ZHANG Hongjian, MENG Jianbo. Automatic Detection Technology and Equipment (1st edition), Chemistry Industry Press, 2004.7<br>[3] YE Dajun. Thermal Machinery Testing Technology, Machinery Industry Press, 1981<br>[4]MAN Hong, LIANG Yingchun et al. Automatic Control Principle, Tsing Hua University Press<br>[5] Advances In Automatic Control, MihailVoicu, Massachusetts: Kluwer Acadamic Publishers, 2004<br>[6] Temperature Measurement and Control, J.R. Leigh, London: Peter Peregrinus Ltd., 1988<br>3. Other materials<br>[1] PPT courseware (self-compiled)<br>[2] Power engineering CAE experiment instruction books (school handout) |

## Process Principle and Equipment

| | |
|---|---|
| Competence field | Engineering Applications |
| Module designation | Process Principle and Equipment |
| Code, if applicable | 11000371 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 5th semester |
| Person responsible for the module | Associate Professor SU Wenxian |
| Lecturer | Associate Professor SU Wenxian<br>Associate Professor YE Li<br>Associate Professor XU BO<br>Lecturer LI Zeqiu<br>Lecturer SUN Li |
| Language | Chinese |
| Relation to curriculum | Process Principle and Equipment is one of the main courses for undergraduates of Process Equipment and Control Engineering program. Industrial processes in which raw materials are changed or separated into useful products, includes multi units. Process Principle and Equipment focuses on introduction of basic concepts and skills of unit operations, the structure and performance of the typical equipment, and its operation principle. Through the analysis of unit operations, to find a suitable operating condition, explore ways to strengthen the process and find a direction to improve the efficiency of process equipment. |
| Type of teaching, contact hours | Target students: junior of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching, experiment teaching<br>Contact hours: 96 hours<br>Of which<br>Theoretical teaching: 76 hours<br>Experiment / practice teaching: 20 hours<br>Size of class: No more than 60 people for theoretical teaching, No more than 5 people in each group for Experiment. |
| Workload | Workload= 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. |

| | |
|---|---|
| Recommended prerequisites | College Physics; College Chemistry; Engineering Fluid Mechanics; Engineering Thermodynamics; Engineering Fluid Mechanics. |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to understand process principles and basic skills of unit operation and equipment through teaching and practice. Specific objectives include:<br>● **Knowledge:** Master basic knowledge and theories required by unit operation such as Fluid Mechanics, Fluid Statics and its applications, and Heat Transfer; understand the operation principles of absorption, separation and rectification, etc.; Master basic principles and methods of major process analysis and equipment design of each field and applicable scope.<br>● **Skills:** Students acquire basic theoretical and specialized knowledge about process and equipment; understand engineering application of unit operations; acquire deep understanding of process phenomena. Master methods for process equipment and operation measurement; be able to analyze and solve all kinds of engineering unit operation problems including analysis and improvement of process equipment.<br>● **Competences:** Students acquire practical abilities of operating unit equipment, explore ways to strengthen the process and increase the efficiency of the equipment, and the preliminary ability using the engineering point of view of analyzing and solving the problem of general process unit operations |
| Content | **Part A. Theoretical teaching (76 contact hours; 68 self-study hours)**<br>**Chapter 1** Introduction (4 contact hours; 4 self-study hours)<br>● Unit operations; **<br>● Unit system;<br>● Basic Concepts;<br>**Chapter 2** Agitation and Mixing Liquid (4 contact hours;4 self-study hours)<br>● Agitation of liquids;<br>● Blending and mixing;<br>● Dispersion operations. **<br>**Chapter 3** Flow of fluid through the granular layer (8 contact hours; 8 self-study hours)<br>● Characterization of solid particles; * |

| | |
|---|---|
| | ● Properties of particulate masses; *<br>● Mixer for free flowing solids; **<br>**Chapter 4** Settlement and fluidization of particles and (6 contact hours; 6 self-study hours)<br>● sieving; *<br>● settlement-separation; *<br>● filtration; **<br>● centrifugalization; *<br>● Fluidization; * *<br>**Chapter 5** Heat transfer (6 contact hours; 4 self-study hours)<br>● Steady state conduction; *<br>● Unsteady state conduction; *<br>● Heat exchange equipment. **<br>**Chapter 6** Evaporation (8 contact hours; 6 self-study hours)<br>● Type of evaporators; *<br>● Performance of tubular evaporators; * *<br>● Vapor recompression.<br>**Chapter 7** Gas Absorption (8 contact hours; 8 self-study hours)<br>● Principles of absorption; **<br>● Rate of absorption.<br>● Mass-transfer correlations.<br>**Chapter 8** Liquid distillation (10 contact hours; 8 self-study hours)<br>● Flash Distillation; *<br>● Continuous distillation with reflux; **<br>● Design of Sieve-plate columns;<br>● Rectification in packed towers;<br>● Batch Distillation.<br>**Chapter 9** Gas-liquid mass transfer equipment (4 contact hours; 4 self-study hours)<br>● Penetration theory of mass transfer; *<br>● Experimental measurement of mass transfer coefficients;<br>● Coefficients for mass transfer through Known Areas.<br>**Chapter 10** Liquid-liquid extraction (6 contact hours; 6 self-study hours)<br>● Principles of liquid extraction; **<br>● Extraction equipment; *<br>● Supercritical fluid extraction.<br>**Chapter 11** Drying of solids (12 contact hours; 10 self-study hours)<br>● Principles of drying; * |

| | |
|---|---|
| | ● Drying equipment; **<br>**Part B. Experiment / practice teaching (20 experiment hours; 16 self-study hours)**<br>● Experimental determination of fluid flow resistance coefficient (2 experiment hours; 2 self-study hours)<br>● Experimental determination of centrifugal pump characteristic curve (2 experiment hours; 2 self-study hours)<br>● Experimental determination of Constant pressure filtration constant (3 experiment hours; 2 self-study hours)<br>● Experimental determination of convective heat-transfer coefficient (3 experiment hours; 2 self-study hours)<br>● Experimental determination and online analysis of the total mass transfer coefficient of absorption and parsing. (3 experiment hours; 2 self-study hours)<br>● Experimental determination of the theoretical number of plate layer and the column efficiency (3 experiment hours; 2 self-study hours)<br>● Operation and optimization of alcohol separation process. (4 experiment hours; 4 self-study hours) |
| Study and examination requirements and forms of examination | Final score includes usual performance (15%); experiment (15%), final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate, |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books<br>[1] CHEN Minheng, CONG DEzi etc.. Principle of chemical engineering, 4th edtion.. Beijing: Chemical Industry Press, 2015.8.<br>2. Reference books<br>[1] Jiang Weijun. Principle of chemical engineering, University of Tsinghua Press, 2001<br>[2] He Hongchao, et al. Principle of chemical engineering. Beijing: Science Press, 2000.8<br>[3] Warren L. McCabe, Unit Operation of Chemical Engineering ,Chemical Industry Press, 2006.9.<br>3. Experiment/computer practice instruction books<br>[1] Teaching materials (self-compiled) |

| | |
|---|---|
| | 4. Other materials<br>[1] PPT courseware (self-compiled) |

## Seal Technology of Process Equipment

| | |
|---|---|
| Competence field | Engineering Applications |
| Module designation | Seal Technology of Process Equipment |
| Code, if applicable | 11000410 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 6th semester |
| Person responsible for the module | Associate Professor Xu Bo |
| Lecturer | Associate Professor Xu Bo<br>Associate Professor Ye Li<br>Lecturer SUN Li<br>Lecturer YAN Weigang |
| Language | Chinese |
| Relation to curriculum | The seal technique of the process Equipment is an engineering application courses for undergraduates of Process Equipment and Control Engineering program. Theoretical knowledge in the curriculum is crucial for main devices applied in Process Equipment and Control Engineering. Based on engineering practice, the course systematically introduces basics of the seal technique. It focuses on introduction of the sealing problem, sealing method, classification, friction and wear of the process equipment, as well as, the flow of molecules, incompressible fluid flow and the compressible fluids. The content coverage the middle and low pressure equipment, piping gasket sealing, high pressure equipment, the flange connection technology, soft packing seal, sealing lips, mechanical seal, labyrinth seal, floating ring seal, centrifugal seal, spiral seal, and the classification and characteristics of pressure leak detection, leak detection method, vacuum leak detection method. |
| Type of teaching, contact hours | Target students: juniors of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching, experiment teaching<br>Contact hours: 96 hours<br>Of which<br>Theoretical teaching: 96 hours<br>Experiment / practice teaching: 0 hours<br>Size of class: No more than 60 people for theoretical teaching |
| Workload | Workload= 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |

| | |
|---|---|
| Credit points | 6.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. |
| Recommended prerequisites | Calculus; Engineering Thermodynamics; Engineering Fluid Mechanics. |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to understand seal process and basic theories through teaching and practice. Specific objectives include:<br>● **Knowledge:** Master basic knowledge and theories required by seal technology such as sealing method, classification, friction and wear of the process equipment; understand the properties of seal in energy and power engineering, seal characteristics and rules; master various sealing methods, technology, equipment and engineering application. Through this course, students can understand the structures such pressure equipment, piping gasket sealing, high pressure equipment, the flange connection technology, soft packing seal, sealing lips and mechanical seal etc.<br>● **Skills:** Students acquire basic theoretical and specialized knowledge about seal engineering; understand engineering application of seal; acquire deep understanding of seal phenomena and mechanism; be able to analyze and solve all kinds of engineering seal problems including analysis and improvement of existing seal methods.<br>● **Competences:** Students acquire practical abilities and innovative thinking on the basis of seal theories and engineering technology knowledge. |
| Content | **Part A. Theoretical teaching (96 contact hours; 84 self-study hours)**<br>**Chapter 1** Introduction (6 contact hours;6 self-study hours)<br>● Sealing, sealing, sealing process equipment classification, leakage;<br>● Friction and wear problems.<br>**Chapter 2** Flow of fluid in the seal gap (12 contact hours; 12 self-study hours)<br>● The flow of molecules;<br>● Incompressible fluid flow; **<br>● The flow of compressible fluids.<br>**Chapter 3** Static seal for process equipment and piping (30 |

| | |
|---|---|
| | contact hours; 30 self-study hours)<br>● The low pressure equipment and piping gasket sealing;<br>● High pressure equipment;**<br>● The flange connection;<br>● Pressure injection agent sealing.<br>**Chapter 4** Dynamic seal of process machinery (30 contact hours; 24 self-study hours)<br>● Soft packing seal, sealing lips;**<br>● Mechanical seal, labyrinth seal;*<br>● Floating ring seal;<br>● Centrifugal seal;<br>● Spiral seal etc.<br>**Chapter 5** leakage detection technology (18 contact hours; 12 self-study hours)<br>● The classification and characteristics of pressure leak detection; **<br>● leak detection method;<br>● vacuum leak detection method.<br>**Part B. Experiment / practice teaching (0 hours)** |
| Study and examination requirements and forms of examination | Final score includes: usual performance (30%); final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate. |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books<br>[1] Gu Yongquan. Practical sealing technology (1 edition). Beijing: Mechanical Industry Press, 2000<br>[2] Gu Yongquan. Fluid seals (1 edition). Dongying: Petroleum University Press, 1999<br>[3] Hu Guozhen. Chemical sealing technology (1 edition). Beijing: Chemical Industry Press, 1990<br>2. Other materials<br>[1] PPT courseware (self-compiled) |

## Design of Process Equipment

| | |
|---|---|
| Competence field | Engineering Applications |
| Module designation | Design of Process Equipment |
| Code, if applicable | 11001910 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 6th semester |
| Person responsible for the module | Associate Professor SU Wenxian |
| Lecturer | Associate Professor SU Wenxian<br>Associate Professor XU Bo<br>Associate Professor YE Li<br>Lecturer LI Zeqiu<br>Lecturer WANG Zhiyuan |
| Language | Chinese |
| Relation to curriculum | Design of Process Equipment is one of the main courses for undergraduates of Process Equipment and Control Engineering program. The course about the classification of pressure vessels, principles and characteristics of heat exchangers, reactor, storage equipment and tower equipment; pressure vessel stress distribution and characteristics; influence on strength of material properties, time and environment; design and calculation method are also discussed of heat exchangers, reactor, storage equipment and tower equipment; domestic and international standards and regulations are also introduced. |
| Type of teaching, contact hours | Target students: juniors of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching, experiment teaching<br>Contact hours: 96 hours<br>Of which<br>Theoretical teaching: 80 hours<br>Experiment / practice teaching: 16 hours<br>Size of class: No more than 60 people for theoretical teaching |
| Workload | Workload= 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. |
| Recommended prerequisites | Calculus; College Physics; College Chemistry; Engineering Thermodynamics; Engineering Fluid Mechanics; Mechanics |

| | |
|---|---|
| | of Materials; Heat Transfer; Process Principle and Equipment. |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to understand combustion process and basic theories through teaching and practice. Specific objectives include:<br>● **Knowledge:** From raw materials to products need a series of physical, chemical or biological processing steps, master knowledge and theories required in this series of processing steps called process and the equipment completing the material crushing, mixing, storage, separation, heat transfer, reaction, and other operations. Understand pressure vessel, its safe and reliable operation. Master the pressure vessel structure, stress analysis model, environment and time effect of material's properties and failure form and design method.<br>● **Skills:** Students acquire basic theoretical and specialized knowledge about materials selections, design, manufacture and test of the pressure vessels. Students understand engineering application of design methods and stress analysis; be able to analyze and solve all kinds of engineering design problems including analysis and improvement of existing pressure vessel, ensure the pressure vessel safety in the whole life cycle.<br>● **Competences:** Students acquire practical abilities and innovative thinking on the basis of the theory of Mechanics of Materials, Process Principle and Equipment; be able to analyze and design the structure of parts and whole equipment under economic, security and process constraints. |
| Content | **Part A. Theoretical teaching (80 contact hours; 74 self-study hours)**<br>**Chapter 1** Pressure Vessel Introduction (4 contact hours;4 self-study hours)<br>● Pressure vessel classification; **<br>● Pressure vessel codes and standards; *<br>**Chapter 2** Stress Analysis of Pressure Vessels (36 contact hours; 36 self-study hours)<br>● Stress in thin walled cylinders; **<br>● Membrane theory; **<br>● Discontinuity analysis of thin walled cylinders; ** |

| | |
|---|---|
| | ● Elastic stresses analysis of thick walled cylinder; **<br>● Elastic-plastic stresses analysis of thick walled cylinder; **<br>● Yield pressure and bursting pressure; *<br>● Bending differential equation of flat plate; **<br>● Stresses in circular plate; **<br>● Bucking analysis of thin wall cylinder under external pressure; **<br>● Critical pressure of other revolution shells; *<br>● Typical local stresses; *<br>**Chapter 3** Pressure Vessel Materials and Properties Effected by Environment and Time (4 contact hours; 4 self-study hours)<br>● Pressure vessel steels; **<br>● Nonferrous metal and nonmetal; **<br>● Combustion products and calculation; **<br>● Pressure vessel steel properties effected by fabrication; *<br>● Pressure vessel steel properties effected by environment; *<br>● Selection of pressure vessel materials. *<br>**Chapter 4** Design of Pressure Vessels (16 contact hours; 16 self-study hours)<br>● Design criterions; *<br>● Cylinder design; *<br>● Head design; **<br>● Sealing device design; **<br>● Opening and reinforcement; **<br>● Support and manhole; **<br>● Welded structure design; **<br>● Pressure test; *<br>**Chapter 5** Storage Equipment (4 contact hours; 4 self-study hours)<br>● Horizontal storage tank; *<br>● Design calculation of horizontal storage tank; **<br>● Spherical storage tank; *<br>**Chapter 6** Heat Exchanger (4 contact hours; 4 self-study hours)<br>● Basic types of shell-and-tube heat exchangers; **<br>● Shell-and tube heat exchanger structure; *<br>● Tube sheet design; **<br>● Expansion joint design; **<br>● Tubes vibration and protection; ** |

| | |
|---|---|
| | • Forced heat transfer; **<br>**Chapter 7** Tower (8 contact hours; 8 self-study hours)<br>• Packed tower; *<br>• Plate column; *<br>• Accessories; *<br>• Strength design of tower; **<br>• Vibration of tower; **<br>**Chapter 8** Reactors (4 contact hours; 4 self-study hours)<br>• Classification and characteristics of reactors; *<br>• Basic structure of mechanical agitated reactor; **<br>• Agitated Vessel; **<br>• Agitator Impeller; **<br>• Shaft design; **<br>• Sealing Device; **<br>• Gearing; **<br>**Part B. Experiment / practice teaching (16 experiment hours; 10 self-study hours)**<br>• Experiment of the stress measurement of thin walled vessel with internal pressure (5 experiment hours; 3 self-study hours)<br>• Experiment of the unstability of external pressure thin wall vessel (5 experiment hours; 3 self-study hours)<br>• Experiment of the bursting and testing of thick-walled cylinder (6 experiment hours; 4 self-study hours) |
| Study and examination requirements and forms of examination | Final score includes usual performance (15%); experiment (15%), final exam (closed-book written examination) (70%) Usual performance includes: assignment, attendance rate. |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books<br>[1] Zheng Jinyang, Design of Process Equipment. 4th edtion, Chemical Industry Press, 2015<br>2. Reference books<br>[1] Wang Zhiwen, Design of Chemical Pressure Vessel. Chemical Industry Press,2005.<br>[2] Chen Xu, Mechanics Foundation of Process Equipment. Chemical Industry Press, 2002.<br>[3] James R. Farr. Guidebook for the Design of ASME Section VIII Pressure Vessels. Third Edition ASME Press, 2005.<br>3. Other materials |

| | |
|---|---|
| | [1] PPT courseware (self-compiled) |

## Process Fluid Machinery

| | |
|---|---|
| Competence field | Engineering Applications |
| Module designation | Process Fluid Machinery |
| Code, if applicable | 11000330 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 6th semester |
| Person responsible for the module | Associate Professor ZHAO Jun |
| Lecturer | Associate Professor ZHAO Jun<br>Associate Professor SAI Qingyi<br>Associate Professor SUN Xiaojing<br>Lecturer SUN Li |
| Language | Chinese |
| Relation to curriculum | Process Fluid Machinery is one of the main courses for undergraduates of Process Equipment and Control Engineering program. Process Fluid Machinery is widely used in process engineering. Based on engineering practice, the course systematically introduces fluid machinery commonly used in process engineering, such as pump, compressor and centrifuge. It focuses on introduction of basic concepts of working principle, structure, operating characteristics, adjustment method, safety and reliability of process fluid machinery. New achievements in process fluid machinery in recent years are also introduced. Basic theories related in Process Fluid Machinery, regarding Engineering Fluid Mechanics, Engineering Thermodynamics and Heat Transfer, are applied in analyzing the thermal performance of working process. It lays a foundation for controlling the working process of fluid machinery, application of fluid machinery in engineering, design and operation of process fluid machinery. |
| Type of teaching, contact hours | Target students: Juniors of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching, experiment teaching<br>Contact hours: 96 hours<br>Of which<br>Theoretical teaching: 76 hours<br>Experiment / practice teaching: 20 hours<br>Size of class: No more than 60 people for theoretical teaching |

| | |
|---|---|
| Workload | Workload= 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. |
| Recommended prerequisites | Calculus; College Physics; College Chemistry; Theoretical Mechanics; Engineering Thermodynamics; Engineering Fluid Mechanics; Heat Transfer. |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to understand structure, working process, operating performance and adjustment method of process fluid machinery through teaching and practice. Specific objectives include:<br>● **Knowledge:** Master basic knowledge and theories required by Process Fluid Machinery such as Engineering Thermodynamics, Engineering Fluid Mechanics and Heat Transfer; understand the phenomena of energy conversion and transmission, heat transfer in fluid delivery; master the components and operating mechanisms of pump, compressor and centrifuge; understand what factors affect the fluid machinery performance; master the performance parameters and curves, and judge the scope of application through them.<br>● **Skills:** Students acquire basic theoretical and specialized knowledge about Process Fluid Machinery; understand engineering application of fluid machinery; acquire deep understanding of energy conversion mechanism; master methods for adjustment of fluid machinery operation; be able to analyze and solve all kinds of engineering problems including analysis and improvement of existing fluid machinery adjustment methods, increase the operating efficiency; master the selection method of fluid machinery.<br>● **Competences:** Students acquire practical abilities and innovative thinking on the basis of fluid machinery theories and engineering technology knowledge. |
| Content | **Part A. Theoretical teaching (76 contact hours; 68 self-study hours)**<br>**Chapter 1** Introduction (7 contact hours; 4 self-study hours)<br>● Definition, classification and use of process fluid |

| | |
|---|---|
| | machinery;<br>● Application status and development trend of process fluid machinery.<br>**Chapter 2** Displacement Compressor (17 contact hours; 12 self-study hours)<br>● Working principle of displacement compressor;**<br>● Rotary Compressor l;<br>● Screw Compressor; **<br>● Roots Blower;<br>● Scroll Compressor;<br>● Thermal properties of displacement compressor;<br>● Adjustment and Control of displacement compressor.<br>**Chapter 3** Centrifugal Compressor (16 contact hours; 16 self-study hours)<br>● Structure of centrifugal compressor; *<br>● Working principle of centrifugal compressor; **<br>● Operating performance<br>● Adjustment and control. **<br>● Safe and reliable operation; *<br>● Selection. *<br>**Chapter 4** Pump (18 contact hours; 18 self-study hours)<br>● Classification and use of pump; *<br>● Structure of centrifugal pump; **<br>● Working principle of centrifugal pump;<br>● Operating characteristics of centrifugal pump;<br>● Other types of pumps;<br>● Pump selection.<br>**Chapter 5** Centrifuge (18 contact hours; 18 self-study hours)<br>● Structure of Centrifuge; **<br>● Working principle of Centrifuge; *<br>● Filtration Centrifuge;<br>● Sedimentation Centrifuge;<br>● Selection of Centrifuge.<br>**Part B.Experiment / practice teaching (20 experiment hours; 16 self-study hours)**<br>● Experimental analysis of pump performance (5 experiment hours; 4 self-study hours)<br>● Screw compressor performance experiment (6 experiment hours; 4 self-study hours)<br>● Experimental analysis of centrifugal compressor performance (5 experiment hours; 4 self-study hours)<br>● Cyclone separator experiment (4 experiment |

| | |
|---|---|
| | hours; 4 self-study hours) |
| Study and examination requirements and forms of examination | Final score includes: usual performance (20%); experiment (10%), final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate, and computer practice<br>Experiment score includes: experiment report (100%) |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books<br>[1] KANG Yong, ZHANG Jianwei, LI Guishui. Process Fluid Machinery. Beijing: Chemical Industry Press, 2008<br>2. Reference books<br>[1] LI Yun, JIANG Peizheng. Process Fluid Machinery. Beijing: Chemical Industry Press, 2008<br>[2] XING Ziwen. Theory, Design and Application of Scroll Compressor. Beijing: China Measuring Press, 2008<br>[3] Christopher Earls Brennen. Hydrodynamics of Pumps. Zhenjiang：Jiangsu University Press, 2012<br>3. Experiment/computer practice instruction books<br>[1] Teaching materials (self-compiled)<br>4. Other materials<br>[1] PPT courseware (self-compiled) |

## Control Technology and Application of Process Equipment

| | |
|---|---|
| Competence field | Engineering Applications |
| Module designation | Control Technology and Application of Process Equipment |
| Code, if applicable | 11000380 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 6th semester |
| Person responsible for the module | Associate Professor HU Zhuohuan |
| Lecturer | Professor ZHANG Lixin<br>Lecturer SUN Li<br>Lecturer Li Zeqiu<br>Lecturer YE Li<br>Lecturer WANG Zhiyuan |
| Language | Chinese |
| Relation to curriculum | This course highlights the characteristics of Process Equipment and Control Engineering. Students can master basic knowledge of control theories as well as participate in practice and application. Main contents include basic concepts of process control systems; basic measurement methods of temperature, velocity, pressure and flow rate; basic principles and applications of transducer, regulator, actuator and other process control devices; PLC programming languages and practices and application schemes of typical process control system. This course contains basic concepts of automatic control, mathematical models of control system such as open and closed loop transfer functions, time domain analysis method, root locus technique, frequency domain analysis of control system, design and calibration of control system and application schemes of typical process control system such as PLC control system and PID control system. |
| Type of teaching, contact hours | Target students: juniors of Process Equipment and Control Engineering program.<br>Type of teaching: theoretical teaching, Experiment / practice teaching<br>Contact hours: 48 hours<br>Of which<br>Theoretical teaching: 42 hours<br>Experiment / practice teaching: 6 hours<br>Size of class: No more than 60 people for theoretical teaching |

| | |
|---|---|
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Calculus; Linear Algebra; Electrical Engineering and Electronics ; Engineering Thermodynamics; Heat Transfer; Measurement and Control Technology of Power Engineering; Process Control Theory. |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to understand the static and dynamic characteristics of process flow and production process and build a fine foundation for future practical work and scientific research:<br>● **Knowledge:** Master basic knowledge of process equipment and control as well as basic method of error analysis and data processing; Master process detection technology principle;<br>● **Skills:** realize methods, principles and instruments of measuring pressure, temperature, flow rate and liquid level; understand the basic principle of process control device; be able to analyze and design the typical process control system.<br>● **Competence:** Obtain a broad knowledge of control techniques for process equipment; master basic method of system integration of computer measurement and control techniques for process equipment; acquire a certain practical application ability. |
| Content | **Part A. Theoretical teaching (42 contact hours; 36 self-study hours)**<br>**Chapter 1** Basic Concepts of Control System (8 contact hours; 8 self-study hours)<br>● Composition and classification of control system;<br>● Diagram of pipeline and instrumentation;**<br>● Performance index and transition process of control systems;*<br>● Missions and requirements of process equipment and control.<br>**Chapter 2** Basis of Process Equipment and Control (8 contact hours; 8 self-study hours)<br>● Signal system，transmission mode and anti-explosion |

| | |
|---|---|
| | basic knowledge of process control device;**<br>● Characteristics of controlled object;*<br>● Complex control system.<br>**Chapter 3** Process Detection Technology (8 contact hours; 6 self-study hours)<br>● Basic knowledge of measurement and error;**<br>● Main performance index of instruments;**<br>● Basic principles and methods of measuring pressure, temperature, flow rate, liquid level;**<br>● New progress in process detection technology.<br>**Chapter 4** Process Control Device (6 contact hours; 4 self-study hours)<br>● Basic principles of various process control device;<br>● Process control function.*<br>**Chapter 5** PLC (8 contact hours; 6 self-study hours)<br>● PLC programming language and manner of working;**<br>● Basic composition and performance index;<br>● Basic and application instructions;**<br>● Common methods of control system design;*<br>● application schemes of typical process control system<br>● Open and closed loop frequency characteristics of linear systems;**<br>● Analysis of absolute stability of system;**<br>● Calculation of relative stability index;**<br>● Relationship between frequency domain and time domain index.**<br>**Chapter 6** Application Schemes Of Typical Process Control System (4 contact hours; 4 self-study hours)<br>● Basic steps of process control system design;<br>● Typical control schemes of heat exchange reactor, fluid conveying equipment and reactor control.*<br>**Part B. Experiment / practice teaching (6 experiment hours; 6 self-study hours)**<br>● Training process simulation of PLC control system in computer operation (6 experiment hours; 6 self-study hours) |
| Study and examination requirements and forms of examination | Final score includes: usual performance (20%); experiment (10%); final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate. |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |

| | |
|---|---|
| Reading list | 1. Required books<br>[1] WANG Yi, ZHANG Zaoxiao. Application and Control Techniques for Process Equipment. Chemical Industry Press, 2007<br>2. Reference books<br>[1] LIU Jianqing. Electrical Control and PLC Technology. Beijing: National Defence Industry Press, 2007<br>[2] WANG Ziyan. Chemical Process Control and Instrument. Xi'an: Xi'an Jiaotong University Press, 1998 |

## Chemical Drawing

| | |
|---|---|
| Competence field | Engineering Applications |
| Module designation | Chemical Drawing |
| Code, if applicable | 11000490 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 6th semester |
| Person responsible for the module | Professor GUO Xueyan |
| Lecturer | Associate Professor YE ZHou<br>Associate Professor SUN Xiaojing<br>Associate Professor XU Bo<br>Lecturer SUN Li<br>Lecturer WANG Zhiyuan |
| Language | Chinese |
| Relation to curriculum | Chemical Drawing is one of enginnerinig applicaiton courses for undergraduates of Process Equipment and Control Engineering program. Theoretical knowledge in Chemical Drawing is crucial for main devices applied in Process Equipment and Control Engineering, such as pressure vessel, heat exchanger, tower, and reactor. Based on engineering practice, the course systematically introduces chemical equipment's structure and expression characteristics. It focuses on the reading and drawing of typical process equipment drawing, including Chemical process diagram, equipment layout, and piping arrangement drawing. |
| Type of teaching, contact hours | Target students: Junior of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching<br>Contact hours: 48 hours<br>Of which<br>Theoretical teaching: 48 hours<br>Size of class: No more than 60 people for theoretical teaching |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |

| | |
|---|---|
| Recommended prerequisites | Fundamentals of Engineering Drawing; Mechancial Engineering Drawing; Mechanics of Materials; Fundamentals of Engineering Materials; Process Principle and Equipment. |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to understand basic theories and methods through teaching and practice. Specific objectives include:<br>● **Knowledge:** Master the basic structure and expression characteristics of general chemical equipment; understand the technical requirements of chemical drawing; master the basic method to draw.<br>● **Skills:** Students acquire basic theoretical and specialized knowledge about chemical drawing; understand engineering application of chemical drawing; master methods to read and draw chemical equipment drawing and the chemical process diagram; be able to analyze and solve all kinds of problems during the drawing of chemical equipment.<br>● **Competences:** Students acquire practical abilities and innovative thinking on the basis of chemical engineering theories and engineering technology knowledge. |
| Content | **Part A. Theoretical teaching (48 contact hours; 42 self-study hours)**<br>**Chapter 1** Introduction (9 contact hours; 6 self-study hours)<br>● Common chemical equipment; *<br>● Typical chemical equipment. **<br>**Chapter 2** Basic knowledge of chemical equipment (6 contact hours; 6 self-study hours)<br>● Classification of chemical equipment; *<br>● Basic drawing principle of chemical equipment drawings; * *<br>● Column of chemical equipment drawing. *<br>**Chapter 3** Expression characteristics of chemical equipment (3 contact hours; 3 self-study hours)<br>● Basic expression of chemical equipment; *<br>● Dimension of chemical equipment drawing; **<br>● Technical requirements of chemical equipment drawing. **<br>**Chapter 4** Expression of weld structure (3 contact hours; 6 self-study hours)<br>● Basic characteristics of weld structure; * |

| | |
|---|---|
| | ● Expression of welding line. **<br>**Chapter 5** Drawing of chemical equipment drawing (3 contact hours; 3 self-study hours)<br>● Design conditions of equipment; *<br>● View selection of chemical equipment; *<br>● Methods and steps of drawing chemical equipment drawings. **<br>**Chapter 6** Chemical equipment drawing (3 contact hours; 3 self-study hours)<br>● Basic requirement of reading chemical equipment drawing; *<br>● Methods and steps of reading chemical equipment drawing. **<br>**Chapter 7** Chemical process flow diagram (3 contact hours; 3 self-study hours)<br>● Flow chart of program; **<br>● Material balance diagram; **<br>● Construction process flow diagram. **<br>**Chapter 8** Introduction of building drawing (3 contact hours; 3 self-study hours)<br>● Basic content and characteristic of building drawing; *<br>● International standards; *<br>● Reading method. **<br>**Chapter 9** Chemical equipment layout (6 contact hours; 3 self-study hours)<br>● Functions and contents of equipment layout; *<br>● Characteristic of equipment layout; *<br>● Drawing and reading of equipment layout. **<br>**Chapter 10** Piping arrangement drawing (9 contact hours; 6 self-study hours)<br>● Functions and contents of Piping arrangement drawing; *<br>● Characteristic of piping layout arrangement drawing; *<br>● Drawing and reading of arrangement drawing. **<br>**Part B. Experiment / practice teaching (0 hour)** |
| Study and examination requirements and forms of examination | Final score includes: usual performance (30%); final exam (opened-book written examination) (70%)<br>Usual performance includes: assignment and attendance rate. |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books:<br>[1] ZHENG Xiaomei, WEI Chongguang. Chemical |

| | |
|---|---|
| | Drawing. Beijing: Chemical Industry Press, 2008<br>2. Referencebooks<br>[1]CAI Jining, ZHANG Qiuxiang. Foundation Curriculum Design Instruction of Chemical Equipment. Beijing: Chemical Industry Press, 2000<br>[2] ZHANG Qiuxiang, CAI Jining. Chemical Drawing. Beijing: Chemical Industry Press, 2015.<br>[3]DONG Zhenke, LU Dayong. Chemical Drawing. Beijing: Chemical Industry Press, 2014<br>3. Other materials<br>[1] PPT courseware (self-compiled) |

## Fabrication and Examination of Process Equipment

| | |
|---|---|
| Competence field | Engineering Applications |
| Module designation | Fabrication and Examination of Process Equipment |
| Code, if applicable | 11001880 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 7th semester |
| Person responsible for the module | Associate Professor YE Li |
| Lecturer | Associate Professor YE Li<br>Associate Professor SU Wenxian<br>Lecturer YANG Jie(M)<br>Lecturer WANG Zhiyuan<br>Lecturer Xu Jiayin |
| Language | Chinese |
| Relation to curriculum | Fabrication and Examination of Process Equipment is a very important and basic course, which integrates theory with practice. It focuses on introduction of different examination methods, fabrication processes and quality requirements. In this course, students can learn the massive knowledge of process equipment, which is useful for students to engage in related work. Students can start this course after completing courses including: Design of Process Equipment, Process Fluid Machinery, Control Technology and Application of Process Equipment and Safety Technology of Process Equipment. |
| Type of teaching, contact hours | Target students: seniors of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching, experiment teaching<br>Contact hours: 96 hours<br>Of which:<br>Theoretical teaching: 80 hours<br>Experiment teaching: 16 hours<br>Size of class: no more than 60 people for theoretical teaching; no more than 60 people for experiment teaching |
| Workload | Workload= 180 hours<br>Contact hours = 96 hours<br>Self-study hours = 84 hours |
| Credit points | 6.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3, assignment completion rate over 2/3, and performing required experiments are allowed to take the exam. |
| Recommended prerequisites | Design of Process Equipment; Process Fluid Machinery; |

| | |
|---|---|
| | Control Technology and Application of Process Equipment; Safety Technology of Process Equipment. |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to master the fabrication and examination method of process equipment through teaching and practice. Specific objectives include:<br>● **Knowledge:** The examination method of process equipment, such as X-ray inspection, $\gamma$-ray inspection, ultrasonic inspection and penetrant inspection; the fabrication process of process equipment, such as welding of steel pressure vessels, fabrication preparation of pressurized shell, forming process and typical pressure vessel; the quality requirements for process manufacturing, such as mechanical working precision, machined surface quality and assembly process.<br>● **Skills:** Students acquire basic theoretical and specialized knowledge about fabrication and examination method of process equipment; understand the principles of different examination methods; master fabrication methods of common pressure vessel. Be able to analyze and solve all kinds of engineering problems including select fabrication and examination methods for different process equipment; design the mechanical working precision, and so on.<br>● **Competences:** Students acquire practical abilities and innovative thinking on the basis of studying fabrication and examination theories. |
| Content | **Part A. Theoretical teaching (80 contact hours; 72 self-study hours)**<br>**Chapter 1** Introduction (4 contact hours; 4 self-study hours)<br>● Development history of process equipment;<br>● Development of fabrication technology.<br>**Chapter 2** Periodic inspection of equipment fabrication (6 contact hours; 4 self-study hours)<br>● Periodic inspection;*<br>● Routine inspection.*<br>**Chapter 3** Radiographic inspection and defect grade evaluation (8 contact hours; 6 self-study hours)<br>● X-ray inspection and γ-ray inspection;*<br>● Principle and preparation of Radiographic inspection;**<br>● Defect grade evaluation;**<br>● Safety protection. |

| | |
|---|---|
| | **Chapter 4** Ultrasonic inspection and defect grade evaluation (8 contact hours; 6 self-study hours)<br>● Basic knowledge of Ultrasonic inspection;*<br>● Defect detection by Ultrasonic inspection;**<br>● Defect grade evaluation.*<br>**Chapter 5** Surface inspection and defect grade evaluation (8 contact hours; 6 self-study hours)<br>● Magnetic particle inspection;**<br>● Penetrant inspection.*<br>**Chapter 6** Welding of steel pressure vessels (6 contact hours; 4 self-study hours)<br>● Welded joint;**<br>● Welding method and welding technology;*<br>● Welding of common steel;*<br>● Post-weld heat treatment.*<br>**Chapter 7** Fabrication preparation of pressurized shell (6 contact hours; 6 self-study hours)<br>● Pretreatment of steel; **<br>● Underlined.<br>**Chapter 8** Forming process (8 contact hours; 8 self-study hours)<br>● Shell Ring;*<br>● Head;*<br>● Tube.*<br>**Chapter 9** Typical pressure vessel (6 contact hours; 6 self-study hours)<br>● Shell and tube heat exchangers;*<br>● Fabrication of high pressure vessels. *<br>**Chapter 10** Mechanical Working Precision (8 contact hours; 8 self-study hours)<br>● Geometric error of process system;**<br>● Force deformation of process system;**<br>● Thermal deformation of process system;*<br>● Deformation caused by residual stress.*<br>**Chapter 11** Machined surface quality (6 contact hours; 6 self-study hours)<br>● Factors affecting the surface quality of machined surface;*<br>● Surface strengthening technology.*<br>**Chapter 12** Assembly process (6 contact hours; 8 self-study hours)<br>● Assembly dimension chain; **<br>● Assembly method. |

| | |
|---|---|
| | **Part B. Experiment teaching (16 experiment hours; 12 self-study hours)**<br>● Experimental study on stress measurement of thin walled vessel with internal pressure (8 experiment hours; 6 self-study hours)<br>● Experimental study on failure of external pressure thin wall vessel (8 experiment hours; 6 self-study hours) |
| Study and examination requirements and forms of examination | Final score includes: usual performance (20%); experiment (10%), final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate, and computer practice<br>Experiment score includes: experiment report (50%); and experiment exam (50%) |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books<br>[1]. Fabrication and Examination of Process Equipment, ZOU Guanghua, Chemical Industry Press, 2011<br>2. Reference books<br>[1]. Process equipment control technology and Application, WANG Yi, ZHANG Zaoxiao, Chemical Industry Press, 2010<br>[2]. Process control engineering, YU Jintao, JIANG Weisun, Electronics Industry Press, 2007<br>[3]. Process Equipment Manufacturing Technology, WANG Wenyou, China Petrochemical Press, 2009<br>3. Experiment practice instruction books<br>[1] Teaching materials (self-compiled)<br>4. Other materials<br>[1]. PPT courseware (self-compiled) |

# Electives

## Chemical Reaction Engineering

| | |
|---|---|
| Competence field | Electives |
| Module designation | Chemical Reaction Engineering |
| Code, if applicable | 11000430 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 6th semester |
| Person responsible for the module | Professor LI Ling |
| Lecturer | Associate Professor YE Li<br>Lecturer XU Jiayin<br>Lecturer Wang Zhiyuan<br>Lecturer YANG Jie(F) |
| Language | Chinese & English |
| Relation to curriculum | Chemical Reaction Engineering is an elective course required for undergraduates of Process Equipment and Control Engineering program. It aims to study the change regulations and transfer laws, as well as process rate of engineering reaction processes. It lays a foundation for the optimal design and optimal operation of reactors, which can serve as the foundation for following elective courses such as Process Analysis and Integration, Water Treatment Engineering; pratical raining course, such as Professional Comprehensive Course Design, Innovation and Entrepreneurship Project Training, Internship, and Bachelor Thesis. |
| Type of teaching, contact hours | Target students: juniors of Process Equipment and Control Engineering<br>Type of teaching: theoretical teaching<br>Contact hours: 48 hours<br>Size of class: No more than 60 people |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3, assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Engineering Thermodynamics; Engineering Fluid Mechanics; Heat Transfer; Process Principle and Equipments. |
| Module objectives/intended | Module objectives: |

| | |
|---|---|
| learning outcomes | The task of this course is to enable students to understand basic theories of chemical reaction dynamics and macro-reaction dynamics which are important for reactor design and optimization, and obtain engineering experiences related to experiments, enlargement and controlling. Specific objectives include:<br>● **Knowledge:** Master basic knowledge and theories required by chemical reaction technology such as deducing of reaction intrinsic kinetics, confirming of reaction optimum temperature, combinatorial calculation among ideal and non-ideal flow models, and determination of reactor kinetic parameters.<br>● **Skills:** Students acquire basic theoretical and specialized knowledge about optimal design and optimal operation of reactors; understand engineering application of catalytic reaction; acquire deep understanding of catalytic reaction phenomena and catalytic reaction mechanism; be able to analyze and solve all kinds of engineering problems including analysis and improvement of existing reaction methods, increase raw material utilization efficiency , etc.<br>● **Competences:** Students acquire practical abilities and innovative thinking on the basis of reaction theories and engineering technology knowledge. |
| Content | **Part A. Theoretical teaching (48 contact hours; 42 self-study hours)**<br>**Chapter 1** Introduction (4 contact hours; 2 self-study hours)<br>● Classification of chemical reactions and reactors;<br>● Methods of reactor enlargement and model construction;<br>● Scientific application and development of chemical reaction engineering.<br>**Chapter 2** Basic theories of chemical reaction dynamics (8 contact hours; 8 self-study hours)<br>● Chemical reaction rate, reaction rate equations;**<br>● Order of reaction, batch reaction system, continuous reaction system and multiple reaction system;*<br>● Intrinsic kinetics of different reactions, analysis of key components.**<br>● Influences of temperature on reaction rate and reaction selectivity. *<br>**Chapter 3** Ideal flow reactors (8 contact hours; 8 self-study hours) |

| | |
|---|---|
| | ● Flow model of reactors;*<br>● Batch reactors, continuous stirred tank reactors, and piston flow reactors;**<br>● Multistage CSTR in series and its optimization;**<br>● Combustion temperature calculation;*<br>● Combination of ideal reactors, selectivity of multiple reactions in ideal reactors;*<br>● Optimum selection of homogeneous phase reactors.*<br>**Chapter 4** Non-ideal flow reactors (10 contact hours; 10 self-study hours)<br>● Mixed state of materials in continuous reactors and its influences on reactor operation performances;<br>● Conception and experimental determination method of residence time distribution;**<br>● Non-ideal flow reactor models. **<br>**Chapter 5** Macro mechanics of gas-solid catalytic reaction (8 contact hours; 6 self-study hours)<br>● Macro reaction process of gas-solid catalytic reaction;**<br>● Structure and physical properties of porous catalyst;*<br>● Gas diffusion in porous catalyst, influences of gas diffusion on reaction rate of gas-solid;**<br>● Mass transfer and heat transfer between particles and fluid;*<br>● Intrinsic reaction rate and overall reaction rate equations of gas-solid catalytic reaction.**<br>**Chapter 6** Gas-solid catalytic reactor (6 contact hours; 4 self-study hours)<br>● Classification of packed catalytic reactors;*<br>● Flow and heat properties of packed catalytic reactors;**<br>● Model equations of packed catalytic reactors.<br>**Chapter 7** Measuring method of kinetic parameters (4 contact hours; 4 self-study hours)<br>● Basic knowledge about measuring method of kinetic parameters;<br>● Integration, differentiation and half-life methods.*<br>**Part B. Experiment teaching (0 hour)** |
| Study and examination requirements and forms of examination | Final score includes usual performance (30%); final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate, and computer practice |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |

| | |
|---|---|
| Reading list | 1. Required books<br>[1] WANG Anjie. Chemical Reaction Engineering. Beijing: Chemical Industry Press, 2010<br>2. Reference books<br>[1] H.Scott Fogler. Chemical Reaction Engineering. Beijing: Chemical Industry Press, 2005<br>[2] ZHU Bincheng. Chemical Reaction Engineering. Beijing: Chemical Industry Press, 2002<br>[3] YUAN Weikang. Chemical Reaction Engineering Analysis. Shanghai: East China University of Science and Technology Press, 2000<br>3. Other materials<br>[1] PPT courseware (self-compiled) |

## Chemical Process Technique

| | |
|---|---|
| Competence field | Electives |
| Module designation | Chemical Process Technique |
| Code, if applicable | 11000480 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 6th semester |
| Person responsible for the module | Professor LU Mei |
| Lecturer | Associate Professor Ye Li<br>Lecturer XU Jiayin<br>Lecturer Wang Zhiyuan<br>Lecturer Yan Weigang |
| Language | Chinese |
| Relation to curriculum | Chemical Process Technique is an elective course for junior students of Process Equipment and Control Engineering program. It aims to study the basic theories of process productions and chemical reaction process. Make some introduction to general reactions, inorganic reactions, organic reactions, coal chemical reactions and fine chemical reactions. It lays a foundation for further study of chemical engineering processes related courses, such as elective courses (Process Analysis and Integration, Water Treatment Engineering); pratical raining course (Professional Comprehensive Course Design, Innovation and Entrepreneurship Project Training, Internship), and Bachelor Thesis. |
| Type of teaching, contact hours | Target students: juniors of Process Equipment and Control Engineering<br>Type of teaching: theoretical teaching<br>Contact hours: 48 hours<br>Size of class: No more than 60 people for theoretical teaching |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3, assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | College Chemistry; Process Principle and Equipment. |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to understand |

| | |
|---|---|
| | chemical technology and basic theories through teaching. Specific objectives include:<br>● **Knowledge:** Master basic knowledge and theories required by chemical technology such as general reaction units, inorganic reaction units, organic reaction units, coal chemical reaction units and fine chemical reaction units;<br>● **Skills:** Students acquire basic theoretical and specialized knowledge about chemical engineering, be able to analyze and solve kinds of engineering problems including analysis and improvement of existing reaction methods, increase raw material utilization efficiency, etc.<br>● **Competences:** Students acquire practical abilities and innovative thinking on technology design, systems integration and system development on various chemical reaction units. |
| Content | **Part A. Theoretical teaching (48 contact hours; 42 self-study hours)**<br>**Chapter 1** Introduction (3 contact hours; 3 self-study hours)<br>● Development history of chemical technologies;<br>● Scientific application of chemical technologies.<br>**Chapter 2** Chemical resources and the handling processes (9 contact hours; 9 self-study hours)<br>● Classifications of Chemical ore;*<br>● Coal and its handling process;**<br>● Petroleum and its handling process;**<br>● Natural gas and its handling process.**<br>**Chapter 3** General reaction units (9 contact hours; 6 self-study hours)<br>● Oxidation reaction units;**<br>● Hydrogenation and dehydrogenation reaction units;*<br>● Electrolyze reaction units.*<br>**Chapter 4** Inorganic reaction units (9 contact hours; 9 self-study hours)<br>● Calcination, incineration and sintering;*<br>● Leaching;*<br>● Double decomposition. *<br>**Chapter 5** Organic reaction units, (9 contact hours; 6 self-study hours)<br>● Hydrocarbon pyrolysis;*<br>● Chloration; |

| | |
|---|---|
| | ● Alkylation;<br>● Hydrolysis and hydratation.*<br>**Chapter 6** Coal chemical reaction units (6 contact hours; 6 self-study hours)<br>● Distillation of coal;**<br>● Gasification of coal;*<br>● Liquefaction of coal;*<br>● Deep processing of coal.<br>**Chapter 7** Fine chemical reaction units (3 contact hours; 3 self-study hours)<br>● sulfonation reaction; *<br>● Nitrification reaction; *<br>● Esterification reaction.<br>**Part B. Experiment teaching (0 hour)** |
| Study and examination requirements and forms of examination | Final score includes: usual performance (30%);final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate, and computer practice |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books<br>[1] HUANG Zhongjiu, FNAG Dingy. Chemical Ttechnologies. Beijing: Higher Education Press, 2005<br>2. Reference books<br>[1] MIAO Qiaoli, MI Zhentao. Chemical Ttechnologies. Beijing: Chemical Engineering Industry Press, 2004.<br>[2] ZHANG Xiuling, QIU Yu'e. Chemical Ttechnologies. Beijing: Chemical Engineering Industry Press, 2012.<br>[3]PAN Hongzhang. Chemical Ttechnologies. Beijing: Higher Education Press, 2010<br>3. Other materials<br>[1] PPT courseware (self-compiled) |

## Process System Identification and Simulation

| | |
|---|---|
| Competence field | Electives |
| Module designation | Process System Identification and Simulation |
| Code, if applicable | 11000360 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 6th semester |
| Person responsible for the module | Professor ZHANG Lixin |
| Lecturer | Associate Professor Hu Zhuohuan<br>Associate Professor ZHAO Ming<br>Lecturer SUN Li<br>Lecturer LI Zeqiu |
| Language | Chinese |
| Relation to curriculum | Process System Identification and Simulation is an elective course for undergraduates of Process Equipment and Control Engineering program. After studing of Calculus, Process Principle and Equipment, Process Control Theory, Measurement and Control Technology of Power Engineering and this course, students can further study of process control, optimization and integration related courses such as Process Analysis and Integration, Energy Management, Complete Set Technology of Process Equipment, Equipment Fault Diagnosis. Through this course, students not only master the basic theories and methods of system identification and simulation but also apply knowledge to preliminarily conduct process modeling study, the computer simulation as well as computer aided design of control system. which will lay a solid foundation for further study and future engagement in engineering work. |
| Type of teaching, contact hours | Target students: junior of Process equipment and control engineering<br>Type of teaching: theoretical teaching, experiment teaching<br>Contact hours: 48 hours<br>Of which<br>Theoretical teaching: 42 hours<br>Experiment / practice teaching: 6 hours<br>Size of class: no more than 60 people for theoretical teaching |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the | Students with class attendance rate over 2/3 and assignment |

| | |
|---|---|
| examination regulations | completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Calculus; College Physics; Linear Algebra; Engineering Thermodynamics; Process Principle and Equipment. |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to understand basic theories and methods of system identification and simulation. Specific objectives include:<br>● **Knowledge:** Master basic concepts of process system, process system model, system simulation; understand the method of parameter optimization of PID controller; master steady state simulation method of system optimization.<br>● **Skills:** Master the expressions of mathematical model, master response curve method and closed-loop experimental method to acquire mathematical model; master Fibonacci method; master indirect and direct optimization methods of system simulation; master several kinds of commonly used probability distribution functions and figure measurement of basic characteristics of random noise.<br>● **Competences:** Students acquire abilities of applying theories and knowledge of system identification and simulation combined with examples. |
| Content | **Part A. Theoretical teaching (42 contact hours; 39 self-study hours)**<br>**Chapter 1** Introduction (3 contact hours; 3 self-study hours)<br>● Concepts of process system, process system model and system simulation;<br>● Classification of mathematical process system model and modeling method;<br>● Application and development direction of current system simulation.<br>**Chapter 2** Mathematical model and modeling principle (3 contact hours; 2 self-study hours)<br>● Modeling method and modeling process;*<br>● Expressions of mathematical model;**<br>● Credibility of model.<br>**Chapter 3** Establishing of process unit dynamic mathematical model (4 contact hours; 4 self-study hours)<br>● Pathway and mechanism of establishing dynamic mathematical model;*<br>● Experimental methods of mathematical model,<br>● Response curve method, closed-loop experimental |

| | |
|---|---|
| | method of mathematical model. **<br>**Chapter 4** Modeling of process system (6 contact hours; 6 self-study hours)<br>● Directed graph, matrix structure, structure table and joint equation of describing process system;**<br>● Calculation of typical system degrees of freedom and selection of decision variable;<br>● Physical property data and its estimation method.*<br>**Chapter 5** Digital simulation of continuous system (6 contact hours; 6 self-study hours)<br>● Representation of continuous system mathematical model;*<br>● Method of converting differential equation or transfer function into state equation;**<br>● Numerical integration method;**<br>● Integral stability， step selection equation-oriented approach of system simulation;<br>● Discretization model of typical link.**<br>**Chapter 6** Digital simulation of random noise (5 contact hours; 4 self-study hours)<br>● Random variable, random process and the basic characteristic of the random process;<br>● Several kinds of commonly used probability distribution functions and figure measurement of basic characteristics of random noise;*<br>● Generation of random numbers and reshaping method for noise.<br>**Chapter 7** Continuous system simulation and controller parameters optimization (6 contact hours; 6 self-study hours)<br>● Indirect and direct optimization method;**<br>● Fibonacci method and uniformly-spaced method;**<br>● Conjugate gradient method;<br>● Quality of control system;**<br>● PID controller parameter optimization method.*<br>**Chapter 8** Process system identification and simulation method (3 contact hours; 2 self-study hours)<br>● Principle of sequential-modular approach and cutting technology of recirculating flow;**<br>● Advantages and disadvantages of sequential-modular approach, equation-oriented approach and simultaneous modular approach;<br>● Current commonly used function of process flow simulation system. |

| | |
|---|---|
| | **Chapter 9** Process system optimization method based on simulation (3 contact hours; 3 self-study hours)<br>● Basic concept of optimization and mathematical definition;**<br>● Establishment of optimization model;*<br>● Optimization method of steady state simulation.**<br>**Chapter 10** Training process simulation in computer operation (3 contact hours; 3 self-study hours)<br>● Characteristics of process simulation in computer operation;<br>● Methods and steps of mathematical model establishment;*<br>● Development process and development trend of process simulation training system.<br>**Part B. Experiment / practice teaching (6 experiment hours; 3 self-study hours)**<br>● Training process simulation in computer operation (6 experiment hours; 3 self-study hours) |
| Study and examination requirements and forms of examination | Final score includes: usual performance (20%); experiment (10%), final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate, and computer practice<br>Experiment score includes: experiment report (50%); and experiment exam (50%) |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books<br>[1] CHEN Zonghai. Process system modeling and simulation. Hefei: University of Science and Technology of China Press, 2002<br>2. Reference books<br>[1] HAN Pu, LUO Yi, ZHOU Lihui, et al. Control system digital simulation technology. Beijing: China Electric Power Press, 2007<br>[2] TU Jian. Digital simulation of control system and computer aided design. Beijing: Huazhong University of Science and Technology Press, 1985<br>[3] KANG Fengju. Modern simulation technology and application. Beijing: National Defend Industry Press, 2001<br>[4] SUN Liang. MATLAB language and control system simulation. Beijing: Beijing University of Technology Press, 2001 |

## Energy Management

| | |
|---|---|
| Competence field | Electives |
| Module designation | Energy Management |
| Code, if applicable | 11001400 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 6th semester |
| Person responsible for the module | Professor Cai Xiaoshu |
| Lecturer | Professor ZHANG Lixin<br>Professor DOU Binlin<br>Associate Professor XIE Yingming<br>Lecturer SUN Li<br>Lecturer YANG Jie(F)<br>Lecturer HANG Xiuhui |
| Language | Chinese |
| Relation to curriculum | Energy Management is a course offered to juniors of energy and power engineering related programs. After learning courses of Calculus, Engineering Thermodynamics and Heat Transfer, students can start this course including energy balance of the enterprise and its equipment, energy audit, energy system analysis theory, energy system network, input-output analysis, linear programming and optimization, forecasting theory of social and economic energy demand, etc. Through this course, students can understand various energy systems, basic principle of energy conservation, and common method of energy management. The course lays a foundation for the following work of the energy management and the energy policy research. |
| Type of teaching, contact hours | Target students: students of energy and power engineering related program<br>Type of teaching: theoretical teaching<br>Contact hours: 48 hours<br>Of which,<br>Theoretical teaching: 48 hours<br>Size of class: no more than 60 people for theoretical teaching |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Calculus; Engineering Thermodynamics; Heat Transfer |

| | |
|---|---|
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to understand various energy systems, basic principle of energy conservation, common method of energy management, and to lay a foundation for the following work of the energy management and the energy policy research. Specific objectives include:<br>● **Knowledge:** Master general principles of energy audit, energy system analysis, energy system network, input-output analysis, linear programming and optimization, forecasting theory of social and economic demand.<br>● **Skills:** Students acquire basic theoretical and specialized knowledge about energy system; understand engineering application of energy management; master methods for energy audit, energy system analysis; be able to work out rational energy development plan according to different regional needs and calculate relevant economic benefits.<br>● **Competences:** Develop abilities in energy system design and process optimization; be able to solve problems by using acquired knowledge in future work and study. |
| Content | **Part A. Theoretical teaching (48 contact hours; 42 self-study hours)**<br>**Chapter 1** Introduction (3 contact hours; 2 self-study hours)<br>● Energy profile;<br>● The energy policy of our country;<br>● The development of energy and energy conservation;<br>● Energy technology economic analysis;<br>● Energy systems engineering and energy management.<br>**Chapter 2** The energy balance of the enterprise (6 contact hours; 5 self-study hours)<br>● Introduction;<br>● Energy balance data of test and statistics, checking; *<br>● Mass balance and energy balance; *<br>● The division of testing system , effective energy utilization; *<br>● Boiler thermal balance; *<br>● Fan and water pump energy balance test.<br>**Chapter 3** Statistics and energy audit (9 contact hours; 7 self-study hours)<br>● Macro decision-making of energy statistics and energy |

| | |
|---|---|
| | audit;<br>● Energy statistics and checking; **<br>● Energy consumption index , the reduction factor of the direct production of decomposition and its energy consumption; **<br>● Energy audit calculation table. *<br>**Chapter 4** Balance (9 contact hours; 9 self-study hours)<br>● The second law of thermodynamics, entropy and exergy loss; **<br>● Exergy calculation and grade coefficient; **<br>● Exergy loss calculation of thermal process; **<br>● T-S diagram and heat exergy diagram; **<br>● The exergy balance and efficiency of the thermal system. *<br>**Chapter 5** Energy systems can flow network diagram and its application (4 contact hours; 4 self-study hours)<br>● Energy systems energy flow network diagram;<br>● Energy system network graph structure; *<br>● The application of network diagram energy system; *<br>**Chapter 6** Energy linear programming model (4 contact hours; 5 self-study hours)<br>● Introduction of the linear programming model;<br>● Energy linear programming model of the application; *<br>● The general requirements of energy structure linear programming model and basic steps. *<br>**Chapter 7** Energy input-output model (5 contact hours; 4 self-study hours)<br>● Introduction of input-output analysis;<br>● Examples;<br>● Input and output analysis table; *<br>● Energy input-output model; *<br>● The application of energy input-output model<br>**Chapter 8** Energy demand forecasting (8 contact hours; 6 self-study hours)<br>● Summary of energy demand forecasting;<br>● Regression analysis method; *<br>● Elastic coefficient method; *<br>● Per capita energy method; *<br>● Energy consumption per unit output value ( output ) forecast method; *<br>● Industrial branch analyzing method; *<br>● Input-output method; *<br>● The general procedure and matters of energy demand |

| | |
|---|---|
| | forecasting.<br>**Part B. Experiment / practice teaching (0 hours)** |
| Study and examination requirements and forms of examination | Final score includes: usual performance (30%) and final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment and attendance rate |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books<br>[1] Long Minxian, Liu Tiejun. Energy Management Engineering (1st edition). Guangzhou: South China University of Technology Press, 2000<br>2. Reference books<br>[1] China Petroleum and Chemical Industry Association, China Association of Chemical Energy Saving Technology. Petroleum and chemical industry energy manager tutorial (1st edition). Beijing: Chemistry Industry Press, 2007<br>[2] PEREZ Francisco Macia. Energy Management (1st edition). InTech Press, 2010<br>[3] TANG Xuezhong. Heat Energy Conversion and Utilization (2nd edition). Beijing: Metallurgical Industry Press, 2002<br>3. Other materials<br>[1] PPT courseware (self-compiled)<br>[2] Supplementary new energy management teaching materials (self-compiled) |

## Process Analysis and Integration

| | |
|---|---|
| Competence field | Electives |
| Module designation | Process Analysis and Integration |
| Code, if applicable | 11000310 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 7th semester |
| Person responsible for the module | Professor CUI Xiaoyu |
| Lecturer | Associate Professor YE Li<br>Lecturer WANG Zhiyuan<br>Lecturer YANG Jie(F)<br>Lecturer Xu Jiayin |
| Language | Chinese/English |
| Relation to curriculum | The students get the ability of solving and analyzing process problems basing on system engineering from the course after learning Process Principles and Equipment, Chemical Reaction Engineering, and other related courses. The course mainly focus on the analysis, the optimization and synthesis of chemical process system. The system analysis mainly consists of system processing, loop analysis, modeling and the solution of the steady state and dynamic model. The synthesis of chemical process system consists of the intermittent operation system, the comprehensive use of energy and the separation sequence synthesis. The optimization of chemical process consists of the general optimization problems, the optimization of the large chemical system, the tuning problems, etc. |
| Type of teaching, contact hours | Target students: seniors of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching<br>Contact hours: 48 hours<br>Of which,<br>Theoretical teaching:48 hours<br>Size of class: No more than 60 people for theoretical teaching |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Engineering Thermodynamics; Heat Transfer; Process Principle and Equipment |

| | |
|---|---|
| Module objectives/intended learning outcomes | Module objectives:<br>• **Knowledge:** Students master the basic knowledge of process analysis and synthesis, the common modeling software of chemical process and CIPS technology in enterprise; know the three basic methods of modeling process system, the method of dynamic modeling of process system and mastering the basic knowledge of the concentrative parameter model, distributed parameter model and multilevel concentrative parameter model; master the basic knowledge of the optimization problem of the process system and knowing the solution method of classic liner / non-liner problem; know the method and meaning of the tuning; mastering the equipment design and optimization method in an multi-product intermittent process; master the method using pinch technology for the synthesis of heat exchange network; master the basic knowledge of the separation tower sequence synthesis and knowing the common method.<br>• **Skills:** Students acquire basic theoretical and specialized knowledge about process analysis and synthesis; understand engineering application of the modeling of chemical process system; mastering the general modeling methods of the process system, the establishment of a dynamic model and the mathematical treatment methods.<br>• **Competences:** Students acquire practical abilities and innovative thinking on the basis of the synthesis technology and the optimization method, and be capable of designing the appropriate and optimal separation processing in chemical industry. |
| Content | **Part A. Theoretical teaching** (48 contact hours; 42 self-study hours)<br>**Chapter 1**. Introduction of Process Analysis and Integration (6 contact hours; 3 self-study hours )<br>• Course system structure; *<br>• Chemical process modeling system; *<br>• CIPS technology in enterprise;*<br>• The application of artificial intelligence in process.*<br>**Chapter 2**. The Analysis and Modeling of A Steady-state Process System (6 contact hours; 6 self-study hours)<br>• The basic methods of modeling the process system (the sequential modular method, the equation oriented method and the simultaneous modular method); **<br>• The analysis and modeling of synthesis of ammonia; * |

| | |
|---|---|
| | **Chapter 3**. The Analysis and Modeling of A Dynamic Process System (6 contact hours; 6 self-study hours)<br>• The dynamic model of the process system; **<br>• The dynamic characteristic of the continuous stirring reactor; *<br>• The dynamic characteristic of the distillation tower; *<br>• The analysis and modeling of PSA process; *<br>**Chapter 4**. The Optimization of the Process System (6 contact hours; 6 self-study hours)<br>• The basic concepts of the optimization of the process system; *<br>• The liner programming and non-liner programming problems in the process; *<br>• The optimization of the large process system. *<br>**Chapter 5**. The Tuning of Operation Conditions in the Manufacture Process (6 contact hours; 6 self-study hours)<br>• The effect and meaning of the tuning of operation conditions in the manufacture process; *<br>• The method of off-line tuning of operation conditions in the manufacture process. *<br>**Chapter 6**. The Modeling of Intermittent Chemical Process (6 contact hours; 6 self-study hours)<br>• The intermittent and continuous process; *<br>• The dynamic modeling of the process; *<br>• The optimal time schedule in the intermittent process;*<br>• The equipment design and optimization of the intermittent process for multi- product; *<br>• The control model of the intermittent process. *<br>**Chapter 7**. The Synthesis of Heat Exchange Network (6 contact hours; 6 self-study hours)<br>• The synthesis problem of heat exchange network; *<br>• The pinch technology of the synthesis of heat exchange network; **<br>• The tuning of heat exchange network; *<br>• The synthesis of heat exchange network in actual engineering projects. *<br>**Chapter 8**.The Separation Tower Sequence Synthesis (6 contact hours; 3 self-study hours)<br>• The general concept of the separation sequence synthesis; *<br>• The dynamic programming; *<br>• The separation coefficient sequence method; *<br>• The relative cost function method； * |

| | |
|---|---|
| | • The tuning；* <br>• The separation sequence of complex tower. ** <br>**Part B. Experiment / practice teaching (0 hour)** |
| Study and examination requirements and forms of examination | Final score includes: usual performance (30%); final exam (closed book written examination) (70%)<br>Usual performance: attendance; classroom performance |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks, teachers pointer |
| Reading list | 1. Required books<br>[1] MA Dexian, etc. The Analysis and Synthesis of Chemical Process. Beijing: Chemical Industry Press, 2002.<br>2. Reference books<br>[1] XU Guangyou. The Artificial Intelligence and Its Application (2nd edition). Beijing: Tsinghua University Press, 1996. |

## FEM Numerical Simulation

| | |
|---|---|
| Competence field | Electives |
| Module designation | FEM Numerical Simulation |
| Code, if applicable | 11850050 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 7th semester |
| Person responsible for the module | Professor HUANG Diangui |
| Lecturer | Associate Professor YANG Fan<br>Associate Professor CHEN Eryun<br>Lecturer YANG Jie(M)<br>Lecturer CHEN Liu<br>Lecturer Xu Jiayin |
| Language | Chinese |
| Relation to curriculum | Finite Element Method (FEM), as a powerful tool, is widely used in design and development of Engineering equipment, and is significantly concerned by the engineering application area due to its generalization and efficiency. FEM Numerical Simulation is a course offered to undergraduates of Process Equipment and Control Engineering program. It is designed to help students understand basic principles and application of the course and cultivate students' abilities in analyzing simple statics and dynamics problems by using this tool so as to lay a foundation for follow-up courses such as Internship and Bachelor Thesis. Students can start this course after completing courses including Calculus, Linear Algebra, Mechanics of Materials and Theoretical Mechanics. |
| Type of teaching, contact hours | Target students: seniors of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching, computer practice<br>Contact hours: 48 hours<br>Of which:<br>Theoretical teaching: 24 hours<br>Computer practice: 24 hours<br>Size of class: No more than 60 people for theoretical teaching; no more than 60 people for computer practice |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Calculus; Linear Algebra; Mechanics of Materials; |

| | Theoretical Mechanics |
|---|---|
| Module objectives/intended learning outcomes | Module objectives:<br>FEM Numerical Simulation is an engineering application course offered to undergraduates of Process Equipment and Control Engineering program. It is designed to help students understand basic principles and application of the course and cultivate students' abilities in analyzing simple statics and dynamics problems, and lay a foundation for follow-up courses such as Internship and Bachelor Thesis. Specific objectives include.<br>● **Knowledge:** The application and significance of FEM in engineering; structural analysis of rod and beam; mechanical description of continuous deformable bodies; analysis of continuous deformable bodies; analysis of static structure; analysis of vibration problems etc.<br>● **Skills:** Learn to use common FEM simulation tools, including establishment of geometric model and mesh generation, establishment of statics and dynamics problem model, post-processing of calculation results etc; students are able to simulate and analyze simple engineering problems by using common FEM software.<br>● **Competences:** Develop students' abilities in analyzing and studying statics and dynamics problems by using FEM tools so as to lay a foundation for engagement in FEM simulation in future scientific research and engineering application endeavor. |
| Content | **Part A. Theoretical teaching (24 contact hours; 21 self-study hours)**<br>**Chapter 1** The Application and Significance of FEM in Engineering (3 contact hours; 3 self-study hours)<br>● Brief introduction of basic principles, development and application of FEM;<br>● Solution to the problem of one dimensional ladder rod structure;*<br>**Chapter 2** Structural Analysis of Rod and Beam (4 contact hours; 3 self-study hours)<br>● Mechanical analysis of simple spring, rod and beam structure;*<br>● Beam element and related coordinate conversion method;<br>● Treatment of boundary conditions;**<br>● The basic process of finite element analysis.* |

| | |
|---|---|
| | **Chapter 3** Mechanical Description of Continuous Deformable Bodies (3 contact hours; 3 self-study hours)<br>● Basic mechanical equations of plane problem and space problem;<br>● Energy representation of elastic problems;<br>● Virtual displacement; virtual displacement and virtual work principle.*<br>**Chapter 4** Analysis of continuous deformable bodies (4 contact hours; 4 self-study hours)<br>● Unit construction of plane problem, axisymmetric problem and space problem;*<br>● Treatment of unit division force.<br>**Chapter 5** Analysis of Static Structure (5 contact hours; 4 self-study hours)<br>● Static analysis method of beam structure. **<br>**Chapter 6** Analysis of Vibration Problems (5 contact hours; 4 self-study hours)<br>● Basic equation of vibration analysis; *<br>● Vibration analysis of simple structure. **<br>**Part B. Computer practice (24 contact hours; 21 self-study hours)**<br>● Numerical analysis of rod structure and beam structure (4 contact hours; 2 self-study hours)<br>● Parametric analysis of bridge structure (6 contact hours; 6 self-study hours)<br>● Parametric analysis of hydraulic press frame (6 contact hours; 6 self-study hours)<br>● Vibration modal analysis of automotive suspension system (8 contact hours; 7 self-study hours) |
| Study and examination requirements and forms of examination | Open book exam (accounting for 50% of final score); four computer practices (accounting for 50% of final score) |
| Media employed | Blackboard, electronic blackboard, combination with computer practice |
| Reading list | 1. Required books<br>[1] Finite Element Analysis in Engineering, ZENG Pan, Science Press, 2010<br>2. Reference books<br>[1] Foundation of Finite Element Method, JIANG Xiaoyu, Tsinghua University Press, 1992<br>[2] Finite Element Analysis -- ANSYS Theory and Application (The Third Edition), (US) Moaveni, S. WANG Song trans. Electronics Industry Press, 2008 |

| | |
|---|---|
| | [3] Foundation of Finite Element Technique, LENG Jitong, Chemical Industry Press, 2007<br>[4] Finite Element Method (The First Edition), WANG Xucheng, Tsinghua University Press, 2005<br>3. Other materials<br>[1] PPT courseware (self-compiled) |

## CFD Numerical Simulation

| | |
|---|---|
| Competence field | Electives |
| Module designation | CFD Numerical Simulation |
| Code, if applicable | 11850020 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 7th semester |
| Person responsible for the module | Professor GUO Xueyan |
| Lecturer | Professor YANG Ailing<br>Professor HUANG Diangui<br>Associate Professor GUO Xueyan<br>Asociate professor YANG Fan<br>Asociate professor CHEN Eryun<br>Lecturer WANG Ying |
| Language | Chinese |
| Relation to curriculum | Computational Fluid Dynamics (CFD), as a powerful tool, is widely used in design and development of process equipment. CFD Numerical Simulation is a course offered to undergraduates of energy and power engineering related programs. It is designed to help students understand basic principles and application of the course and cultivate students' abilities in analyzing complex fluid problems by using this tool so as to lay a foundation for follow-up courses such as Internship and Bachelor Thesis. Students can start this course after completing courses including Calculus, Engineering Fluid Mechanics, Computer Modeling Practice and mastering basic laws of fluid motion and control equations. |
| Type of teaching, contact hours | Target students: seniors of energy and power engineering related programs related programs.<br>Type of teaching: theoretical teaching, computer practice<br>Contact hours: 48 hours<br>Of which:<br>Theoretical teaching: 24 hours<br>Computer practice: 24 hours<br>Size of class: No more than 60 people for theoretical teaching; no more than 60 people for computer practice |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3 are allowed to take the exam. |

| | |
|---|---|
| Recommended prerequisites | Calculus; Engineering Fluid Mechanics; Computer Modeling Practice |
| Module objectives/intended learning outcomes | Module objectives:<br>CFD Numerical Simulation is an engineering application course offered to undergraduates of energy and power engineering related programs. It is designed to help students understand basic principles and application of the course and cultivate students' abilities in analyzing complex fluid problems by using fluid mechanics methods, and lay a foundation for follow-up courses such as Internship and Bachelor Thesis. Specific objectives include.<br>● **Knowledge:** Flow conservation equation and numerical discretization method; determination of boundary conditions; method for solving linear equations; processing and analysis of simulation results etc.<br>● **Skills:** Learn to use common CFD simulation tools, including establishment of geometric model and mesh generation, establishment of fluid problem model, post-processing of calculation results etc; students are able to simulate and analyze simple fluid problems by using common CFD software.<br>● **Competences:** Develop students' abilities in analyzing and studying fluid problems by using CFD tools so as to lay a foundation for engagement in CFD simulation in future scientific research and engineering application endeavor. |
| Content | **Part A. Theoretical teaching (24 contact hours; 24 self-study hours)**<br>**Chapter 1** Introduction (4 contact hours; 4 self-study hours)<br>● Brief introduction of basic principles, development and application of fluid mechanics;<br>● Fluid mechanics control equation;*<br>● Mathematical properties of fluid mechanics control equation.<br>**Chapter 2** One Dimensional Compressible Flow Differential Method of Euler Equation (8 contact hours; 8 self-study hours)<br>● One-dimensional shock tube problems;<br>● One-dimensional Euler conservation equations;*<br>● Space discretization of convection term;**<br>● Time marching scheme;* |

| | |
|---|---|
| | ● Programming for numerical calculation of one dimensional Euler equation.*<br>**Chapter 3** Finite Volume Method of 2-D Non-compressible Viscous Flow N-S Equation (8 contact hours; 8 self-study hours)<br>● Control equation of two-dimensional square cavity driven;<br>● Finite volume discretization of two-dimensional N-S equation;**<br>● Staggered mesh;*<br>● Discrete boundary conditions;*<br>● Calculation steps of the Simple algorithm.*<br>**Chapter 4** Preliminary Application of CFD Commercial Software (4 contact hours; 4 self-study hours)<br>● Review of some key problems in calculation fluid mechanics;*<br>● Introduction of mature commercial software;<br>● Application of NUMECA software.*<br>**Part B. Computer practice (24 contact hours; 18 self-study hours)**<br>• Procedures for the preparation and operation of one-dimensional Euler equation; solving of one-dimensional shock tube problem (4 contact hours; 2 self-study hours)<br>• Debugging and operation of two-dimensional non-compressibleN-S equation; Solution to simple two-dimensional non compressible flow, such as Driven square cavity (4 contact hours; 2 self-study hours)<br>• Two-dimensional simulation of viscous flow with NUMECA (including mesh generation, solving and analysis) (6 contact hours; 4 self-study hours)<br>• Complex 3D simulation of viscous flow with NUMECA (such as flow in compressor stage, flow in turbine stage, etc.) (10 contact hours; 10 self-study hours) |
| Study and examination requirements and forms of examination | Open book exam (accounting for 50% of final score); four computer practices (accounting for 50% of final score) |
| Media employed | Blackboard, electronic blackboard, combination with computer practice |
| Reading list | 1. Required books |

| | |
|---|---|
| | [1] Computational Fluid Mechanics and Application, (US) John D. Anderson. WU Songping, LIU Zhaomiao trans. Machinery Industry Press, 2007<br>2. Reference books<br>[1] Computational Fluid Mechanics Analysis -- Principles and Application of CFD Software, WANG Fujun, Tsinghua University Press, 2004<br>[2] Engineering Fluid Mechanics, GUI Keting, Science Press, 2004<br>[3] Numerical Heat Transfer, TAO Wenquan, Xian Jiaotong University Press, 2001<br>[4] Computational Fluid Dynamics: The Basic with ApplicationsJohn D. Anderson Jr.McGraw-Hill, Inc.1995<br>3. Other materials<br>[1] PPT courseware (self-compiled) |

## Complete Set Technology of Process Equipment

| | |
|---|---|
| Competence field | Electives |
| Module designation | Complete Set Technology of Process Equipment |
| Code, if applicable | 11000390 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 7th semester |
| Person responsible for the module | Associate Professor Xu bo |
| Lecturer | Associate Professor Xu bo<br>Associate Professor SU Wenxian<br>Associate Professor FAN Fengxian<br>Lecturer SUN Li |
| Language | Chinese |
| Relation to curriculum | The packaged technique of the process assembling is one of the main courses for undergraduates of Process Equipment and Control Engineering program. Theoretical knowledge in the curriculum is crucial for main devices applied in process industry. Based on engineering practice, the course systematically introduces basic the packaged technique. It focuses on introduction of application of the engineering characteristics, process industry equipment and technology, as well as, process development, process route selection, process design, investment estimation and cost analysis, process design and process flow chart, process equipment design, mechanical structure design of equipment, machine selection, selection of driving machine, piping design requirements and general procedures, piping stress analysis, pipeline vibration. |
| Type of teaching, contact hours | Target students: seniors of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching<br>Contact hours: 48 hours<br>Of which<br>Theoretical teaching: 48 hours<br>Experiment / practice teaching: 0 hours<br>Size of class: No more than 60 people for theoretical teaching |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the | Only students with class attendance rate over 2/3, assignment |

| | |
|---|---|
| examination regulations | completion rate over 2/3, and performing required experiments are allowed to take the exam. |
| Recommended prerequisites | Calculus; Engineering Thermodynamics; Engineering Fluid Mechanics. |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to understand the process technique and basic theories through teaching and practice. Specific objectives include:<br>● **Knowledge:** Students acquire basic theoretical and specialized knowledge about packaged technique of the process assembling; understand engineering application of the packaged technique; acquire deep understanding of the phenomena and mechanism;<br>● **Skills:** Through this course, students are able to analyze and solve related technique problems of the process assembling, including analysis and improvement of existing technique.<br>● **Competences:** Students acquire practical abilities and innovative thinking on the basis of the theories and engineering technology knowledge. |
| Content | **Part A. Theoretical teaching (48 contact hours; 42 self-study hours)**<br>**Chapter 1** Introduction (4 contact hours;4 self-study hours)<br>● The characteristics of the process industry;<br>● The engineering application of the process industry equipment; **<br>● The main tasks and basic requirements of the process equipment.<br>**Chapter 2** Process development and process design (6 contact hours; 4 self-study hours)<br>● Process development process and process design;<br>● Program and design documents; **<br>● Overall design of process design;<br>**Chapter 3** Economic analysis and evaluation (8 contact hours; 6 self-study hours)<br>● Investment estimation and cost analysis; *<br>● Economic evaluation; **<br>● Environmental impact assessment;<br>● Feasibility study report.<br>**Chapter 4** Process design and equipment layout design (10 contact hours; 10 self-study hours)<br>● Process design and equipment layout design; **<br>● Basic principles of process design, drawing a simple |

| | |
|---|---|
| | process flow chart;<br>● Basic principles of equipment layout, reading equipment layout chart.<br>**Chapter 5** Design and selection of process equipment (12 contact hours; 10 self-study hours)<br>● Process equipment technology design; *<br>● Mechanical structure design of equipment;**<br>● Machine selection;<br>● Selection of driving machine.<br>**Chapter 6** Piping design (8 contact hours; 8 self-study hours)<br>● Basic requirements for piping design;<br>● Pipeline design, pipeline stress analysis; **<br>● Piping vibration;*<br>● Measures to eliminate and reduce the vibration of pipes.<br>**Part B. Experiment / practice teaching （0 hour)** |
| Study and examination requirements and forms of examination | Final score includes: usual performance (30%); final exam (closed-book written examination) (70%)<br>Usual performance includes: assignment, attendance rate, and computer practice |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books<br>[1] Huang Zhenren et al. packaged technique of the process assembling (1 edition). Beijing: Chemical Industry Press, 2001<br>[2] Huang Zhenren et al. Guide for design of packaged technique of the process assembling (1 edition). Beijing: Chemical Industry Press, 2001<br>[3] Zheng Jinyang. Process equipment design Chemical Industry Press (3 edition). Beijing: Chemical Industry Press, 2010<br>2. Other materials<br>[1] PPT courseware (self-compiled) |

## Water Treatment Engineering

| | |
|---|---|
| Competence field | Electives |
| Module designation | Water Treatment Engineering |
| Code, if applicable | 11001130 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 7th semester |
| Person responsible for the module | Associate Professor MA Youfu |
| Lecturer | Associate Professor MA Youfu<br>Lecturer WANG Zhiyun<br>Lecture YANG Jie(F) |
| Language | Chinese/Engilish |
| Relation to curriculum | Water treatment is an engineering course focusing on the techniques of water pollution control and feed water treatment. It mainly consists of the technologies of the separation and conversion of pollutants in wastewater, the wastewater disinfecting technologies, the circulating cooling water treatment technologies, the design and plan for water treatment engineering, etc. The main contents are the adjustments of the quality and quantity of water, the filtration, the coagulation, the sedimentation and flotation, the adsorption and ion exchange, the membrane separation technology, the oxidation and reduction, the activated sludge process, the biofilm process, the anaerobic biochemical treatment, the bio-denitrification technology, the concentration and disposal of sludge, the treatment and utilization of circulating cooling water, the design of waste water treatment engineering, etc. |
| Type of teaching, contact hours | Target students: senior of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching<br>Contact hours: 48 hours<br>Of which,<br>Theoretical teaching:48 hours<br>Size of class: No more than 60 people for theoretical teaching |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Process Fluid Machinery, Process Principle and Equipment |

| | |
|---|---|
| Module objectives/intended learning outcomes | Module objectives:<br>• **Knowledge:** The general situation of water source in China and around the world. Types of process and devices of waste water or feed water pollution control; the basic principles and methods of water pollution control and water purification with popularity; the working principles of devices of water treatment.<br>• **Skills:** Systematic understanding of basic types and current situation of all kinds of process and devices of waste water or feed water pollution control; be familiar with components, structure, working principles and operation adjustment of devices of water treatment. Students can broaden horizon.<br>• **Competences:** The technologies introduced by this course are common technologies for solving problems connected with industrial devices, such as high efficient water treatment technology, design for different kinds of devices of water treatment, optimization and arrangement technology for waste water treatment engineering, industrial water treatment technology, operation and accident handling technology for related equipment, etc. This course, therefore, lays a foundation for further study and future practical work. |
| Content | **Part A. Theoretical teaching (48 contact hours; 42 self-study hours)**<br>**Chapter 1**. Introduction of Water Treatment (6 contact hours; 3 self-study hours)<br>• Overview of water source in China and around the world; *<br>• The general situation of water pollution around the world. *<br>**Chapter 2**. Physical Treatment Methods (6 contact hours; 6 self-study hours)<br>• The grille method; *<br>• The filtration method; *<br>• The centrifugal method; *<br>• The precipitation method. *<br>**Chapter 3**. Chemical Process Treatment Method (6 contact hours; 6 self-study hours)<br>• The coagulation method; *<br>• The chemical neutralization method; *<br>• The oxidation and reduction method; *<br>**Chapter 4**. Physical-Chemical Treatment Method (6 contact |

| | |
|---|---|
| | hours; 6 self-study hours)<br>• The adsorption and ion exchange method; *<br>• The extraction method; *<br>• The air and steam stripping method; *<br>• The membrane method. *<br>**Chapter 5**. Biochemical Treatment Method (6 contact hours; 6 self-study hours)<br>• The activated sludge method; *<br>• The biofilm method; *<br>• The anaerobic biochemical method; *<br>• The bio-denitrification method. *<br>**Chapter 6**. Recycling Utilization of Waste Water and Cycling Cooling Water (6 contact hours; 6 self-study hours)<br>• The recycling of waste water in industry; **<br>• The utilization of cycling water. **<br>**Chapter 7**. Design of Waste Water Treatment Engineering (6 contact hours; 6 self-study hours) *<br>**Chapter 8**. Waste Water Treatment Process in Industry (6 contact hours; 3 self-study hours)<br>• Waste water treatment in Petrochemical Industry; *<br>• Waste water treatment in Coal chemical Industry; *<br>• Waste Water Treatment in printing and dyeing industry. *<br>**Part B. Experiment / practice teaching （0 hour)** |
| Study and examination requirements and forms of examination | Final score includes: usual performance (30%); final exam (closed book written examination) (70%)<br>Usual performance: attendance; classroom performance |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks, teachers pointer |
| Reading list | 1. Required books<br>[1] TANG Yubin. Water Pollution Controlling Engineering (1st edition). Harbin: Harbin Institute of Technology Press, 2006.<br>2. Reference books<br>[1]. GAO Yanyao. Water Pollution Controlling Engineering (3rd edition). Beijing: High Education Press, 2007.<br>[2] DING Huanru. Industrial Water Treatment Engineering. Beijing: Tsinghua University Press, 2005.<br>[3] Wasterwater Engineering: Treatment and Reuse (4th edition), Metcalf & Eddy, Inc. Beijing: Chemical Industry Press, 2004.<br>[4] REN Nanqi. Principles and Technologies of Water Pollution Control. Beijing: Tsinghua University Press,2007. |

## Equipment Fault Diagnosis

| | |
|---|---|
| Competence field | Electives |
| Module designation | Equipment Fault Diagnosis |
| Code, if applicable | 11001890 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 7th semester |
| Person responsible for the module | Associate Professor SAI Qingyi |
| Lecturer | Associate Professor ZHAO Jun<br>Associate Professor LU Wei<br>Lecturer SUN Li<br>Lecturer YANG Jie(M) |
| Language | Chinese |
| Relation to curriculum | Equipment Fault Diagnosis is a course offered to seniors of Process Equipment and Control Engineering. This course introduces machine fault types, mechanism, performance characteristics and method of prevention and cure for the various rotating machines and reciprocating pumps in the fields of chemical, petrochemical, electric power, steel and aviation. It focuses on various high parameters of rotating machines, on the base of vibration fault diagnosis. It includes the mechanism and characteristics of various unbalanced faults and the self-excited vibration of high-speed rotors stated by theory and experience, diagnostic analysis method and prevention measures of fault vibration of reciprocating compressors and pipelines, fault diagnosis of various pump components, fault principle, the signal characteristics and the fault detection method of gear and rolling bearing, vibration signal analysis technique, etc. |
| Type of teaching, contact hours | Target students: senior of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching<br>Contact hours: 48 hours<br>Of which,<br>Theoretical teaching: 48 hours<br>Size of class: No more than 60 people for theoretical teaching |
| Workload | Workload= 90 hours<br>Contact hours = 48 hours<br>Self-study hours = 42 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the |

| | |
|---|---|
| | exam. |
| Recommended prerequisites | Probability Theory and Mathematical Statistics, Process Fluid Machinery, Design of Process Equipment, Process Principle and Equipment |
| Module objectives/intended learning outcomes | Module objectives:<br>The task of this course is to enable students to master general fault diagnosis methods, to understand fault prevention and control measures, and to upgrade the abilities of equipment design, manufacture, installation, maintenance and management. Specific objectives include:<br>● **Knowledge:** Machine fault types, mechanism, performance characteristics and method of prevention and cure for the various rotating machines and reciprocating pumps in the fields of chemical, petrochemical, electric power, steel and aviation.<br>● **Skills:** Analysis of various unbalanced faults and the self-excited vibration of high-speed rotors stated; diagnostic analysis of fault vibration of reciprocating compressors and pipelines; fault diagnosis of various pump components; fault detection of gear and rolling bearing.<br>● **Competences:** Develop abilities in equipment design, manufacture, installation, maintenance and management; be able to diagnose various rotating machines faults with high parameters. |
| Content | **Part A. Theoretical teaching (48 contact hours; 42 self-study hours)**<br>**Chapter 1** Introduction (3 contact hours; 1.5 self-study hours)<br>● The purpose of equipment fault diagnosis and meaning;<br>● The type of equipment failure and condition monitoring technology;<br>● Equipment fault state recognition method;<br>**Chapter 2** Equipment fault state recognition method (6 contact hours; 4.5 self-study hours)<br>● Basic knowledge of signal processing;<br>● Vibration signal graphics processing of commonly used rotating machinery; *<br>● The time-frequency analysis of signals; *<br>**Chapter 3** Fault diagnosis of rotation machinery (9 contact hours; 7.5 self-study hours)<br>● The rotor imbalance fault diagnosis;<br>● Misalignment rotor fault diagnosis; * |

| | |
|---|---|
| | ● Sliding bearing fault diagnosis; *<br>● The rotor rubbing fault diagnosis; *<br>● Floating ring seal of fault diagnosis; *<br>● Vane fluid vibration fault diagnosis of the machine; *<br>● The self-excited vibration of high speed rotating machinery unstable failure analysis method; *<br>**Chapter 4** The fault analysis and pipeline vibration of reciprocating compressor (9 contact hours; 9 self-study hours)<br>● Reciprocating compressor fault type and the cause of the problem; **<br>● The measurement and fault analysis of the indicator diagram and the valve motion principle; **<br>● Air pressure fluctuation and pipeline vibration of compressor; **<br>**Chapter 5** Gear fault diagnosis (6 contact hours; 6 self-study hours)<br>● Common gear fault;<br>● Gear fault vibration diagnosis; *<br>● The fault diagnosis of gear noise; *<br>**Chapter 6** Fault diagnose of rolling bearing (6 contact hours; 4.5 self-study hours)<br>● Fault form and the cause of rolling bearing;<br>● Rolling bearing fault detection method; *<br>● The fault diagnosis of rolling bearing vibration;*<br>**Chapter 7** The application of nondestructive testing technology in equipment diagnosis (6 contact hours; 6 self-study hours)<br>● Sample analysis techniques in the diagnosis of equipment;<br>● Acoustic emission testing technology in the diagnosis of equipment;<br>**Chapter 8** The application of modern intelligent diagnosis technology (3 contact hours; 3 self-study hours)<br>● Fault diagnosis expert system;<br>● Application of fuzzy mathematics in fault diagnosis; *<br>● Application of neural network in fault diagnosis; *<br>**Part B. Experiment / practice teaching （0 hour)** |
| Study and examination requirements and forms of examination | Final score includes: usual performance (30%) and final exam (open-book written examination) (70%)<br>Usual performance includes: assignment and attendance rate |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, |

| | |
|---|---|
| | chalks |
| Reading list | 1. Required books<br>[1] SHEN Qinggen. Equipment Fault Diagnosis (1st edition). Beijing: Chemical Industry Press, 2010.<br>2. Reference books<br>[1] WANG Jiangping. Mechanical equipment fault diagnosis technology and its application (1st edition). Xi'an: Northwestern Polytechnic University Press, 2001.<br>[2] ISERMANN Rolf. Fault-Diagnosis Systems (1st edition). Berlin: Springer Press, 2006<br>3. Other materials<br>[1] PPT courseware (self-compiled)<br>[2] Supplementary new energy management teaching materials (self-compiled) |

# Foreign Language

## Fundamental English

| | |
|---|---|
| Competence field | Language Teaching |
| Module designation | Fundamental English |
| Code, if applicable | 15002110 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 1st semester |
| Person responsible for the module | Associate Professor LIN Shangling |
| Lecturer | Associate Professor DONG Yuping<br>Associate Professor LIN Shanling<br>Associate Professor YANG Tao<br>Associate Professor NI Xiujing<br>Associate Professor ZHANG Ziqin,<br>Lecturer HU Yinping,<br>Lecturer ZHENG Dahu<br>Lecturer ZHANG Wuhan,<br>Lecturer WEN Yan<br>Lecturer LIU Sha,<br>Lecturer XUE Xiangying<br>Lecturer DENG Yongping,<br>Lecturer CHEN Yonggang<br>Lecturer HUANG Chen,<br>Lecturer QIAO Xiaohong<br>Lecturer PAN Yuhua,<br>Lecturer MA Xiaohong<br>Lecturer CHEN Shuying |
| Language | English |
| Relation to curriculum | Fundamental English is a prerequisite course for Intensive English. It belongs to the fundamental course of college English and is a required course to all the non-English majors in the university. It aims to lay a solid foundation for the students' learning of listening, speaking, reading, writing and translation skills via step-by-step and systemic training. This course is divided into five modules: Pronunciation, Vocabulary, Grammar, Listening, Reading and Writing. Each module focuses on one special area of essential English knowledge or skill. This course and other College English serial courses jointly comprise the complete English curriculum for non-English majors, which is designed to help the students master English as a handy tool to communicate effectively and efficiently both in life and at work. |

| | |
|---|---|
| Type of teaching, contact hours | Target students: Non-English majors<br>Type of teaching: Most of the time is for lectures, and some time is for classroom presentations and discussions<br>Contact hours: 48 hours<br>Of which,<br>Theoretical teaching: 48 hours<br>Experiment / practice teaching: 0 hour<br>Computer practice: 0 hour<br>Size of class: 40-60 students |
| Workload | Workload = 48 hours<br>Contact hours = 48 hours<br>Self-study hours = 0 hours |
| Credit points | 2.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | None |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>The general objective of learning college English is to use the English language in practice. Fundamental English aims to help students to grasp the basic knowledge and skills in communication with people around the world.<br>● **Knowledge:** Pronunciation and spelling rules of English words, grammar rules, discourse rules, English speech and writing styles, intercultural communication principles.<br>● **Skills:** Basic listening, speaking, reading, writing and translation skills.<br>● **Competences:** Being able to express one's opinions both orally and in the written form. |
| Content | **Part A. Theoretical teaching (48 contact hours)**<br>**Unit 1:** Pronunciation Learning (10 contact hours)<br>● Vowels and consonants.*<br>● Pronunciation and spelling rules of English words.*<br>● Reduced sounds.*<br>● Liaison.*<br>● Assimilation.*<br>● Stressed syllables.*<br>● Sentence stress and rhythm.**<br>● Intonation and attitude.*<br>● Pronunciation guides for different dialect speakers.<br>**Unit 2:** How To Expand English Vocabulary (8 contact hours)<br>● Root, prefix and suffix** |

| | |
|---|---|
| | ● Synonym, antonym, homonym, homograph*<br>● Hyponym*<br>● Clans of English words<br>**Unit 3:** Grammar Rules and English Writing (10 contact hours)<br>● What functions do English words play in a sentence*<br>● How to write English sentences correctly **<br>● How to write English sentences persuasively*<br>● How to write a paragraph in English*<br>● How to write expository essays *<br>● How to write persuasive essays*<br>**Unit 4:** Reading Skills (10 contact hours)<br>● Lesson 1 Learning a language *<br>Useful reading skills: Skimming, scanning and perusing<br>● Lesson 2 Growing up*<br>Useful reading skills: How to guess the meaning of new words<br>● Lesson 3 Care of the elderly*<br>Useful reading skills: How to understand the rhetorical devices<br>● Lesson 4 Parents and children*<br>Useful reading skills: How to recognize the author's opinions<br>● Lesson 5 Relationships and communication*<br>Useful reading skills: How to find out the supporting details<br>● Lesson 6 College life**<br>Useful reading skills: How to do critical reading<br>**Unit 5:** Translation Skills (10 contact hours)<br>● Similarities and difference between English and Chinese.**<br>● Basic rules for translation and a translator.**<br>● Translation by adding words.*<br>● Translation by omitting words.*<br>● Translation by adjusting the order of sentences.*<br>● Translation by converting the sentence patterns.*<br>**Part B. Experiment / practice teaching (0 hour)** |
| Study and examination requirements and forms of examination | After-class exercises should be completed by students independently.<br>Usual performance accounts for 50%, consisting of attendance, assignments and mid-semester examination; final exam (oral exam and closed book written exam) accounts for 50%. |

| | |
|---|---|
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] Qin Xiubai, Jiang Jingyi, Integrated Course Book 1, New Century College English, Shanghai Foreign Language Education Press, 2012.<br>2. Reference books<br>[1] Zheng Shutang, Listening and Speaking Book 1, New Horizon College English, Foreign Language Teaching and Research Press, 2011.<br>[2] Shu Dingfang, Fast Reading Book 1, New Century College English, Shanghai Foreign Language Education Press, 2012.<br>[3] Huang Yuanshen, Qin Xiubai, Reading Book 1, New Century College English, Shanghai Foreign Language Education Press, 2012.<br>[4] Tu Pei, Practical Course of English Pronunciation, Foreign Language Teaching and Research Press, 2005.<br>3. Other resources<br>[1] http://open.163.com/.<br>[2] http://ocw.mit.edu/courses/writing-and-humanistic-studies.<br>[3] http://www.bbc.com/.<br>[4] http://edition.cnn.com/. |

## Intensive English

| | |
|---|---|
| Competence field | Language Teaching |
| Module designation | Intensive English |
| Code, if applicable | 15002120 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 2nd semester |
| Person responsible for the module | Lecturer LI Qin |
| Lecturer | Lecturer ZHAO Dan<br>Lecturer HE Zheng-ye<br>Lecturer SHI Yi-li<br>Lecturer HUANG Chen |
| Language | English |
| Relation to curriculum | Intensive English is a follow-up course of Fundamental English and is a required course to non-English major undergraduates. Learning a language should be a long-term and continuous process. Intensive English, as an essential link of the whole process, focuses mainly on the reinforcement of basic knowledge and skills imparted and acquired in Fundamental English and makes effort on preparing the students for advanced Interactive Practical English. The two courses of Fundamental English and Intensive English jointly provide a solid groundwork for students in terms of grammar, vocabulary, methodology and so on. Intensive English is an important transition from newly admitted college students, who are usually confused and troubled by the different environment, psychologically, physically and academically, and struggle with the adaption to the new. Hence Intensive English is all the more important now that they have been acclimated and know better how to learn English in college. Intensive English is supposed to be a highly yielding phase |
| Type of teaching, contact hours | Target students: non-English major undergraduates<br>Type of teaching: Most of the time is for lectures, and some time is for classroom discussions and group work<br>Contact hours: 48hours<br>Of which,<br>Theoretical teaching: 48 hours<br>Experiment / practice teaching: 0 hour<br>Computer practice: 0 hour<br>Size of class:40-60 students |
| Workload | Workload = 48 hours<br>Contact hours = 48 hours |

| | |
|---|---|
| | Self-study hours = 0 hours |
| Credit points | 2.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Fundamental English |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>Intensive English is a required fundamental course for all non-English major undergraduates. Its goal is to develop students' English in a well-rounded way, especially in listening and speaking.<br>● **Knowledge:** students are required to master the grammar rules not only in reading comprehension as they did in high school but also in accurate translation and composition writing; largely expand their recognizable vocabulary and enhance their awareness of correct usage and frequent collocations of core vocabulary; acquire necessary knowledge about the culture of English-speaking countries, especially that of America and the UK, communication-related etiquette and signs and cues of socializing in culturally different everyday life; learn some basics of paragraph translation and how it differs from sentence translation in translating strategies and skills; use English as a tool to have some knowledge about various fields in the reading materials.<br>● **Skills:** be able to read articles of various genres and on various topics including humanities and popular science and common technology; be able to understand listening materials of all kinds of topics of everyday life and academic issues on the mediate level; be able to do paragraph translation on general topics and academic issues of the common kinds; be able to express themselves orally in quite fluent and accurate English.<br>● **Competences:** by taking the course of English Band 2, students are expected to acquire certain skills in listening comprehension, speaking, reading and translating, so as to lay the foundation for the study of follow-up advanced English. Besides, students are supposed to promote their intercultural communication awareness and competence. By virtue of having abundant group work and individual tasks, students are also expected to be more autonomous and |

| | |
|---|---|
| | ready for the follow – up courses which requires more self-teaching and self-discipline. Accurate written English and fluent spoken English is one of the necessary conditions required for enterprise talents. |
| Content | **Part A. Theoretical teaching (48 contact hours)**<br>**Unit 1:** Clarification and Orientation (8 contact hours)<br>● Self-introduction;*<br>● Clarification of the course English Band 2 including the scope and flow of lectures, requirements on the students, evaluation system, routine tasks and required reading materials;**<br>● Orientations on how the goal of English Band 2 is supposed to be achieved and what they are expected to do;*<br>● Sectioning students into groups.<br>**Unit 2:** Routine Lectures (12 contact hours)<br>● Pre-reading assignments;<br>● Checking pre-reading assignments; introduction of back-ground information; explanation of terminologies or peculiar concepts, theme-related discussion;*<br>● Global reading: analysis of the structure of passages, patterns and skills of writing, etc.;**<br>● Detailed reading: zooming into important words and expressions, checking the understanding of or explaining difficult sentences, notes and lectures on features of the passage like rhetorical devices, effective persuasion, smooth narration and vivid description; **<br>● After-reading: checking their grasp of required information and knowledge; further discussion of the same topic from a different but related perspective;*<br>● Extensive reading: supplementary reading material with tasks designed for group work or self-study; *<br>● Listening exercises including situation-based and function-based tasks*<br>**Unit 3:** Mid-term Exam and Preparation & Review(8 contact hours)<br>● Review of the materials learnt so far and key language points and skills;*<br>● Review of the test paper and reflection on the problems to be worked on and plans for future improvement; * |

| | |
|---|---|
| | **Unit 4:** Routine Lectures (12 contact hours)<br>● Pre-reading assignments;<br>● Checking pre-reading assignments; introduction of back-ground information; explanation of terminologies or peculiar concepts, theme-related discussion;*<br>● Global reading: analysis of the structure of passages, patterns and skills of writing, etc.;**<br>● Detailed reading: zooming into important words and expressions, checking the understanding of or explaining difficult sentences, notes and lectures on features of the passage like rhetorical devices, effective persuasion, smooth narration and vivid description; **<br>● After-reading: checking their grasp of required information and knowledge ; further discussion of the same topic from a different but related perspective;*<br>● Extensive reading: supplementary reading material with tasks designed for group work or self-study; *<br>● Listening exercises including situation-based and function-based tasks*<br>**Unit 5:** Review and Oral Exam (8 contact hours)<br>● Review of the materials learnt in the latter half of the semester and key language points and skills and important questions discussed in class;*<br>● Oral exam<br>**Part B. Experiment / practice teaching (0 hour)** |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 50%, consisting of assignments, mid-semester examination and attendance; final exam (closed book written examination) accounts for 50%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] Longman Dictionary of Contemporary English, The Commercial Press, first edition,1998.<br>[2] Wang Wenchang, A Dictionary of English Collocations, Modern Press, 1994<br>[3] Ma Degao, New Requirements for the Vocabulary of CET-4, Foreign Language Education Press, 2009<br>[4] Yu Minhong, Root Associative Memory for the |

| | |
|---|---|
| | Vocabulary of CET-4, Qun Yan Publishing House, 2013.<br>[5] Qiao Zhigao, A New Interpretation of American English, Guangxi Normal University Press.<br>2. Reference books<br>[1] Kate Fox. Watching the English——The Hidden Rules of English Behavior. Hodder and Stoughton Ltd. 2004<br>[2] Lin Yu-tang. My Country and My People. Foreign Language Teaching and Research Press. 2009. |

## Interactive Practical English

| | |
|---|---|
| Competence field | Language Teaching |
| Module designation | Interactive Practical English |
| Code, if applicable | 15002130 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 3rd semester |
| Person responsible for the module | Associate Professor YU Jinhong |
| Lecturer | Associate Professor GU Dinglan<br>Associate Professor WEI Yongjia<br>Lecturer HE Zhengye<br>Lecturer JIN Zhaohui<br>Lecturer LI Qin<br>Lecturer SHI Yili<br>Lecturer ZHAO Dan |
| Language | English |
| Relation to curriculum | Interactive Practical English is a follow-up course of Intensive English. It belongs to the fundamental course of college English and is a required course to all the non-English majors in the university. This course is a connecting link between Intensive English and Interactive Comprehensive English, focusing on the continuous promotion of students' language competence in listening, speaking, reading, writing and translation. After learning the courses of Fundamental English and Intensive English, students have had certain language foundation in all these aspects. In the 3rd level, they should be provided with more practice in them, so that they can acquire more competence and confidence in using English as a communicative tool and get prepared for the further study of English. It provides the reading and practice materials with a higher level of difficulty, requiring students' larger vocabulary, stronger comprehensive and thinking ability and more efforts in writing. The materials are up-to-date and thought-provoking, focusing more on critical thinking instead of just reading and understanding, therefore the students must have a good language comprehensive ability and try to think in English, completing the transition from just understanding to thinking, so as to lay the foundation for the study of Interactive Comprehensive English. |
| Type of teaching, contact hours | Target students: Non-English majors of the 3rd semester<br>Type of teaching: Lectures, discussions and students' presentations<br>Contact hours: 48 hours |

| | |
|---|---|
| | Of which,<br>Theoretical teaching: 48 hours<br>Experiment / practice teaching: 0 hour<br>Computer practice: 0 hour<br>Size of class: 40-60 students |
| Workload | Workload = 48 hours<br>Contact hours = 48 hours<br>Self-study hours = 0 hours |
| Credit points | 2.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Fundamental English; Intensive English |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>The general objective of learning college English is to use the English language in practice. In the study of Interactive Practical English, the students should be equipped with more profound ability to understand and think critically in English, and get prepared for further English learning.<br>● **Knowledge:** students are required to master the reading and listening materials the course has provided and obtain the corresponding vocabulary.<br>● Skills: be able to understand materials exposed, such as letters, emails, news, magazines, and videos, etc. be able to describe a fact or a phenomenon, give presentations, and express ideas, proposals, and suggestions.<br>● **Competences:** by learning this course, students are expected to acquire certain skills in listening, speaking, reading writing and translation, so as to lay the foundation for the further study of follow-up courses and use the language as a communicative tool. Just acquiring the vocabulary is not enough, though it is very important in English learning. In the study of this level, students should not be staying at the vocabulary level, they should be thinking in an English way and understand English materials more profoundly and critically. They should be expressing themselves with more confidence and more fluently besides catching the listening materials and understanding the reading materials.<br>1. Vocabulary: to master 4500-5000 words and expressions;<br>2. Listening: to understand the lecture in the class or on general topics and daily conversations;<br>3. Speaking: to talk fluently in English with foreigners |

| | |
|---|---|
| | by using certain conversation strategies, discuss on a topic and give a presentation after preparation;<br>4. Reading: to understand English articles of medium difficulty, grasp the main idea and details, identify the attitude and comment with effective reading techniques;<br>5. Writing: to employ writing skills to write a 120-150-word article on a general topic within 30 minutes and describe the experiences, facts, attitudes and feelings well, with no big grammatical mistakes and ambiguity.<br>6. Translation: to translate Chinese into English or vice versa with translation skills and remain faithful to the original. |
| Content | **Part A. Theoretical teaching（48 contact hours）**<br>**Unit 1:** Friendship (6 contact hours)<br>● Background information.<br>● Organization of the passage**<br>● Text understanding, words and expressions **<br>● Discussion**:<br>1. What are your criteria for making friends?<br>2. What can we do to keep friendship as long as possible?<br>● Presentation*<br>● Exercises** (self-study)<br>**Unit 2:** Love (8 contact hours)<br>● Background information.<br>● Organization of the passage**<br>● Text understanding, words and expressions **<br>● Discussion**: Now many young people fall in love when they are college students. Some people think it a good thing for college students to experience love, and some think the opposite. What is your opinion? If it is good, what are the positive effects campus love may produce on college students? If it is bad, then what are the negative effects?<br>● Presentation*<br>● Exercises** (self-study)<br>**Unit 3:** Happiness (10 contact hours)<br>● Background information.<br>● Organization of the passage**<br>● Text understanding, words and expressions **<br>● Discussion**: What do you think are the keys to happiness? Why?<br>● Presentation* |

| | |
|---|---|
| | ● Exercises** (self-study)<br>**Unit 4:** Health (8 contact hours)<br>● Background information.<br>● Organization of the passage**<br>● Text understanding, words and expressions **<br>● Discussion**: What do you think are the criteria of being healthy?<br>● Presentation*<br>● Exercises** (self-study)<br>**Unit 5:** Education (10 contact hours)<br>● Background information.<br>● Organization of the passage**<br>● Text understanding, words and expressions **<br>● Discussion**:<br>1. What is your idea of an ideal university life?<br>2. How does education improve your life?<br>3. How does cyber education benefit students?<br>● Presentation*<br>● Exercises** (self-study)<br>**Unit 6:** Intercultural Communication (6 contact hours)<br>● Background information.<br>● Organization of the passage**<br>● Text understanding, words and expressions **<br>● Discussion**: Do you sometimes find it difficult to adapt to a new environment? Why? Please give some examples.<br>● Presentation*<br>● Exercises** (self-study)<br>**Part B. Experiment / practice teaching (0 hour)** |
| Study and examination requirements and forms of examination | After-class exercises should be completed by students independently after each class.<br>Usual performance accounts for 50%, consisting of assignments, mid-semester examination discussion, presentation and attendance; final exam (closed book written examination accounts for 40% and oral test accounts for 10%.) |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | Recommended book<br>[1] Qin Xiu bai, Zhang Fengchun, Zooming in: An Integrated English Course, Shanghai Foreign Language Education Press, 2007<br>[2] Qin Xiubai, Huang Yuanshen, Learning to Read: An Reading English Course, Shanghai Foreign Language Education Press, 2008 |

| | |
|---|---|
| | [3] Qin Xiubai, Shu Dingfang, Reading Faster, Shanghai Foreign Language Education Press, 2007<br>[4] Susan Stempleski, Yang Huizhong, Video Course, Shanghai Foreign Language Education Press, 2007 |

## Reading and Writing in Technical English

| | |
|---|---|
| Competence field | Language teaching |
| Module designation | Reading and Writing in Technical English |
| Code, if applicable | 17001612 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 3rd semester |
| Person responsible for the module | Professor TAO Leren |
| Lecturer | Associate Professor XU Hongtao<br>Lecturer LIU Ni<br>Lecturer YANG Huinan<br>Lecturer SUN Li |
| Language | Chinese/English |
| Relation to curriculum | Reading and Writing in Technical English is a basic course of Energy and Power Engineering program. Through this course, students can acquire systematic understanding of English subject (i.e, College English --- its recommended prerequisite), deeper understanding of professional English, understand basics methods of English reading and writing, get familiar with basic English sentence patterns and tenses, and master the English expression of technical term and professional knowledge. The course is designed to train students in English reading and writing, especially concerning the program itself, so as to broaden students mind and lay a foundation for further study. |
| Type of teaching, contact hours | Targeted students: undergraduates of Process Equipment and Control Engineering and related programs<br>Contact hours: 48 hours<br>Of which,<br>Theoretical teaching: 48 hours<br>Experiment / practice teaching: 0 hours<br>Computer practice: 0 hour<br>Size of class: no more than 60 people for theoretical teaching |
| Workload | Workload = 48hours<br>Contact hours = 48 hours<br>Self-study hours =0 hour |
| Credit points | 2.0 |
| Requirements according to the examination regulations | Only students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | College English |

| | |
|---|---|
| Module objectives/intended learning outcomes | Module objectives:<br>● **Knowledge:** Introduction of basic procedures and methods for English reading and writing. Improve students' ability in listening comprehension, speaking, reading and writing through this course. The course is focused on explanation of words, phrases and relevant contents of this program with professional English teaching materials. The course is also focused on teaching of features and skills of professional English reading and writing.<br>● **Skills:** Students are able to read and quickly understand relevant specalized English literature; be able to translate professional literature into Chinese; be able to translate professional Chinese texts into English with the help of dictionary; be able to preliminarily communicate in English; be able to write abstract of Bachelor Thesis in English.<br>● **Competences:** Students are expected to be able to read professional literature so as to be able to solve specialized problems in future. Students are also expected to acquire capabilities in English writing, listening and speaking so as to be able to communicate with international counterparts. |
| Content | **Part A. Theoretical teaching (48 contact hours)**<br>**Chapter 1** Introduction to Thermal Science<br>● Fundamental of Engineering Thermodynamics; *<br>● Fundamental of Fluid mechanics; *<br>● Fundamental of Heat Transfer.*<br>**Reading and Translation *** (4 contact hours): Introduction to Thermal Science Fundamental of Engineering Thermodynamics; Fundamental of Fluid Mechanics; Fundamental of Heat Transfer.<br>**Video watching and practice*** (2 contact hours)<br>**Chapter 2** Introduction to Boiler and Steam Turbine<br>● Development of Utility Boiler; Fuel and Combustion;<br>● System Arrangement and Key Components: Casing, Turbine rotors and Couplings, Blading, Condensing system;**<br>● Supercritical steam turbine technologies.<br>**Reading and Translation *** ( 4 contact hours): Introduction to Boiler and Steam Turbine: Development of Utility Boiler; Fuel and Combustion; System Arrangement and Key Components; Casing, Turbine Rotors and Couplings; Blading; Condensing system; Supercritical Steam Turbine Technologies<br>**Video watching and practice*** (2 contact hours)<br>**Chapter 3** Introduction to Environmental Control and Renewable Energy<br>● Ash Collection, Reducing Sulphurate Oxides and Nitric |

| | |
|---|---|
| | Oxides Emission; *<br>● Nuclear Energy;<br>● Renewable Energy.<br>**Reading and Translation *** (4 contact hours): Introduction to Environmental Control and Renewable Energy Ash Collection; Reducing Sulphurate Oxides and Nitric Oxides Emission; Nuclear Energy; Renewable Energy<br>**Grammar **** (4 contact hours): grammar for EST writing 1- Sentence writing<br>**Simulated writing **1- Resume (2 contact hours)<br>**Video watching and practice*** (2 contact hours)<br>**Chapter 4** Introduction to Instrumentation and Process Control<br>● Documentation and symbols;<br>● Essential instrumentation and Controls.<br>**Reading and Translation *** (2 contact hours): Introduction to Instrumentation and Process Control Documentation and symbols; Essential Instrumentation and Controls<br>**Grammar **** (2 contact hours): Characteristics of writing in professional English<br>**Simulated writing **** (2 contact hours): 2- Cover letter<br>**Video watching and practice*** (2 contact hours)<br>**Chapter 5** Introduction to Air conditioning and Refrigeration<br>● Air conditioning; Refrigeration;**<br>● Cryogenics.<br>**Reading and Translation *** (4 contact hours): Introduction to Air Conditioning and Refrigeration Air conditioning; Refrigeration; Cryogenics<br>**Grammar **** (2 contact hours): Writing practice of sentences and paragraphs<br>**Writing practice **** (2 contact hours): 3-Abstract I<br>**Video watching and practice*** (2 contact hours)<br>**Chapter 6** Reading of latest professional literature<br>**Grammar **** (2 contact hours): Correction practice<br>**Writing practice **** (2 contact hours): 4-Abstract II<br>**Video watching and practice*** (2 contact hours) |
| Study and examination requirements and forms of examination | Final score is based on usual performance and examination.<br>usual performance: literature translation (10%); listening comprehension practice (10%); writing practice (10%);<br>final examination (closed book written exam and oral exam) accounts for 70% |
| Media employed | Multimedia computer, projector, laser pointer, blackboard, chalks, etc. |
| Reading list | 1. Required books |

| | |
|---|---|
| | [1] CHEN Donglin et al. Specialty English for Energy & Power Engineering, Wuhan: Huazhong University of Science and Technology Press, 2009<br>[2] YAN Weiping et al. Specialty English for Thermal Energy and Power Engineering (3rd edition), China Electric Power Press, 2009<br>2. Reference books<br>[1] ZHANG Yinping et al. English for Institutions of Higher Learning (1st edition), China Architecture & Building Press, 2005<br>[2] WANG Jianwu et al. EST Writing: Writing Skills and Model Essays (1st edition), Xian: Northwestern Polytechnical University, 2000<br>[3] ASHRAE fundamentals handbook 2001<br>[4] ASHRAE system and equipment handbook 2000<br>3. Experiment/computer practice instruction books<br>Self-compiled<br>4. Other materials<br>[1] PPT courseware (self-compiled)<br>[2] Supplementary reading and writing teaching materials (self-compiled) |

## Interactive Comprehensive English

| | |
|---|---|
| Competence field | Language Teaching |
| Module designation | Interactive Comprehensive English |
| Code, if applicable | 15003850 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 4th semester |
| Person responsible for the module | Associate Professor GU Dinglan |
| Lecturer | Associate Professor ZHAO Wanzi<br>Lecturer JIN Zhaohui<br>Lecturer CHEN Yangtao |
| Language | Chinese & English |
| Relation to curriculum | Interactive Comprehensive English is a follow-up course of Interactive Practical English. These two courses belong to professional fundamental courses of college English and are required courses to non-English majors. It fosters the development of active English learners through a multifaceted approach to interaction: interaction with the text, with other learners, with teachers, with readings from sources beyond the classroom and with the self-access language learning center. This course features stimulating extensive reading, listening and writing combined with extensive practice provided by well designed tasks that develop both fluency and accuracy at this level. It incorporates the latest approaches to teaching productive strategies from learning vocabulary for different contexts, understanding the purpose and nature of different texts to learning how to access information in the media and over the Internet and learning the skill to make a presentation on various topics. Students gain confidence in their reading, writing, listening, speaking and translation abilities as they discover how to access information more easily from the press, over the Internet, and in their professions or fields of study. With this course, learners lay the foundation for the study of English for specific purpose (such as Intermediate Interpretation, American and British Culture, etc) |
| Type of teaching, contact hours | Target students: students of non-English majors<br>Type of teaching: Some time is for lectures, and some time is for classroom discussions and presentations.<br>Contact hours: 48 hours<br>Of which,<br>Theoretical teaching: 48 hours<br>Experiment / practice teaching: 0 hour<br>Computer practice: 0 hour |

| | |
|---|---|
| | Size of class: 40-60 students |
| Workload | Workload = 48 hours<br>Contact hours = 48 hours<br>Self-study hours = 0 hours |
| Credit points | 2.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3, 32 hours of self-access learning and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Fundamental English; Intensive English; Interactive Practical English |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>● **Knowledge:** Students are required to master the reading and listening materials the course has provided and obtain the corresponding vocabulary.<br>● **Skills**: This course provides for 1) The development of active readers through interaction with a variety of texts, and with authentic reading outside of the classroom. 2) Thematic units featuring high-interest, level-appropriate, informative topics that include texts about culture, science, the environment, innovation, sports and entertainment. 3) A skills and strategies overview of the comprehensive reading skills and strategies in each chapter that feature the development of critical thinking and information processing. 4) Opportunities for personal reading, writing, and speaking activities. With this course the students are expected to achieve the following learning outcomes:<br>● **Competences:**<br>Critical thinking: Effective analyze and evaluate evidence, arguments, claims, and beliefs; Analyze and evaluate major alternative points of view; synthesize and make connections between information and arguments; interpret information and draw conclusions based on the best analysis; Reflect critically on learning experiences and processes; Solve different kinds of unfamiliar problems in both conventional and innovative ways; Identify and ask significant questions that clarify various points of view and lead to better solutions.<br>Communication: Articulate thoughts and ideas effectively using oral, written, and nonverbal communication skills in a variety of forms and contexts; Listen effectively to decipher meaning, including knowledge, values, attitudes, and intentions; Use communication for a range of purposes; |

| | |
|---|---|
| | Communicate effectively in diverse environments.<br>Collaboration: Demonstrate ability to work effectively and respectfully with diverse teams; Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal; Assume shared responsibility for collaborative work, and value the individual contributions made by each team member.<br>Creativity: use a wide range of idea creation techniques; Create new and worthwhile ideas; Elaborate, refine, analyze, and evaluate original ideas to improve and maximize creative efforts; Develop, implement, and communicate new ideas to others effectively; Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work.<br>Cross-Cultural Competence: Develop certain personal and interpersonal awareness and sensitivities, understanding certain bodies of cultural knowledge, and mastering a set of skills. |
| Content | **Part A. Theoretical teaching (48 contact hours)**<br>**Unit 1:** Man and Society (6 contact hours)<br>● Grasp the main idea; **<br>● Appreciate the various techniques employed by the writer; **<br>● Master the key language points and grammatical structures in the text; **<br>● Conduct a series of reading, listening, speaking and writing activities related to the theme of the unit;**<br>● Do more research on man's footprints on the environment. *<br>**Unit 2:** Man and Technology (6 contact hours)<br>● Understand the main idea; **<br>● Learn to use various resources for information; **<br>● Grasp the key language points and grammatical structures in the text ;**<br>● Conduct a series of reading, listening, speaking and writing activities related to the theme of the unit;**<br>● Do more research on the relationship between man and technology. *<br>**Unit 3:** Knowledge and Knowledge Transfer (6 contact hours)<br>● Grasp the main idea; **<br>● Learn to use various techniques in writing more effectively and to use keywords for more efficient reading; **<br>● Master the key language points and grammatical structures in the text; ** |

| | |
|---|---|
| | ● Conduct a series of reading, listening, speaking and writing activities related to the theme of the unit;**<br>● Develop the ability of solving problems.<br>**Unit 4:** Work and Career (6 contact hours)<br>● Understand the main idea and structure of the text; **<br>● Appreciate the difference between formal speech and informal speech; **<br>● Grasp the key language points and grammatical structures in the text; **<br>● Conduct a series of reading, listening, speaking and writing activities related to the theme of the unit;**<br>● Do more research on the difference between work and career. *<br>**Unit 5:** Fame and Success (6 contact hours)<br>● Understand the main idea and the structure of the text; **<br>● Learn to memorize words in association; **<br>● Grasp the key language points and grammatical structures in the text; **<br>● Conduct a series of reading, listening, speaking and writing activities related to the theme of the unit;**<br>● Do more research on celebrities' privacy. *<br>**Unit 6:** Attitudes to Life (6 contact hours)<br>● Grasp the main idea and the structure of the text; **<br>● Appreciate the various techniques employed by the writer; **<br>● Master the key language points and grammatical structures in the text **<br>● Conduct a series of reading, listening, speaking and writing activities related to the theme of the unit**<br>● Do more research on the meaning of life. *<br>**Unit 7:** Lifestyles (6 contact hours)<br>● Understand the main idea; **<br>● Appreciate the various techniques employed by the writer; **<br>● Master the key language points and grammatical structures in the text **<br>● Conduct a series of reading, listening, speaking and writing activities related to the theme of the unit**<br>● Do more research on various lifestyles.*<br>**Unit 8:** Literary Appreciation (6 contact hours)<br>● Grasp the main idea and structure of the text; **<br>● Appreciate the writing strategies employed by the author; **<br>● Master the key language points and grammatical structures |

| | |
|---|---|
| | in the text **<br>● Conduct a series of reading, listening, speaking and writing activities related to the theme of the unit**<br>● Do more research on the role of literature in our life. * |
| Study and examination requirements and forms of examination | After-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 50%, consisting of assignments, class performance, mid-semester examination and attendance; final exam (oral & written tests) accounts for 40%; self-access learning accounts for 10%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc. |
| Reading list | 1. Recommended book<br>[1] Qin, Xiubai and Liu, Jianbo, Zooming In: An Integrated English Course (1st edition), Shanghai Foreign Language Education Press, 2008<br>[2] Huang, Yuanshen, Learning to Read: An English Reading Course 3 (1st edition), Shanghai Foreign Language Education Press, 2008<br>[3] Zheng, Shutang, New Horizon College English: Speaking, Listening and Viewing 3(2nd edition), Foreign Language Teaching and Research Press, 2011 |

# Practical Training

## Metalworking Practice

| | |
|---|---|
| Competence field | Practical Training |
| Module designation | Metalworking Practice |
| Code, if applicable | 14100610 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 5th semester |
| Person responsible for the module | Professor WANG Zhonghou |
| Lecturer | Teachers of Engineering Training Center |
| Language | Chinese |
| Relation to curriculum | Metalworking Practice is a technical fundamental course featured by strong practice and the practice teaching link that familiarizes students of Process Equipment and Control Engineering program with machining production process and develops practical operational capacity. Through the study of Metalworking Practice, students are expected to master the general process of mechanical manufacture and the main process methods and process of metal machining, to get familiar with the methods of safe use and operation of various equipment and tools, to understand the use of new processes and technologies in mechanical manufacture, to acquire the skills of selection of simple parts machining methods and process analysis, and to develop the skills of understanding drawings and machining symbols and technical conditions. This course is designed to train students' habits of labor participation and discipline compliance and rigorous style of theory-practice combination; this course helps to lay a solid foundation for the study of follow-up courses such as Principles and Design of Heat Exchanger, Design and Calculation of Boiler, Manufacturing Technology of Thermal Power Machinery, etc. |
| Type of teaching, contact hours | Target students: students of Process Equipment and Control Engineering program and related programs<br>Type of teaching: Practice teaching and a small amount of after-school exercises<br>Contact hours: 60 hours<br>Of which,<br>Theoretical teaching: 12 hours<br>Experiment / practice teaching: 40 hours<br>Computer practice: 8 hours (NC technical programming on |

| | |
|---|---|
| | computer)<br>Size of class: 40-60 students |
| Workload | Workload = 90 hours<br>Contact hours = 60 hours<br>Self-study hours = 30 hours |
| Credit points | 3.0 |
| Requirements according to the examination regulations | Students with class attendance rate over 2/3 and assignment completion rate over 2/3 are allowed to take the exam. |
| Recommended prerequisites | Fundamentals of Engineering Drawing, Mechanical Principle and Mechanical Parts, Machine Design |
| Module objectives/intended learning outcomes<br>/ | Module objectives:<br>Through the study of this course, students are expected to preliminarily get exposed to practical production, so as to lay the practical foundation for the follow-up study of Process Principle and Equipment, Design of Process Equipment and the related courses and future jobs related to mechanical design, manufacture and management. This course focuses on training students' independent operation and in the premise where teaching requirements are satisfied, such training is carried out in conjunction with practical products.<br>● **Knowledge:** to enable students to learn about relevant engineering terminology and technical documents, as well as general mechanical manufacture process. Get familiar with the common machining methods of mechanical parts, and the working principles, typical mechanism, tools, fixtures and measuring instruments of mechanical parts as well as safe operation skills. Understand the basic process knowledge and some new processes related to mechanical manufacture and the application of new technologies in mechanical manufacture.<br>● **Skills:** students are expected to complete the basic practical training, and acquire initial capacity of process analysis and machining method selection, so as to lay the foundation for the study of follow-up courses and future jobs related to machine design. Get familiar with main machining methods of metal and the equipment and tools used, acquire initial operational skills, and try as much as possible to get exposed to new equipment, new processes and new technologies.<br>● **Competences:** train students' attitude to labor, |

| | |
|---|---|
| | innovation spirit and the scientific style of theory-practice combination; exercise students' practical operation capacity, and initially establish quality, cost, efficiency, safety and environmental protection awareness; enable students to adapt to the production environment, understand operational specifications and safe and technical specifications, and form engineering awareness; initially master traditional machining methods and modern NC machining methods; this course helps to lay a solid foundation for follow-up study of relevant mechanical courses and participation in scientific and technological innovation activities. |
| Content | **Turner** (Workload = 16 hours, including 2 hours for theoretical teaching, 8 hours for practice teaching and 6 hours for self-study)<br>● Understand the basics of machining, especially turning.<br>● Understand the relationship among parts machining precision, cutting specifications and machining economic efficiency.<br>● Understand the application of NC technology in turning and the concept of turning mechanization and automation production.<br>● Get familiar with the name of horizontal lathe, the major components and their roles.<br>● Master turning operation methods, and be able to properly select tools, fixtures and measuring instruments and develop simple turning sequence according to the technical requirements of practice drawings.<br>**Fitter** (Workload = 16 hours, including 2 hours for theoretical teaching, 8 hours for practice teaching and 6 hours for self-study)<br>● Understand the status and importance of fitter in mechanical manufacture and equipment maintenance.<br>● Be familiar and able to independently select the tools, measuring instruments and other accessories for such operations as scribing, sawing, filling, drilling, reaming, countersinking, tapping and thread die cutting, scraping, grinding, assembly and disassembly, etc.<br>● Master the basic operations of fitter, and be capable of |

| | |
|---|---|
| | machining of simple parts according to parts drawing; acquire certain practical skills in the selection of machining methods, and the arrangement of process, etc.<br>● Initially establish the concept of machine production process, and have a complete understanding of map reading, parts manufacture, machine assembly and commissioning.<br>**Casting** (Workload = 16 hours, including 1 hour for theoretical teaching, 9 hours for practice teaching and 6 hours for self-study)<br>● Understand the process and characteristics of casting production.<br>● Understand the structure of sand mould, and the relationship among parts, mould and castings.<br>● Be able to correctly adopt common tools for simple two-box hand molding.<br>● Be able to identify casting process drawings and understand the principles of their formulation.<br>● Understand the general process of casting molding.<br>● Understand common casting defects and their causes.<br>● Understand advanced casting methods and their characteristics.<br>● Briefly understand special casting methods and characteristics.<br>● Understand how to select the content of casting process program and the steps.<br>**Heat Treatment** (Workload = 3 hours, including 0.5 hour for theoretical teaching, 1.5 hours for practice teaching and 1 hour for self-study)<br>● Understand the grades, properties and uses of common steel materials.<br>● Understand Rockwell hardness test method commonly used in production.<br>● Understand spark identification method of steel and the spark characteristics of common carbon steel and cast iron.<br>● Understand common heat treatment equipment.<br>● Understand common heat treatment process methods, types, purpose and application.<br>● Understand basic metallographic structure and metallurgical analysis.<br>**Forging** (Workload = 3 hours, including 0.5 hour for |

| | |
|---|---|
| | theoretical teaching, 1.5 hours for practice teaching and 1 hour for self-study)<br>● Understand the classification of metal pressure machining and the concepts of forging and sheet metal stamping.<br>● Understand carbon steel heating and forgings cooling.<br>● Understand the forging properties of metal and the concept of forging fibrous tissue.<br>● Understand the types of main forging equipment and the application occasions.<br>● Be familiar with the free forging by machine and the main processes of sheet metal stamping.<br>● Be familiar with the structural differences between free forgings and die forgings, and master the principles for selection of these two forging methods.<br>**Welding** (Workload = 3 hours, including 0.5 hour for theoretical teaching, 1.5 hours for practice teaching and 1 hour for self-study)<br>● Understand welding characteristics, classification and application.<br>● Master shielded metal arc welding method, understand welding equipment and the selection of common welding electrodes.<br>● Understand the characteristics and applications of gas welding flame, basic operation methods of gas welding, and master the safe operation of gas welding.<br>● Introduce to students plasma cutting, laser cutting and water jet cutting processes.<br>● Understand the characteristics of other common welding methods and the application of bonding technology.<br>● Introduce a variety of welding defects, including welding stress and deformation.<br>**Miller** (Workload = 4.5 hours, including 0.5 hour for theoretical teaching, 2 hours for practice teaching and 2 hours for self-study)<br>● Understand the basics of milling.<br>● Understand the function of common milling machine accessories (dividing head, rotary table, vertical milling head).<br>● Understand common tooth machining methods.<br>● Understand common milling cutters such as cylindrical cutter, end mill, keyseat cutter, butt mill, |

| | |
|---|---|
| | face and side milling cutter and formed milling cutter.<br>● Be familiar with the name, motion and function of the main components of universal horizontal miller.<br>● Understand the working characteristics of other milling machine tools and their application occasions.<br>**Grinder** (Workload = 4.5 hours, including 0.5 hour for theoretical teaching, 2 hours for practice teaching and 2 hours for self-study)<br>● Understand the basics of grinding, such as grinding characteristics, major grinding motion, wheel selection, commonly used grinder attachment and grinder working range, etc.<br>● Understand the structural features of grinder, and get familiar with the main components of universal cylindrical grinder and their functions.<br>● Understand the methods and working characteristics of cylindrical grinding, plane grinding and internal grinding.<br>**Non-traditional Machining** (Workload = 3 hours, including 0.5 hour for theoretical teaching, 1.5 hours for practice teaching and 1 hour for self-study)<br>● Understand the characteristics, classification and development of non-traditional machining,.<br>● Understand the working principles, process characteristics and applications of EDM wire cutting.<br>● Understand the functions of NC wire cutting manual programming instruction, and be able to carry out simple parts programming.<br>● Be able to implement wire cutting under the guidance of clinical teachers.<br>● Understand the working principles, features and applications of SEDM.<br>**NC Milling** (Workload = 12 hours, including 2 hours for theoretical teaching, 2 hours for practice teaching, 6 hours for computer practice and 2 hours for self-study)<br>● Understand the application of NC technology in milling.<br>● Understand the motion and control mode of NC miller, and the name and role of main control elements.<br>● Understand the basic types of NC millers and their major structural components.<br>● Understand NC milling programming format and key instructions. |

| | |
|---|---|
| | ● Prepare simple parts machining process under the guidance of clinical teachers, and independently complete program input, feed-simulation and parts milling.<br>● Understand the differences among NC machining center, NC miller and NC lathe, and the application range and working features of machining center.<br>● Understand the main components of NC machining center.<br>**NC Turning** (Workload = 6 hours, including 1 hour for theoretical teaching, 2 hours for practice teaching, 2 hours for computer practice and 1 hour for self-study)<br>● Understand the basic principles of NC machining and the role of NC technology in turning.<br>● Understand the motion and control mode of NC lathe, and the name and role of main control elements.<br>● Understand the basic types of NC lathes and their major structural components.<br>● Understand the differences between manual programming and automatic programming, and get familiar with the general format of manual programming and the major instructions.<br>● Prepare simple parts machining process under the guidance of clinical teachers, and independently complete program input, feed-simulation and parts turning.<br>● Understand the major differences between full-function NC lathe and ordinary NC lathe.<br>**Technical Measurement** (Workload = 3 hours, including 1 hour for theoretical teaching, 1 hour for practice teaching and 1 hour for self-study)<br>● Understand the application of high-precision measurement equipment.<br>● Understand the basic types and structural components of high-precision measurement equipment.<br>● Under the guidance of clinical teachers, complete high-precision measurement of parts. |
| Study and examination requirements and forms of examination | The practice content and after-school exercises should be completed by students independently after each class.<br>Usual performance accounts for 70%, which consists of practice performance, assignments and attendance; final exam (closed book written examination) accounts for 30%. |
| Media employed | PPT courseware, multimedia computers, projectors, laser |

| | |
|---|---|
| | pens, blackboards, lathes, planers, millers, NC machine tools, measuring instruments, welding equipment, casting and forging equipment, etc. |
| Reading list | 1. Recommended book<br>[1] ZHU Zhen and WU Xiaozhu, Engineering Practice and Training (2nd edition), Shanghai Science and Technology Literature Publishing House, 2006<br>2. Reference books<br>[1] WU Xiaozhu and ZHU Zhen, Technical Surveying Practice and Training (1st edition), Shanghai Science and Technology Literature Publishing House, 2008<br>[2] ZHU Zhen and WU Xiaozhu, Metalworking Practice Reports and Should-be-known Exercise Book (2nd edition), Shanghai Science and Technology Press, 2008 |

## Comprehensive Experiment

| | |
|---|---|
| Competence field | Practical Training |
| Module designation | Comprehensive Experiment |
| Code, if applicable | 11100470, 11100500, 11100440, 11100530 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 7th semester |
| Person responsible for the module | Professor WU Weidong |
| Lecturer | Associate Professor SU Wenxian<br>Associate Professor SHAN Yanguang<br>Associate Professor CHEN Eryun<br>Lecturer CHEN Liu<br>Lecturer NAN Guofang<br>Assistant Researcher HU Xiaohong<br>Assistant Experimentalist HUANG Xiaohuang<br>Assistant Experimentalist SHENG Jian<br>Assistant Experimentalist TIAN Chang<br>Assistant Experimentalist ZHANG Huichen<br>Assistant Experimentalist ZHOU Yanfang, etc., etc. |
| SLanguage | Chinese |
| Relation to curriculum | As one of the most important practical courses of Process Equipment and Control Engineering program, Power Engineering Specialized Experiment is a practical course matching theoretical course and is taken after completion of all basic courses. With a focus on classic technology and engineering practical application, the course enables students to understand engineering practice, master engineering practical skills and learn how to use theoretical knowledge to solve engineering problems so as to complete engineering technical work. The course may also help students learn about the present situation of the field at home and abroad as well as advanced technology, which lays a foundation for students' future work and study. |
| Type of teaching, contact hours | Target students: seniors of Process Equipment and Control Engineering program<br>Type of teaching: experimental teaching<br>Contact hours: 64 hours |
| Workload | Workload= 120 hours<br>Contact hours = 64 hours<br>Self-study hours = 56 hours |
| Credit points | 4.0 |
| Requirements according to the examination regulations | Complete all required experiments and submit experimental reports. |

<table>
<tr><td>Recommended prerequisites</td><td>Engineering Fluid Mechanics; Heat Transfer; Measurement and Control Technology of Power Engineering; etc.</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td>Module objectives:<ul><li>Knowledge: Measurement principles, technology and testing method of specialized experiment of different courses (Measurement and Control Technology of Power Engineering, Computer Modeling Practice, Engineering Thermodynamics, Design of Process Equipment, Process Principle and Equipment, etc.)</li><li>Skills: Students understand the performance/principles/application method of modern testing technology and inspection instrument of all fields of Process Equipment and Control Engineering program; master specialized experiment methods, skills and data treatment methods so as to improve quality of experimental teaching; develop experimental operation abilities and abilities in analyzing and solving practical problems by using theoretical knowledge.</li><li>Competences: Develop students' practical ability, specialized experimental skills and ability in knowledge application. Cultivate students' ability in scientific experiment ability so as to meet demands for engineering talent from market economy.</li></ul></td></tr>
<tr><td>Content</td><td>Experiment teaching:<br>Experiments of Process Equipment and Control Engineering program includes 4 basic energy and power experiments (A) and 12 specialized equipment design experiments (B).
<table>
<tr><td>NO.</td><td>Experiment</td><td>Contact hours</td><td>Self-study hours</td></tr>
<tr><td>A1</td><td>Steam turbine equipment experiment*</td><td>4</td><td>2</td></tr>
<tr><td>A2</td><td>Pump performance test experiment*</td><td>4</td><td>4</td></tr>
<tr><td>A3</td><td>Fan performance test experiment*</td><td>4</td><td>2</td></tr>
<tr><td>A4</td><td>Boiler operation (thermal balance) experiment*</td><td>4</td><td>4</td></tr>
<tr><td>B1</td><td>Small-scale refrigeration device multi-parameter automation test experiment*</td><td>4</td><td>4</td></tr>
<tr><td>B2</td><td>Gas turbine power generation system performance experiment*</td><td>4</td><td>2</td></tr>
</table></td></tr>
</table>

| | | | | | |
|---|---|---|---|---|---|
| | B3 | EHD enhanced boiling heat exchange experiment* | 4 | 4 | |
| | B4 | Transcritical CO2 heat pump water heater performance test experiment* | 4 | 4 | |
| | B5 | Natural cycle boiler hydrodynamic property experiment* | 4 | 4 | |
| | B6 | Boiler heating surface heat transfer property experiment* | 4 | 4 | |
| | B7 | Parallel pipe bundle flow distribution experiment* | 4 | 4 | |
| | B8 | Vane natural frequency measurement* | 4 | 4 | |
| | B9 | Centrifugal compressor test* | 4 | 2 | |
| | B10 | Blade cascade incidence characteristics experiment* | 4 | 4 | |
| | B11 | Measurement of single span rotor critical speed* | 4 | 4 | |
| | B12 | Comprehensive heat transfer performance experiment* | 4 | 4 | |
| Study and examination requirements and forms of examination | Usual performance accounts for 50% of final score (attendance, participation in experiment process, experimental ability and experiment quality). Experimental report accounts for 50% of final score (understanding of experiment objectives / principles / equipment; results of experimental data; analysis of experimental data) | | | | |
| Media employed | Multimedia aided teaching | | | | |
| Reading list | 1. Required books<br>[1]. Energy Power Experimental Teaching Center. Experiment Instruction Books for Process Equipment and Control Engineering Program. USST, 2013<br>2. Reference books<br>[1]. TANG Jinwen. Thermal Measurement Technology. Chongqing: Chongqing University Press, 2007<br>[2]. LÜ Chongde. Measurement and Handling of Thermal Parameter (2nd edition). Beijing: Tsinghua University Press, 2001<br>[3]. YANG Fengzhen. Basics of Power Machinery Testing. Dalian: Dalian University of Technology, 2005 | | | | |

| | |
|---|---|
| | [4]. YAN Zhaoda. Testing Technology for Thermal and Power Machinery. Beijing: Machinery Industry Press, 2005 |

## Professional Comprehensive Course Design

| | |
|---|---|
| Competence field | Practical Training |
| Module designation | Professional Comprehensive Course Design |
| Code, if applicable | 11100271 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 7th semester |
| Person responsible for the module | Associate Professor SU Wenxian |
| Lecturer | Associate Professor SU Wenxian<br>Associate Professor YE li<br>Lecturer LI Zeqiu<br>Lecturer YANG Jie(M)<br>Lecturer WANG Zhiyuan |
| Language | Chinese |
| Relation to curriculum | Student's project here is the course offered for senior students of Process Equipment and Control Engineering program. After taking Engineering Thermodynamics, Heat Transfer, Engineering Fluid Mechanics, Process Principle and equipment, Design of Process Equipment. Students can do the application case study which based on the theory and knowledge of Process Principle and equipment, Design of Process Equipment, etc. The main contents of the course are: Calculation and design of process flowsheet, and type selection and design of equipment structure (cooling tower, rectifying column, heat exchanger, reboiler, etc.). This course combines basic theories, basic skills and specialized knowledge. With reference of technical literature and manuals as well as specialized knowledge and skills, students may learn basic methods and procedures of equipment design which will lay a foundation for follow-up courses including Internship and Bachelor Thesis. |
| Type of teaching, contact hours | Target students: seniors of Process Equipment and Control Engineering program<br>Type of teaching: practice<br>Contact hours: 4 weeks<br>Theoretical teaching and experiment/practice teaching are arranged by instructors on the basis of each student and its team's specific project situation.<br>Size of class: each instructor teaches 3-5 teams, each group 5-7 students. |
| Workload | Workload= 120 hours |
| Credit points | 4.0 |
| Requirements | During the project, students shall participate all the team meeting, |

| | |
|---|---|
| according to the examination regulations | complete all tasks carefully, listen attentively to instructions of teachers. |
| Recommended prerequisites | Calculus; College Physics; College Chemistry; Engineering Thermodynamics; Engineering Thermodynamics, Heat Transfer; Engineering Fluid Mechanics; Process Principle and equipment; Design of Process Equipment; |
| Module objectives/intended learning outcomes | Module objectives:<br>As an important part of practice teaching of the specialty, Student's project is a comprehensive application of the theoretical courses. The object and task of the Student's project is enabling students to integrate theoretical knowledge with practical work, acquire deep understanding of the fields the specialty serve and understand the design process and technology of the field.<br>● **Knowledge:** Through project, students may acquire deeper understanding of the specialty. Be able to conduct theoretical calculation, selection and design of different types of process unit in industrial production process.<br>● **Skills:** Through project, students master basic principles and methods of major process analysis and equipment design of each field; develop student's ability in using basic theoretical knowledge, skills and specialized knowledge to analyze and solve engineering problems; cultivate students engineering design ability in design/calculation, drawing and technical documents development with reference to technical literature, documents and manuals.<br>● **Competences:** Students may have a good sense of teamwork and self- learning capacity. |
| Content | **Professional Comprehensive Course Design (4 weeks)**<br>Project contains two parts. one part is a two-week team work, in which team members should work together for analysis the project demand, find information, and then accomplish the process structure design. The other part is 2-week individual work, which one of the equipment in the entire flowsheet should be exhaustive analyzed and design.<br>(1) Process demand analysis; **<br>(2) Investigate process information, main equipment (structure, performance, configuration parameter and working principles), flowsheet layout and operation requirements/skills of each unit; **<br>(3) Calculation of mass flowrate and thermal load; **<br>(4) Unit equipment design and type selection<br>(5) Drawing equipment design specifications; **<br>(6) Accomplish the design instruction.** |
| Study and examination requirements and forms | At the end of project, every student need to hand in design instruction, which introduce the team work and individual work. And every team |

| | |
|---|---|
| of examination | gives a final presentation. Evaluation is based on students' performance and the whole team's design work, quality of students' presentation and defense.<br>Usual performance and individual design instruction account for 40% of final score. Team report and presentation account for 60% of final score |
| Media employed | Multimedia computers, projector, laser pointers, blackboard, chalks |
| Reading list | 1. Required books<br>[1] Instructors recommend books to students according to specific academic needs<br>2. Other materials<br>[2] PPT courseware (self-compiled) used by teachers for explanation to students. |

## Innovation and Entrepreneurship Project Training

| | |
|---|---|
| Competence field | Practical Training |
| Module designation | Innovation and Entrepreneurship Project Training |
| Code, if applicable | 11850010 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 7th semester |
| Person responsible for the module | Professor YANG Ailing |
| Lecturer | All teaching staff of this program |
| Language | Chinese |
| Relation to curriculum | As an innovation and entrepreneurship experimental and practice course, this course is designed to carry out innovation and entrepreneurship practical teaching at Energy & Power Engineering Experiment Teaching Center (National Experimental Teaching Demonstration Center) and production/education/research base jointly established by School of Energy & Power Engineering and enterprise. Under the guidance of teachers, students complete innovative work concerning scientific research, experiment and product development of Process Equipment and Control Engineering Program, which can develop students' abilities in innovation, entrepreneurship and practice. This is an innovation and entrepreneurship orientated course based on acquired basic theoretical knowledge and specialized experiment experience, demand for solutions to practical problems by students teams under instructions of teachers on selecting topic and engaging in practice independently). The course is focus on developing students engineering practice and innovation abilities. |
| Type of teaching, contact hours | Targeted students: seniors of Process Equipment and Control Engineering program<br>Type of teaching: theoretical and practice teaching<br>Contact hours: 64 hours<br>Of which<br>Theoretical teaching: 8 hours<br>Experiment / practice teaching: 56 hours<br>Size of class: 60 people |
| Workload | Workload= 120 hours<br>Contact hours = 64 hours<br>Self-study hours = 56 hours |
| Credit points | 4.0 |
| Requirements according to the examination regulations | Complete proposal report, project design and execution plan; carry out project and complete report; Evaluate team work and reports of other teams |

<table>
<tr><td>Recommended prerequisites</td><td>Fundamentals of Engineering Drawing, Machine Design, Engineering Thermodynamics, Engineering Fluid Mechanics, Heat Transfer, Comprehensive Experiment, etc.</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td>Module objectives:<br>● Knowledge: advanced technique, methods and processed related to Process Equipment and Control Engineering program such as advanced control strategies, advanced production process, advanced manufacturing, and optimal operating procedure.<br>● Skills: Students are able to write a proposal on research topic and execution plan and carry out innovative research and engineering practice independently with innovation teaching-practice module (mainly machining tool), multi-function experiment teaching-practice module (experiment and measurement system) and simulation experiment teaching platform (numerical simulation). Develop students' abilities in innovation, entrepreneurship and engineering practice as well as awareness of innovation and entrepreneurship.<br>● Competences: By taking innovation and entrepreneurship practice course, students can learn how to engage increative thinking and innovative work with acquired basic theoretical knowledge, skills and specialized knowledge. Students can write innovative proposals on scientific research, experiment and product development with literature review so as to develop creative thinking and abilities in solving practical engineering problems.</td></tr>
<tr><td>Content</td><td>1. Theoretical teaching
<table>
<tr><td>No.</td><td>Theoretical teaching</td><td>Contact hours</td><td>Self-study hours</td></tr>
<tr><td>1</td><td>Innovation teaching module, multi-function experiment teaching module and simulation experiment teaching platform introduction</td><td>3</td><td>3</td></tr>
<tr><td>2</td><td>Research on topic selection and learning proposal report development</td><td>2</td><td>2</td></tr>
<tr><td>3</td><td>Learning plan development</td><td>3</td><td>3</td></tr>
</table>
2. Experiment/ practice teaching
<table>
<tr><td>Experiment 1</td><td>Research on topic selection</td><td>Contact Hours</td><td>Self-study hours</td></tr>
<tr><td>Content and requirement</td><td>1. Introduce present situation at home and abroad and</td><td>12</td><td>10</td></tr>
</table></td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| | | development level through literature search and reading (including intellectual and technical standard situation); economic construction and social development requirements<br>2. Make proposal on innovative topics and technical value of innovation<br>3. Make proposal on complete innovation plan | | |
| | Experiment 2 | Evaluation by classmates on report on topic selection | Contact Hours | Self-study hours |
| | Content and requirements | Evaluate topic selection report of three classmates<br>1. Whether report conforms to standard;<br>2. If innovative topics and technical value of innovation convincing<br>3. If innovation plan is feasible | 10 | 8 |
| | Experiment 3 | Implement innovative project and experimental validation | Contact Hours | Self-study hours |
| | Content and requirements | 1. Innovation plan execution<br>2. Uncertainty analysis of experiment<br>3. Scientific analysis for innovation plan improvement<br>4. Patents writing and application<br>5. Summary of results | 24 | 20 |
| | Experiment 4 | Designing entrepreneurial plan with innovation project | Contact Hours | |
| | Content and requirement | 1. Application and market prediction<br>2. Design execution plan<br>3. Design finance plan<br>4. Analysis of economic and social benefits<br>5. Write up business proposal | 10 | 10 |

| | |
|---|---|
| Study and examination requirements and forms of examination | Usual performance accounts for 30% of final score (theoretical course; attendance of discussion and experiment classes; completion).<br>Exams account for 30% of final score (proposal 20%; evaluation of classmates proposal 10%; execution and experimental report 30%; entrepreneurship plan 10%) (oral defense). |
| Media employed | Multimedia computer; projector; product model |
| Reading list | 1. Required books<br>[1] Handout on energy and environment innovation & entrepreneurship, USST<br>2. Reference books<br>[1] Study, Response and Insight Regarding Entrepreneurship Plan and Competition: Exploration and Practice of College Students Innovation & Entrepreneurship Education, ZHEN Bingzhang, LIU Dezhi, JIA Dongshui, WU Hong. China Earth Press, 2005<br>[2] Innovation Entrepreneurship and Employment. FU Yun. Machinery Industry Press, 2009<br>[3] Instruction Course on College Students Innovation & Entrepreneurship, DENG Zegong, China Communication Press, 2004 |

## Internship

| | |
|---|---|
| Competence field | Practical Training |
| Module designation | Internship |
| Code, if applicable | 11100160, 11100031 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 8th semester |
| Person responsible for the module | Professor CAI Xiaoshu |
| Lecturer | All teaching staff of this program |
| Language | Chinese |
| Relation to curriculum | Internship is a preparatory stage before Bachelor Thesis which is designed to allow students to integrate theoretical knowledge with practical work, acquire deep understanding of the related fields of Process Equipment and Control Engineering, and understand the production process and technologies of the program. On the basis of internship and requirements/contents of Bachelor Thesis, students may conduct technical material collection and research, and thus prepare for Bachelor Thesis. |
| Type of teaching, contact hours | Targeted students: seniors of Process Equipment and Control Engineering program<br>Type of teaching: practice<br>Contact hours: 10 weeks<br>Theoretical teaching and experiment/practice teaching are arranged by instructors and enterprise technical personnel on the basis of each students specific internship<br>Size of class: each instructor guides 3-5 students |
| Workload | Workload= 420 hours |
| Credit points | 14.0 |
| Requirements according to the examination regulations | During internship, students shall follow all rules concerning practice, labor administration and safety of the enterprise. Students shall complete all tasks carefully, listen attentively to instructions of enterprise mentors, take intern notes, communicate and discuss regularly with the in-unviersity supervisors.<br>1: The students should fill in the “Internship Application Form” and “Students External Internship Safety Responsibilty Book”;<br>2: The students should submit the internship notebook and internship report after the internship. |
| Recommended prerequisites | Complete all theoretical courses |
| Module objectives/intended learning outcomes | Module objectives:<br>As an important part of practice teaching of the specialty, |

| | |
|---|---|
| | internship is a preparatory stage before Bachelor Thesis. The object and task of internship is enabling students to integrate theoretical knowledge with practical work, acquire deep understanding of the related fields of Process Equipment and Control Engineering, and understand the production process and technologies of the program.<br>• Knowledge: Through Internship, students may acquire deeper understanding of the specialty and the scope as well as significance of application of knowledge in practical work.<br>• Skills: After internship, students may further understand product design method, production process, equipment process technology and principles/performance/parameters of major production equipment. Through site observation, students can understand production and technology of related fields so as to increase knowledge and develop competences.<br>• Competences: Students may have a deeper impression of the enterprise associated with the specialty and deeper understanding of the relationship between enterprise production environment and other industry enterprise. During internship, students may receive social and specialty skills training integrating internship with social practice and thus lay a foundation for adaptation to different kinds of working environment and enterprise culture in the future. All these will help develop students' ability in future work and social practice. |
| Content | 1. Internship (10 weeks)<br>Students go to production/manufacturing enterprise and equipment application enterprise for internship practice in the form of visit, on-site work, study and attending technical lectures, etc.<br>(1) Give safety instructions. Learn about all kinds of production measures and rules of selected plant so as to guarantee safety, acquire production safety knowledge and develop relevant awareness*(3 days);<br>(2) Learn about process, main equipment (structure, performance, configuration parameters and working principles), plant layout and operation requirements/skills of each post**(3 weeks);<br>(3) Get familiar with the basic characteristics of the production and production process of enterprise; get familiar with the basic principles and methods of production process; |

| | |
|---|---|
| | understand design method of system and product **(2 weeks);<br>(4) Analyze process principles of energy & power production process engineering with acquired theoretical knowledge, especially the methods and measures involved in achieving overall production objectives such as high-production, high-quality, low consumption and low pollution** (2 weeks)<br>(5) Understand the operation methods of all production process through video teaching, lecture, seminar and on-site visit; learn about technical parameter, performance, technical level and current situation of product ** (2 weeks)<br>(6) Complete internship report independently according to the specific situation of the enterprise; prepare a topic for oral defense and report independently * (4 days) |
| Study and examination requirements and forms of examination | During internship, instructors shall ask students to submit internship report and organize exam. Evaluation of internship is based on students' performance (compliance with rules and evaluation of employees and technical personnel, 20%), quality of internship notes and report (30%), and the performance in the exam (50%). Score of internship is in hundred-mark system. |
| Media employed | Multi-media computer, projector, laser pointer etc. |
| Reading list | 1. Required books<br>[1] Instructors recommend books to students according to specific academic needs<br>2. Other materials<br>[2] PPT courseware (self-compiled) used by teachers and enterprise technical personnel for explanation to students. |

# Bachelor Thesis

| | |
|---|---|
| Competence field | Bachelor Thesis |
| Module designation | Bachelor Thesis |
| Code, if applicable | 1110011 |
| Subtitle, if applicable | |
| Semester(s) in which the module is taught | 8th semester |
| Person responsible for the module | Associate Professor SU Wenxian |
| Lecturer | All teaching staff of this program |
| Language | Chinese |
| Relation to curriculum | It is arranged after completion of all specialized courses and is designed for consolidation of acquired theoretical knowledge and enhancing link between theory and practice. As the last important teaching activity, Bachelor Thesis requires students to use acquired knowledge to solve comprehensive practical technical problems. |
| Type of teaching, contact hours | Target students: seniors of Process Equipment and Control Engineering program<br>Type of teaching: theoretical teaching; computer practice<br>Contact hours: 12 weeks<br>Theoretical teaching, experiment/practice teaching and computer practice are arranged by instructors on the basis of each student's specific project<br>Size of class: each instructor teaches 3-6 students |
| Workload | Workload=480 hours |
| Credit points | 16.0 |
| Requirements according to the examination regulations | Students complete literature translation and project tasks (experiment, design or calculation) required by instructor; pass mid-term test; complete thesis. |
| Recommended prerequisites | Complete all theoretical courses |
| Module objectives/intended learning outcomes | Module objectives:<br>The objective and tasks of Bachelor Thesis is to give students a chance to integrate acquired knowledge and develop students' abilities in using acquired theoretical knowledge and skills to analyze and solve practical problems.<br>● Knowledge: Review and apply what have learned from courses and familiar with literature review and research methodology.<br>● Skills: Develop students' overall abilities. Students receive comprehensive training required of senior technical personnel so as to develop various kinds of abilities such as ability in research and |

| | |
|---|---|
| | literature/document search, ability in theoretical analysis and design/experimental plan development, hardware and software development ability, data treatment and comprehensive analysis ability, and abilities in writing thesis, design instructions and abstract (in foreign language).<br>● Competences: In the form of a completed project, Bachelor Thesis helps students review what has been learned and develop abilities in understanding, planning, executing and reporting project as well as cooperation abilities with instructors and classmates. |
| Content | **Bachelor Thesis** (12 weeks)<br>(1) Topic presentation and literature reading & translation* (2 weeks)<br>Complete topic selection according to requirements by USST and School of Energy and Power Engineering on Bachelor Thesis (scientific research or technical development topics of teachers; topic originating from production; mock topic related to production). Search literature independently or use recommendation from teachers (literature shall be translated). Instructors shall explain relevant language points for students and check students reading and translation of literature.<br>(2) Research, experiment and calculation of topic ** (7 weeks)<br>Work on Bachelor Thesis under the guidance of instructor; submit proposal including literature review, plan verification, design thinking, schedule and instrument/equipment etc. Specific research includes topic background, relevant research work, plan development, experiment, calculation and data treatment etc. Analyze experimental or calculated results and draw conclusions.<br>(3) Thesis writing and thesis defense** (3 weeks)<br>Write thesis according to requirements by USST regarding format, content, length and originality and complete thesis within prescribed time limit. Supplementary materials are required by some topics such as engineering drawing, program and translated literature etc. Prepare for thesis defense. |
| Study and examination requirements and forms of examination | Usual performance accounts for 40% of final score;<br>evaluation of thesis writing accounts for 20% of final score and thesis defense score accounts for 40% of final score (all are carried out according to Bachelor Thesis evaluation |

| | |
|---|---|
| | method of USST) |
| Media employed | Multimedia computers, projector, laser pointers, experimental models |
| Reading list | 1. Required books<br>[1] Instructors recommend books to students according to specific proposal.<br>2. Other materials<br>[1] PPT courseware (self-compiled) used by teachers and enterprise technical personnel for explanation to students. |