Appendix B2

MODULE HANDBOOK OF RENEWABLE ENERGY 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 Professor YUAN Sanling Associate Professor YU Zhixian Associate Professor LIU Xiaojun Associate Professor WEI Gongming Lecturer ZHANG Tiansi Lecturer LIU Ling etc.
Language	Chinese
Relation to curriculum	Fundamental course for students related to science and engineering related programs. 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: freshmen of science and engineering related programs Type of teaching: most of the time is for lectures, and some time is for classroom discussions Contact hours: 96 hours Of which, Theoretical teaching: 96 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: 60-90 students

Workload	Workload = 180 hours Contact hours = 96 hours 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: • **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. • **Skills:** Understand the theory and methods of derivative and integral for functions of several variables. Skillfully compute partial derivatives and multiple integrals. • **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) **Chapter 1** Functions and Limits (12 contact hours and 12 self-study hours) • Understand the definition of a function;* • Establish a simple practical model with functional relationship;* • Understand the definition of a limit and master rules for working with limits;* • Use properties of infinitesimal to calculate the limit; • Understand the concept of the continuity function;* • Grasp clearly rules and properties of continuous functions on closed interval.** **Chapter 2** Derivatives and Differentials (14contact hours and 12 self-study hours) • Deeply understand definition of derivative at a point and derivative functions;** • Understand geometric significance of derivatives;* • Skillfully grasp rules for derivatives, higher-order derivatives, and derivatives of functions defined by

	parametric functions and implicit functions;** • Understand the concept of differential for a function.* **Chapter 3** Mean Value Theorem and Its Applications (14contact hours and 12 self-study hours) • Grasp Rolle's theorem, Lagrange's mean value theorem and Cauchy's mean value theorem;** • Be familiar with applications of L'Hospital's rule;* • Clear the monotonicity and concavity of curves and points of inflection;* • Sketch the graph of functions;* • Be able to find extremum, maximum and minimum, and their applications.* **Chapter 4** Indefinite Integrals (14 contact hours and 12 self-study hours) • Understand the concept of indefinite integral and its properties;* • Skillfully grasp integration by substitution and some basic integral formula;** • Skillfully master integration by parts;** • Be able to calculate integrations of Trigonometric functions and Rational functions.* **Chapter 5** Definite Integrals (14 contact hours and 12 self-study hours) • Understand the definition of definite integral, its properties and the fundamental theorem, some geometric explanatory remarks;** • Be familiar with the Newtonian - Leibniz formula;* • Skillfully Master integration by substitution and integration by parts;** • Calculate two kinds of improper integral.* **Chapter 6** Geometric and Physical Application of Definite Integral. (14 contact hours and 12 self-study hours) • 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;** • Be able to calculate Work, Pressure and Gravity by using definite integral. **Chapter 7** Introduction to Differential Equations (14 contact hours and 12 self-study hours) • Understand the basic concept of differential equations;* • Be able to find complete solutions and the particular solution for some special differential equations;* • Be able to formulate and solve differential equations

	according to some geometrical and various physical problems.* **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (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 [1] *Higher Mathematics 2*, Department of mathematics, Tongji University, higher education press, sixth edition, 2007. 2. Reference books [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	22000020
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 Professor YUAN Sanling Associate Professor YU Zhixian Associate Professor LIU Xiaojun Associate Professor WEI Gongming Lecturer ZHANG Tiansi Lecturer LIU Ling
Language	Chinese
Relation to curriculum	Fundamental course for students related to science and engineering related programs. 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: freshmen of science and engineering related programs Type of teaching: most of the time is for lectures, and some time is for classroom discussions Contact hours: 96 hours Of which, Theoretical teaching: 96 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: 60-90 students
Workload	Workload = 180 hours Contact hours = 96 hours Self-study hours = 84 hours
Credit points(ECTS)	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	None
Module objectives/intended learning outcomes	Module objectives: • **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. • **Skills:** Understand the theory and methods of derivative and integral for functions of several variables. Skillfully compute partial derivatives and multiple integrals. • **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) **Chapter 8** Space Analytic Geometry and Vector Algebra (24 contact hours and 21 self-study hours) • Definition of vector;* • Scalar and vector product;* • Surface and its equation;* • Line and its equation;** • Plane and its equation.** **Chapter 9** Derivatives of Functions of Several Variables and Applications (24 contact hours and 21 self-study hours) • Definition of function of several variables;* • Partial derivatives;** • The differentials of functions;** • The chain rule for compound functions;** • Partial derivative of implicit functions;** • Directional derivatives and gradients;** • Maximum and minimum: the method of Lagrange multiplier.* **Chapter 10** Multiple Integrals (24 contact hours and 21 self-study hours) • Double integrals;** • Definition and properties;* • Computation: right angled and polar coordinates;** • Triple integrals. Definition and properties;*

	• Computation: right angled, cylindrical and spherical surface coordinates;** • Applications: geometry and physics. **Chapter 11** Curve Integrals and Surface Integrals (24 contact hours and 21 self-study hours) • Curve integral for arc length;* • Curve integral for coordinates;* • Green's formula and applications;** • Surface integral for area;** • Surface integral for coordinate;** • Gauss's formula: applications to geometry and physics.* **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (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 [1] *Higher Mathematics 2*, Department of mathematics, Tongji University, higher education press, sixth edition, 2007. 2. Reference books [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	3rd semester
Person responsible for the module	Professor LIU Xiping
Lecturer	Professor LIU Xiping Associate Professor HE Changxiang Associate Professor FAN Hongfu Lecturer HU Jianhua Lecturer WEI Lianxin Lecturer 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 is described concretely and specifically. Therefore, linear algebra is widely used in abstract algebras, functional analysis and computational mathematics. Its theory has been 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: sophomores of science and engineering related programs Type of teaching: most of the time is for lectures, and some time is for classroom discussions Contact hours: 32 hours Of which, Theoretical teaching:32 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour

	Size of class: 40-60 students
Workload	Workload = 60 hours Contact hours = 32 hours 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	Module objectives: Linear algebra is a common fundamental courses of engineering. It is widely used in modern mathematics. It plays an important role in the related subjects. • **Knowledge:** The theory of linear algebras mainly includes the theory of matrices, determinant, system of linear equations, vector spaces, eigenvalues and eigenvectors, quadric forms. • **Skills:** Through learning, 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. • **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) **Chapter 1** Determinant (6 contact hours and 6 self-study hours) • The concept of determinant;*

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

examination	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 [1] Liu Xiping, Cao Weili and Yu Zhengsheng, *Linear algebras*,Science Press, 2013.9 2. Reference books [1] Department of Applied Mathematics of Usst, *Learning guidance of Linear Algebras*, Science Press, 2014.2 [2] Cao Weili etc., *Linear Algebras*, Hunan Science and Technology Press,2010.1 [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	4th semester
Person responsible for the module	Professor LIU Xiping
Lecturer	Associate Professor: ZHANG HaiQiang Associate Professor: FAN Hongfu, Associate Professor: CAO Weili, Associate Professor: HE Changxiang 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 energy and power engineering program and related programs. 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 related programs Type of teaching: most of the time is for lectures, and some time is for classroom discussions Of which, Theoretical teaching:48 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: 40-60 students
Workload	Workload = 90 hours Contact hours = 48 hours Self-study hours = 42 hours
Credit points(ECTS)	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. Final examination : written examination

Recommended prerequisites	Calculus; Linear Algebra
Module objectives/intended learning outcomes	Module objectives: 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. • **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. • **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. • **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) **Chapter 1** Random Events and Probability (6 contact hours and 5 self-study hours) Outline: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence, problems. • Introduction to probability; • Conditional probability;* • Independence of random events.* **Chapter 2** Random Variables and Distribution (8 contact hours and 6 self-study hours)

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

	Chapter 7 Estimation Problems (6 contact hours and 5 self-study hours) 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. • The method of point estimation problems;* • The evalution criterion of point estimation;** • Confidence intervals.** **Chapter 8** Testing Hypothesis (6 contact hours and 5 self-study hours) 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. • Basic conceptions of testing hypothesis;* • Testing hypothesis of expectation of normal populations;** • Testing hypothesis of variance of normal populations.* **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (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	Beamer and board/whiteboard, electronic scripts, ppt projection, computer practising center, and working documents.
Reading list	1. Recommended book [1] Ci-Nan Ye and Xi-Ping Liu, *Probability Theory and Mathematical Statistics*, Science Press, 2010. [2] Office of Engineering Mathematics, USST, *The study guide to probability theory and mathematical statistics.* [3] Zhou Sheng, Shi-Qian Xian and Cheng-Yi Pan *Probability Theory and Mathematical Statistics*, Zhejiang University Press, 2008. 2. Reference books

	[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 MA Jie Associate Professor OUYANG Ruizhuo Lecturer GU Yingying Lecturer QU Song Lecturer JI Yajun Lecturer AN Yarui Lecturer GUO Ning Lecturer WANG Lu Lecturer LI Jing Lecturer ZHAO Yuefeng Lecturer JIA Chengzheng Lecturer YU Zhihao
Language	Chinese
Relation to curriculum	College Chemistry is a compulsory basic course for undergraduates of science and engineering related programs. It mainly introduces the basic principles of chemistry and the skills of chemistry. The course mainly includes aggregation state, dispersion system, 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: freshmen of science and engineering related programs Type of teaching: theoretical teaching, experiment teaching Contact hours: 96 hours Of which, Theoretical teaching: 76 hours Experiment / practice teaching: 20 hour Computer practice: 0 hour

	Size of class: 60-100 students
Workload	Workload = 180 hours Contact hours = 96 hours Self-study hours = 84 hours
Credit points	6.0
Requirements according to the examination regulations	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	None.
Module objectives/intended learning outcomes /	Module objectives: • **Knowledge:** Understand basic principles of chemistry with emphasis on thermodynamics, kinetics, equilibria, bonding, and electrochemistry. A brief introduction to inorganic, organic and polymer chemistry. • **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. • **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) Chapter 1 Thermochemistry (12 contact hours and 10 self-study hours) • Concepts of thermochemistry; • The First Law of Thermodynamics;** • The concept of enthalpy;* • Standard enthalpies of formation;* • Evaluating enthalpy and entropy changes;* • Fuels, sources of energy and the utilizations. Chapter 2 Principles of Chemical Reactions (12 contact hours and 12 self-study hours) • The concept of entropy;* • Evaluating enthalpy and entropy changes;** • The Second Law of Thermodynamics;** • Standard free energy change;* • Chemical equilibrium;** • The rate of a chemical reaction;*

	• Environmental chemistry and green chemistry. Chapter 3 Solutions and Their Properties (12 contact hours and 10 self-study hours) • Types of solutions and solution concentration;* • Freezing-point depression, boiling point elevation and osmotic pressure of solutions;* • Theories of acids and bases;* • Ionization equilibrium;* • Buffer and pH control;** • Precipitation and Dissolution Equilibrium;** • Water purification and wastewater treatment.* Chapter 4 Electrochemistry (12 contact hours and 10 self-study hours) • Galvanic cell;* • Ecell, ΔGo, and Keq;* • Standard electrode potentials;** • Ecell as a function of concentrations;* • Batteries: producing electricity through chemical reactions;* • Electrolysis: causing nonspontaneous reactions to occur;* • Corrosion and the protections.* Chapter 5 Atomic, Molecular and Crystal Structures (12 contact hours and 10 self-study hours) • Atomic structure;** • The Periodic Law and the Periodic Table;** • Periodic properties of the elements;** • Chemical bonding;* • Molecular orbitals;* • The crystalline solid state.* Chapter 6 Inorganic Chemistry (8 contact hours and 8 self-study hours) • Properties of oxides and halides;* • Coordination compounds;* • Inorganic materials: alloy and inorganic nonmetallic materials.* Chapter 7 Organic Chemistry (8 contact hours and 8 self-study hours) • Organic compounds and structures: an overview; • Polymerization reactions;** • Structures and properties of polymer;** • Applications and molecular design.* **Part B Experiment / practice teaching** (20

	experiment hours; 16 self-study hours) Experiment / practice teaching (20 contact hours and 16 self-study hours) 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);* 3) Determination of iron content by spectrophotometry (4 contact hours and 4 self-study hours);** 4) Determination of water quality by chemical analysis (4 contact hours and 2 self-study hours);** 5) Iodine clock reaction- Hydrogen peroxide variation (4contact hours and 4 self-study hours).* **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score includes: usual performance (20%); experiment (10%), final exam (closed-book written examination) (70%) Usual performance includes: assignment, attendance rate, and computer practice 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 [1] XU Duanjun etc., *General Chemistry (6th edition)*, Higher Education Press, 2012 2. Reference books [1] Ralfh H. Petrucci etc., *General Chemistry: Principles and Modern Applications (10th edition)*, Prentice Hall, 2010 [2] HUA Tongwen etc., *Principles of General Chemistry*, Peking University Press, 2013 [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 Associate Professor TONG Yuanwei Associate Professor YAO Lanfang Associate Professor WANG Lijun Lecturer MA Shanshan Lecturer YAN Feinan Lecturer LIU Yuan Lecturer HUANGFU Quansheng Lecturer LIANG Liping Lecturer NI Weixin Lecturer XU Chunyan Lecturer LI Yuqiong Lecturer DING Yaqiong
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 has great universality, its basic theory can penetrate in many fields of natural sciences and can be used in all branches of production technology, which is the foundation of natural science and engineering technology.
Type of teaching, contact hours	Target students: freshmen of science and engineering related programs Type of teaching: theoretical teaching, experiment teaching Contact hours: 80 hours Of which, Theoretical teaching: 64 hours Experiment / practice teaching: 16 hours Computer practice: 0 hour Size of class: 60-90 students

Workload	Workload = 150 hours Contact hours = 80 hours Self-study hours = 70 hours
Credit points	5.0
Requirements according to the examination regulations	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
Module objectives/intended learning outcomes /	Module objectives: 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. On successful learning of this course module, the student should be able to demonstrate the following learning outcomes: • **Knowledge:** students are required to master the basic concepts and principles in mechanics, thermophysics and electrostatics. • **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. • **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) **Chapter 1** Kinematics (6 contact hours and 6 self-study hours) • Frame of reference, particle;* • Position vector and displacement, velocity and acceleration;** • Circular motion, relative motion.* **Chapter 2** Newton's Law of Motion (4 contact hours and 4 self-study hours) • Newton's law, force, inertial reference frame;* • General properties of forces in mechanics; • Fundamental forces in nature, units and dimensions;* • Application of Newton's law of motion;** **Chapter 3** Momentum and Angular Momentum (6 contact

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

	• Application of the first law of thermodynamics;** • The heat capacities of an ideal gas;* • Application of the first law to adiabatic processes;** • Cyclical processes, thermal efficiency, Carnot cycle, reverse cycle;* • The second law of thermodynamics;** • Reversible and irreversible process; • Statistical meaning of the second law; • Entropy. **Chapter 9** Electrostatic Field in Vacuum (8 contact hours and 6 self-study hours) • Electric charges, Coulomb's law;* • Electric field, electric field line and flux;** • Gauss' law;** • Electric potential;** • Equipotential surface and potential gradient.* **Chapter 10** Conductors and Dielectrics in Electrostatic Field (8 contact hours and 6 self-study hours) • Elecrostatic induction;** • Capacitance and dielectrics;* • Gauss' law in dielectric, electric displacement;* • Energy in electric field.* **Part B Experiment / practice teaching** (16 experiment hours; 12 self-study hours) 1) 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);** 2) 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);** 3) 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);* 4) 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);* 5) 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);* 6) 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); 7) 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); 8) 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). **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score includes: usual performance (20%); experiment (10%), final exam (closed-book written examination) (70%) Usual performance includes: assignment, attendance rate, and computer practice 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 [1] Cheng Shouzhu, Jiang Zhiyong, *General Physics*, Higher Education Press ,2006.12(sixth edition) 2. Reference books [2] Zhang Sanhui, *College Physics*, Tsinghua University Press,1999 (second edition) [3] Ma Wenwei, *Physics*, Higher Education Press, 2006 (fifth edition)

[4] Gu Zhengtian, Chen Jun, *College Physics Synchronous Tutorship Review and Self-testing*, China Machine Press, 2009
[5] WANG Xiaoping, *College Physics Experiment (1st edision)*, Machinery Industry Press,2009
[6] 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 Associate Professor TONG Yuanwei Associate Professor YAO Lanfang Associate Professor WANG Lijun Lecturer YAN Feinan Lecturer LIU Yuan Lecturer HUANGFU Quansheng Lecturer LIANG Liping Lecturer NI Weixin Lecturer XU Chunyan Lecturer LI Yuqiong Lecturer DING Yaqiong
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: freshmen of science and engineering related programs Type of teaching: theoretical teaching, experiment teaching Contact hours: 80 hours Of which, Theoretical teaching: 64 hours Experiment / practice teaching: 16 hours Computer practice: 0 hour Size of class: 60-90 students
Workload	Workload = 150 hours Contact hours = 80 hours Self-study hours = 70 hours
Credit points	5.0
Requirements according to the	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
Module objectives/intended learning outcomes /	Module objectives: 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. Intended learning outcomes : On successful learning of this course module, the student should be able to demonstrate the following learning outcomes: • **Knowledge:** students are required to master the basic concepts and principles in magnetism, vibration and waves, wave optics and modern physics. • **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. • **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) **Chapter 11** Magnetic Field of Steady Current (12 contact hours and 12 self-study hours) • Magnetic phenomena, Ampere's pypothesis;* • Magnetic field, Gauss'law in magnetic field;** • Boit-Savart law and its application;** • Ampere's law and its application;** • Motion of charged particles in magnetic field;* • Magnetic force on current-carrying conductors;* • Magnetic torque on a current loop.* **Chapter 12** Magnetic Field in Media (4 contact hours and 2 self-study hours) • Classifications of media, magnetic permeability; • Micro theory of paramagnetism and diamagnetism; • Ampere's law in the magnetic medium and magnetic intensity H;* • Ferromagnetism. **Chapter 13** Electromagnetic Introduction (8 contact hours

	and 8 self-study hours) • Nonelectrostatic force, Electromotive force, Faraday's law of induction; • Motional electromotive force;** • Induced electric field;* • Self-induction and mutual-induction;* • Energy of the magnetic field;** • Displacement current; • Maxwell's equation.* **Chapter 14** Oscillation (6 contact hours and 6 self-study hours) • Simple harmonic motion (SHM);* • Amplitude, period, frequency, phase; • The Energy of SHM;** • Damped Vibration and Forced Vibration Resonance; • Superposition of two parallel SHM;** • Superposition of two perpendicular SHM. **Chapter 15** Waves (6 contact hours and 6 self-study hours) • Formation and Propagation of mechanical wave; • Wave speed and elasticity of the medium; • Wave function of a plane SHW;** • Energy, energy flow, wave intensity; • Superposition principle of waves, interference of waves, standing waves;** • Doppler effect; • Properties and energy of electromagnetic waves.* **Chapter 16** Interference of Light (6 contact hours and 6 self-study hours) • The coherence of light; • Double slit interference;** • Optical path and optical path difference; • Interference by division of amplitude;** • Michelson' interferometer. **Chapter 17** Diffraction of Light (6 contact hours and 6 self-study hours) • Diffraction of light ,Huygens-Fresnel's principle;* • Fraunhofer single slit diffraction;** • Diffraction Grating;** • Resolving power of optical instrument; • X-ray diffraction. **Chapter 18** Polarization of Light (4 contact hours and 2 self-study hours)

	• Nature light and polarized light, polarization of light, Malus law; • Polarization by reflection;** **Chapter 19** Fundamentals of Quantum Theory (12 contact hours and 10 self-study hours) • Thermal radiation and Plank's theory of radiation; • Photoelectric effect and Einstein's quantum theory;** • Compton effect;* • Atomic spectra, Bohr model of hydrogen atom;** • De Broglie's postulate and matter waves;** • The uncertainty principle;* • The wave function and Schrodinger equation. **Part B Experiment / practice teaching** (16 experiment hours; 12 self-study hours) 1) 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);** 2) 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);** 3) 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);** 4) 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);* 5) 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);*

	6) 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);* 7) 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); 8) 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); **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score includes: usual performance (20%); experiment (10%), final exam (closed-book written examination) (70%) Usual performance includes: assignment, attendance rate, and computer practice 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 [1] Cheng Shouzhu, Jiang Zhiyong, *General Physics*, Higher Education Press ,2006.12 (sixth edition) 2. Reference books [2] Zhang Sanhui, *College Physics*, Tsinghua University Press,1999.4 (second edition) [3] Ma Wenwei, *Physics*, Higher Education Press, 2006.1(fifth edition) [4] Gu Zhengtian, Chen Jun, *College Physics Synchronous Tutorship Review and Self-testing*, China Machine Press, 2009 [5] WANG Xiaoping, *College Physics Experiment (1st edision)*, Machinery Industry Press,2009 [6] Francis W.Sears, Mark W.Zemansky, *College Physics*, Addison-Wesley Publishing Company, 1991

Informatics

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 Associate Professor ZANG Jinsong Lecturer LIU Lixia
Language	Chinese
Relation to curriculum	This course aims to enable students entered the university will be able to 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: freshmen of all programs Type of teaching: most of the time is for lectures, the rest time for classroom exercises and discussion. Contact hours: 48 hours Of which, Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: 60-80 students
Workload	Workload = 90 hours Contact hours =48 hours 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, and PowerPoint. To understand and master the basic principle of the computer network. Understanding and knowledge of information retrieval technology and information security technology. • **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. • **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) **Chapter 1** Basic knowledge of computer;* (introductory content;6 contact hours and 3 self-study hours). **Chapter 2** Experience with the application of Windows operating system;* (Preliminary understanding; 6 contact hours and 3 self-study hours). **Chapter 3** To master the basic operation of word processing software;** (key content; 10 contact hours and 10 self-study hours). **Chapter 4** To master the basic operation of electronic form processing software Excel;** (key content; 10 contact hours and 10 self-study hours). **Chapter 5** Learn how to use PowerPoint to make the presentation;** (key content; 10 contact hours and 10 self-study hours). **Chapter 6** Overview of computer security, the new technology of computer knowledge and Application;* (introductory content; 6 contact hours and 6 self-study hours). **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of	After-school exercises should be completed by students independently after each class.

examination	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 [1] *Fundamentals of Computer Application Tutorial*(2011), East China Normal University press [2] *The application of computer experiment guidance*(2011), East China Normal University press 2. Reference books [1] *Norton,Introduction to Computer Science* (Sixth Edition), Tsinghua University Press

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 Associate Professor ZANG Jinsong, 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: freshmen of engineering related programs Type of teaching: half of the time is for lectures, half for classroom do exercises Contact hours: 32 hours Of which, Theoretical teaching: 16 hours Experiment / practice teaching: 16 hours Computer practice: 0 hour Size of class: 60-80 students
Workload	Workload =60 hours Contact hours = 32 hours 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. • **Knowledge:** students are required to master the basic concepts and principles of information, understand the knowledge of acquisition and utilization in different fields.

	• **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. • **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; 14 self-study hours) **Chapter 1** Introduction: the new application of modern information technology (2 contact hours and 2 self-study hours) • Audio signal processing technology;* • Integration of information and industrialization; • Intelligence technology;* • Cloud computing;** • Next generation internet.* **Chapter 2** Multimedia technology (6 contact hours and 4 self-study hours) • Audio signal processing technology;* • Image information processing technology;** • Animation processing technology;* • Video information processing technology.* **Chapter 3** Basis of computer network (2 contact hours and 2 self-study hours) • The basic concepts of computer network; • LAN;* • Local area networking;* • Internet technology and application.** **Chapter 4** Web design (6 contact hours and 6 self-study hours) • Introduction to HTML and Web design software • The basic elements in the Web page: text, hyperlinks, multimedia, form;* • Web design and publish.** **Part B Experiment / practice teaching** (16 experiment hours; 14 self-study hours) 1) Foundation of multimedia processing: audio, image & animation ((8 contact hours and 6 self-study hours);* 2) Network applications (2 contact hours and 2 self-study hours);** 3) Web design (6 contact hours and 6 self-study hours).**

	Part C Computer practice (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	Reference books [1] Xia Yun, *Basic computer application* (2nd Ed.), Publishing House of Electronics Industry, 2013. [2] Xia Yun, *The application of computer experiment guidance* (2nd Ed.), Publishing House of Electronics Industry, 2013.

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 XIA Yun Associate Professor ZANG Jinsong, Lecturer HUANG Xiaoyu, YANG Zan, CHENG Guoshu
Language	Chinese
Relation to curriculum	Program Design and Practice is one of the informatics courses for all undergraduates of engineering programs. 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 Type of teaching: almost 2/3 of the time is for lectures, and some time is left for classroom do exercises Contact hours: 48 hours Of which, Theoretical teaching: 32 hours Experiment / practice teaching: 16 hours Computer practice: 0 hour Size of class: 60-80 students
Workload	Workload =90 hours Contact hours =48 hours 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. • **Knowledge:** Understand the basic knowledge of programming, some basic knowledge of data

	structure. And master the basic programming analysis methods, such as module method. • **Skills:** be able to analyze problem and solve it by computer programming; and be able to build a whole program using the module method. • **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; 26 self-study hours) **Chapter 1** Basic Knowledge for Programming Design (2 contact hours and 2 self-study hours) • Program and Programming Language;* • Structural Programming Design Method;** • Introduction and representation of Algorithm;* • Getting start. **Chapter 2** An Overview of C (6 contact hours and 4 self-study hours) • Basic structure of C program;* • (Character set, identifiers, expressions, keywords, statements, functions);** • Data types (variable Name, Data Types and Sizes, Constants, Declarations);** • Operations(Arithmetic Operators, Relational and Logical Operators,Type Conversions,Increment and Decrement Operators;** • Sequential Logic Structure and Selective structure.** **Chapter 3** Iteration Constructure (6 contact hours and 4 self-study hours) • The basic concepts of loops;* • The use of Loop, the comparison of three kinds of loops;* • Nested loop;** • Programming examples (output graphics, exhaustive algorithm).* **Chapter 4** Combined data structure and file (6 contact hours and 6 self-study hours) • The basic concept of the array;* • Pointer;** • Structure data type;* • File.**

	Chapter 5 Module and interface (6 contact hours and 6 self-study hours) • C program structure, function definition;** • Function call and data transfer between the functions;** • Scope Rules and variable storage;** • Recursive function calls.* **Chapter 6** Case study(6 contact hours and 4 self-study hours) • Transmission of structured data between functions;* • Basic algorithm practice.* **Part B Experiment / practice teaching** (16 experiment hours; 16 self-study hours) 1) Environment of programming (2 contact hours and 2 self-study hours);** 2) Sequential Logic Structure and Selective structure practice(2 contact hours and 2 self-study hours);** 3) Iterative programming (4 contact hours and 4 self-study hours);** 4) Data process (4 contact hours and 4 self-study hours);* 5) Module and algorithm practice (4 contact hours and 4 self-study hours).* **Part C Computer practice** (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	Reference books [1] "*A First Book of ANSI C*, (Fourth Edition)", By Gary J.Bronson [2] *"A Book on C* : *Programming in C* (Fourth Edition)", By Al Kelley and Ira Pohl ,2004 [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 Associate Professor ZHU Wenbo Lecturer CHEN Long Lecturer JING Lulu
Language	Chinese
Relation to curriculum	Fundamentals of Engineering Drawing is an engineering fundamental course of science and 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 science and engineering related programs Type of teaching: most of the time is for lectures, and some time is for classroom discussions Contact hours: 64 hours Of which, Theoretical teaching: 64 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: 60 students
Workload	Workload = 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
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	None
Module objectives/intended learning outcomes /	Module objectives: 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 science and engineering related programs. • **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. • **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. • **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; 56 self-study hours) **Introduction:** Understand the nature, tasks and methods for learning of this course. (1 contact hour) **Chapter 1** Basic Knowledge of Engineering Drawing (brief introduction; 8 contact hours and 6 self-study hours)

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

	section views;** • Other expression methods and application examples;* • Drawing composite solid by using ruler and compasses as well as various expression methods.* **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (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 [1] QIU Wenyan and QU Yuanshang, *Mechanical Drawing (2nd edition)*, Higher Education Press, 2009 2. Reference books [1] LIU Chaoru, etc., *Mechanical Drawing (5th edition)*, Higher Education Press, 2012 [2] HE Mingxin and QIAN Keqiang, *Mechanical Drawing (5th edition)*, Higher Education Press, 2012 [3] WANG Chunhua, etc., *Modern Engineering Graphics*, China Petrochemical Press, 2012 [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 XIN Shangzhi Associate Professor LIU Jian Associate Professor HOU Wen
Language	Chinese
Relation to curriculum	Electrical Engineering and Electronics is an engineering fundamental course for students of science and 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 science and engineering related programs Type of teaching: most of the time is for lectures, and some time is left for classroom discussions and explaining exercises Contact hours: 96 hours Of which, Theoretical teaching: 78 hours Experiment / practice teaching: 18 hour Computer practice: 0 hour Size of class: 80-100 students
Workload	Workload = 180 hours Contact hours = 96 hours 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	Module objectives:

learning outcomes/	Electrical Engineering and Electronics is an engineering fundamental course. • **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. • **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. • **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, independent ability to remove common faults. This course trains students connately analyzing the experimental phenomena, the ability of processing the experimental data.
Content	1. Theoretical teaching **Part A Theoretical teaching** (78 contact hours; 66 self-study hours) **Chapter 1** Introduction (2 contact hours and 2 self-study hours) **Chapter 2** The basic concepts and the basic laws of circuit (4 contact hours and 4 self-study hours) • Understand the basic concepts of circuit;* • Master Kirchhoff's law.** **Chapter 3** Analysis the methods of circuit (6 contact hours and 6 self-study hours) • Master the circuit equivalent transform method and analysis method of linear circuit;** • Master the principle of superposition and Thevenin's theorem.** **Chapter 4** Sinusoidal alternating circuit (8 contact hours

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

	• Understand the simple applications of comparator.* **Chapter 11** Gate circuit and combinational logic circuit (10 contact hours and 8 self-study hours) • Master the application method of logic algebra, the logic function of gate circuit and analysis and design of combinational logic circuit.** **Chapter 12** The logical circuit of the trigger and logical circuit (12 contact hours and 10 self-study hours) • Understand the basic law of the bistable R-S,J-K and D trigger;* • Master the analysis methods of the registers and counters.** **Part B Experiment / practice teaching** (18 experiment hours; 18 self-study hours) 1) Safety education of electrical engineering experiments and experiment of potential measuring in DC circuits (2 contact hours and 2 self-study hours);* 2) Experiment of Superposition Principle and Thevenin's Theorem (2 contact hours and 2 self-study hours);* 3) Experiment of improving power factor and influence of frequency on capacitance and inductance (2 contact hours and 2 self-study hours);** 4) Experiment of RCL series resonant circuit (2 contact hours and 2 self-study hours);* 5) Introduction of common electronic instrument (2 contact hours and 2 self-study hours);* 6) Experiment of single transistor AC amplifier circuit (2 contact hours and 2 self-study hours);** 7) Experiment of operational amplifier (2 contact hours and 2 self-study hours);** 8) Experiment of gate circuit and combinational logic circuit (2 contact hours and 2 self-study hours);** 9) Experiment of trigger and counter (2 contact hours and 2 self-study hours);** **Part C Computer practice** (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. The specified books [1] "*Electrical and electronic technology*" edited by Shangzhi Xin, China metrology press, 2009 July 2. Reference books [1] "*Electrical Engineering*" (volume 1) electrician technology, (volume 2) electronic technology, sixth edition,Zenghuang Qin, high Education Press,2004 July [2] "*Circuit*"fifth edition,edited by Guanyuan Qiu, high Education Press,2006 May [3] "*The Foundation of Electronic Technology*" *analog electronic part* (fourth edition), edited by Huaguang Kang, high Education Press,1999 June [4] "*The Foundation of Electronic Technology*" *digital electronic part* (fourth edition), edited by Huaguang Kang, high Education Press,2000 June

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	2nd semester
Person responsible for the module	Professor WANG Zhonghou
Lecturer	Associate Professor WENG Guohua Associate Professor LIU Jing Lecturer YU Huijie Lecturer ZHOU Qun
Language	Chinese
Relation to curriculum	Theoretical Mechanics is an engineering fundamental course for students of science and 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: freshmen of science and engineering related programs Type of teaching: most of the time is for lectures, and some time is left for classroom discussions and explaining exercises Contact hours: 96 hours Of which, Theoretical teaching: 96 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: 60-80 students
Workload	Workload = 180 hours Contact hours = 96 hours 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 /	Module objectives: 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. • **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. • **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. • **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; 84 self-study hours) **Introduction:** Main Research Content and Methods of Theoretical Mechanics (Preliminary understanding; 2 contact hours) **Chapter 1** Basic Axioms of Static and Force Analysis of Objects (introduction of basic concepts; 4 contact hours and 4 self-study hours) • Get familiar with the nature of common constraints;

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

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

	• Understand moment of momentum theorem in dynamics and the fixed axis rotating differential equation of rigid body; • Be able to correctly apply moment of momentum theorem to solve dynamics problems of particle and particle system.** **Chapter 14** Theorem of Kinetic Energy (key content; 8 contact hours and 6 self-study hours) • Understand theorem of kinetic energy and associated conservation theorem in dynamics; • Be able to correctly apply theorem of kinetic energy to solve dynamics problems of particle and particle system.** **Chapter 15** D' Alembert Principle (key content; 6 contact hours and 6 self-study hours) • Understand D' Alembert principle; • Be able to simplify the inertial forces system of translational rigid body, fixed axis rotating rigid body and plane motion rigid body;** • Be able to apply D' Alembert principle to solve dynamics problems.* **Chapter 16** Principle of Virtual Displacement (introductory content; 4 contact hours and 4 self-study hours) • Understand the concepts of virtual displacement and ideal constraint; • Be able to apply principle of virtual displacement to solve constraint reaction. **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (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 [1] HAO Tongsheng, *Theoretical Mechanics (3rd edition)*, Beijing: Higher Education Press, 2003 2. Reference books [1] Teaching and Research Office of Theoretical

	Mechanics, Harbin Institute of Technology, *Theoretical Mechanics (7th edition)*, Beijing: Higher Education Press, 2009 [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 [3] JING Rongchun, *Theoretical Mechanics Counseling and Problem Solutions*, Beijing: Tsinghua University Press, 2010 [4] Carl Jenness Coe. *Theoretical Mechanics: a vectorial treatment*. The Macmillan Company. 2008

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	3rd semester
Person responsible for the module	Professor WANG Zhonghou
Lecturer	Associate Professor WENG Guohua Lecturer YU Huijie Lecturer JIAO Guyue
Language	Chinese
Relation to curriculum	Mechanics of Materials is an engineering fundamental course of science and 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: sophomores of science and engineering related programs Type of teaching: most of the time is for lectures, and some time is left for classroom discussions and explaining exercises Contact hours: 96 hours Of which, Theoretical teaching: 96 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: 60-80 students
Workload	Workload = 180 hours Contact hours = 96 hours 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 /	Module objectives: 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. • **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. • **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. • **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; 84 self-study hours) **Chapter 1** Introduction (preliminary understanding; 4 contact hours and 2 self-study hours) • Tasks of Mechanics of Materials; the relation between Mechanics of Materials and productive practice; • Concept of deformable body and basic assumptions; • Internal force, section method; stress and strain.*

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

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

	Chapter 12 Fatigue Strength of Members under Alternating Stress (introductory content; 8 contact hours and 6 self-study hours) • Cycle characteristics of alternating stress; • Endurance limit of materials under symmetric cycle loading; • Factors affecting endurance limit of members; • Strength conditions of members under symmetric cycle loading; • Measures to improve endurance limit of members. **Chapter 13** Energy Method (key content; 8 contact hours and 8 self-study hours) • Rod deformation energy calculation; • Castigliano's theorem and mohrs theorem;** • Apply Castigliano's theorem (or mohrs theorem) to solve static indeterminacy problems.** **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (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 [1] LIU Hongwen, *Concise Mechanics of Materials (2nd edition)*, Beijing: Higher Education Press, 2008. 2. Reference books [1] SHAN Zuhui, *Mechanics of Materials I and II (3rd edition)*, Beijing: Higher Education Press, 2010. [2] SUN Xunfang, FANG Xiaoshu and LU Yaohong, *Mechanics of Materials (3rd edition)*, Beijing: Higher Education Press, 2012. [3] HU Zengqiang, *Mechanics of Materials Study Guide*, Beijing: Higher Education Press, 2006 [4] James M. Gere, Barry J. Goodno. *Mechanics of Materials (8th edition)*. Nelson Engineering, 2012.

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	3nd semester
Person responsible for the module	Professor ZHONG Liangwei
Lecturer	Associate Professor QU Yuanshang Associate Professor ZHU Wenbo Lecturer Dr. CHEN Long Lecturer Dr. JING Lulu
Language	Chinese
Relation to curriculum	Mechanical Engineering Drawing is a follow-up course of Fundamentals of Engineering Drawing. These two courses belong to engineering fundamental courses of science and engineering related programs. Fundamentals of Engineering Drawing focuses on the introduction of geometry projection principles and engineering drawing expression methods, while Mechanical Engineering Drawing further introduces detail drawings (standard and non-standard parts) and assembly drawings. These two courses jointly provide a complete introduction of the principles and national standards of mechanical drawings and the expression methods of engineering drawings, and enable students to acquire the capability of engineering drawings, and get broad professional fundamental knowledge, so as to lay the foundation for the study of mechanical engineering courses (such as Machine Design).
Type of teaching, contact hours	Target students: sophomores of science and engineering related programs Type of teaching: most of the time is for lectures, and some time is for classroom discussions Contact hours: 96 hours Of which, Theoretical teaching: 96 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: 40-60 students
Workload	Workload = 180 hours Contact hours = 96 hours 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
Module objectives/intended learning outcomes	Module objectives: Engineering drawing is the common technical language for engineers. This course is a required professional fundamental course of mechanical engineering programs. • **Knowledge:** students are required to master the standardized drawing and labeling methods of standard parts and commonly used parts; expression methods for various parts; master the labeling method for various technical requirements in detail drawings; read and draw detail drawings; summary of assembly drawing; representation methods of assembly drawings; read and draw assembly drawings; interpreting and separating assembly drawings. • **Skills:** be able to express parts and assembly, draw the engineering drawings for standard parts and commonly used parts with national standardized drawing methods, and read and draw detail drawings and assembly drawings. • **Competences:** by learning the standardized drawing of standard parts and commonly used parts as well as the national standards on detail drawings and assembly drawings, students are expected to acquire certain skills in reading and drawing detail drawings and assembly drawings, so as to lay the foundation for the study of follow-up specialized courses and for product design drawing. Good design and innovation capability is one of the necessary conditions required for enterprise talents.
Content	**Part A Theoretical teaching** (96 contact hours; 84 self-study hours) **Chapter 1** Standard parts and commonly used parts (16 contact hours and 10 self-study hours) • Types of thread; various elements of thread; description of external thread, internal thread, internal and external thread joints;** • Symbols of screw fasteners, and the drawing of bolt joint, stud joint and screw joint;** • Drawing methods of key assembly and pin assembly;**

	• Types of gears; geometric elements and dimensions of a spur gear and conventions in drawing gears;** • Conventional representation for rolling bearings and springs.* **Chapter 2** Detail drawings (40 contact hours and 38 self-study hours) • Purposes and contents of detail drawings; • Types of parts and selection of views, and selection of appropriate representation methods according to the type of parts;* • Dimensioning of detail drawings, datum features and the dimensioning for common structures; • Symbols and marking of the technical requirements (surface roughness, tolerance and fit, form and position tolerances) in detail drawings;* • Process (casting process, machining process) requirements on parts structure, and the methods for their expression in detail drawings; • Methods and procedures for drawing and reading detail drawings;** • Complete the detail drawings exercises in exercise sets and draw a box in an A3 drawing sheet.** **Chapter 3** Assembly drawings (40 contact hours and 36 self-study hours) • Purposes and contents of assembly drawings; • General representation, conventional representation and special representation methods of assembly drawings;* • Dimensioning and specifications for assembly drawings; • National standardized drawing of such content as part numbering and item block, etc. in assembly drawings; • Assembly process requirements on the expression of fitting structures in assembly drawings; • Methods and procedures for drawing and reading assembly drawings;** • Complete the assembly drawings exercises in exercise sets and draw an assembly drawing on A2/A3 drawing sheet;** • Interpreting and separating assembly drawings.** **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination	After-school exercises should be completed by students

requirements and forms of examination	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 [1] QIU Wenyan, QU Yuanshang, etc. *Mechanical Drawing (2nd edition)*, Higher Education Press, 2009 2. Reference books [1] LIU Chaoru, etc., *Mechanical Drawing (5th edition)*, Higher Education Press, 2012 [2] HE Mingxin, QIAN Keqiang, etc., *Mechanical Drawing (5th edition)*, Higher Education Press, 2012 [3] WANG Chunhua, etc., *Modern Engineering Graphics*, China Petrochemical Press, 2012 [4] Colin H Simmons etc., *Manual of Engineering Drawing(Second edition)*, Elsevier Newnes, 2004

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 Lecturer XIONG Min Lecturer ZHOU Jing
Language	Chinese
Relation to curriculum	Fundamentals of Engineering Materials is an engineering fundamental course for science and 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 science and engineering related programs Type of teaching: most of the time is for lectures, and some time is left for classroom discussions and explaining exercises Contact hours: 64 hours Of which, Theoretical teaching: 56 hours Experiment / practice teaching: 8 hours Computer practice: 0 hour Size of class: 80-100 students
Workload	Workload = 120 hours Contact hours = 64 hours 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 /	Module objectives: 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. • **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. • **Skills:** be able to select materials for specific parts, correctly select heat treatment process methods, and reasonably arrange heat treatment process route. • **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; 50 self-study hours) **Introduction:** Introduction on the objectives, tasks and research objects of this course. (4 contact hours) **Chapter 1** Properties of Materials (6 contact hours and 4 self-study hours) • Master the mechanical properties of materials, understand the test methods and corresponding property

	indicators;* • Understand the physical and chemical property indicators of materials; • Understand the process properties of materials. **Chapter 2** Structure of Materials (8 contact hours and 8 self-study hours) • Understand the basic concept of crystal structure; • Focus on three crystal structures and characteristics of common metal;** • Master the crystal structure defects of actual metal;* • Master alloy and crystal structural characteristics;* • Master the concepts of phase and solid solution strengthening.* **Chapter 3** Materials Solidification (14 contact hours and 14 self-study hours) • Master the concept of degree of supercooling;* • Master the crystallization process of pure metals and the volume changes caused by allotropy transformations;* • Master the application, distinction phase and microstructure concepts of Binary Isomorphous Diagram, Binary Eutectic Phase Diagram, Binary Eutectoid Phase Diagram and lever law;** • Master iron-carbon alloy phase diagram and the crystallization process of typical iron-carbon alloy, and be able to make phase diagram analysis;** • Master the concept of refined crystalline strengthening and the methods of grain refinement;* • Understand the characteristics of casting ingot microstructure and its control methods. **Chapter 4** Metal Plastic Deformation and Recrystallization (6 contact hours and 6 self-study hours) • Understand metal plastic deformation and its essence; • Master the differences between cold machining and hot machining, the work hardening of cold-machining metal and its property changes during heating.* **Chapter 5** Steel Heat Treatment (10 contact hours and 10 self-study hours) • Understand the classification and roles of heat treatment processes; • Focus on cooling c curves and unbalanced microstructure of steel;* • 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) • Understand the classification and grades of steel; • Get familiar with the role of alloying elements in steel;* • Focus on the grades, process methods and uses of all kinds of alloy steel.** **Part B Experiment / practice teaching** (8 experiment hours; 6 self-study hours) Experiment 1: Metal Hardness Test (2 contact hour and 2 self-study hour) • Understand the composition and uses of Brinell hardness tester and Rockwell hardness tester; • Master Brinell hardness and Rockwell hardness measurement methods.* Experiment 2: Metal Impact Test (2 contact hour and 2 self-study hour) • Understand the main composition and operation methods of impact tester; • Preliminarily master the testing methods of toughness of metallic materials;* • Preliminarily establish the relation between carbon content of carbon steel and impact toughness.* Experiment 3: Carbon Steel Heat Treatment and Unbalanced Microstructure Observation (4 contact hours and 2 self-study hours) • Design and develop the heat treatment processes of carbon steel with different carbon content, and master the basic operations of steel heat treatment;* • 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; • Observe the microstructure of carbon steel after common heat treatment and identify the features of its typical microstructure; • Deepen the understanding of the relations among carbon steel composition, heat treatment process and its microstructure and properties.** **Part C Computer practice** (0 hour)
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 [1] YU Yongsi, *Mechanical Engineering Materials (9th edition)*, Dalian University of Technology Press, 2014 2. Reference books [1] ZHU Zhangjiao, *Materials Engineering*, Tsinghua University Press, 2001 [2] William D. C. & David G. R.Material Science and Engineering(9th International student edition), New York: John Wiley & Sons, 2014 [3] HU Gengxiang, *Fundamentals of Materials Science (3rd edition)*, Shanghai Jiaotong University Press, 2010 3. Experiment / computer practice instruction books [1] Self-designed teaching materials 4. Other [1] PPT assisted courseware (self-designed) [2] Problem sets (self-designed)

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 LU Mei Professor LI Ling Professor SHAN Yanguang Associate Professor XU Hongtao Associate Professor JIA Zhihai Associate Professor HU Zhuohuan Associate Professor LU Wei Lecturer WANG Zhiyun Lecturer ZHANG Guanhua
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 Type of teaching: theoretical teaching, classroom practice, computer practice, experiment Contact hours: 96 hours Of which, Theoretical teaching: 62 hours Classroom practice: 8 hours Experiment / practice teaching: 16 hours

	Computer practice: 10 hours Size of class: No more than 60 students for theoretical teaching; no more than 60 students for computer practice
Workload	Workload= 180 hours Contact hours = 96 hours 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 having 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: 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: • **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. • **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. • **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) **Chapter 1** Basic Concepts (4 contact hours; 4 self-study hours) • Thermodynamic system;* • State and equilibrium state, state parameter and its

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

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

	thermodynamic energy; • Calculation of enthalpy and entropy;* • 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.* **Part B Experiment / practice teaching** (16 experimental operation hours; 10 self-study hours) 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. Requirements: grasp experiment principles; deepen understanding of theoretical knowledge; learn to how use common thermotechnical test instrument **Part C Computer practice** (10 contact hours; 6 self-study hours) 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 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. **Part D Classroom practice** (8 contact hours; 4 self-study hours) • Application of first and second law of thermodynamics; • Analysis of gas power and steam power cycles; • Calculation of thermodynamic system.
Study and examination requirements and forms of examination	Final score includes: usual performance (20%); experiment (10%), final exam (closed book written examination) (70%) Usual performance includes: assignment; attendance and computer practice 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 [1] SHEN Weidao, TONG Jungeng. *Engineering Thermodynamics* (4th edition). Beijing: Higher Education

	Press, 2007 [2] YAN Jialu, YU Xiaofu, WANG Yongqing. *Thermodynamic Properties Graphs of Water and Steam* (2nd edition). Beijing: Higher Education Press, 2004 2. Reference books [1] ZENG Danling, AO Yue, ZHANG Xinmin. *Engineering Thermodynamics* (2nd edition). Beijing: Higher Education Press, 2002 [2] TONG Jungeng, FAN Yunliang. *Learning Guidance and Answers to Exercises for Engineering Thermodynamics Study* ((2nd edition). Beijing: Higher Education Press, 2008 [3] HE Yaling. *Brief Analysis of Engineering Thermodynamics and Detailed Explanation of Typical Questions*. Xian: Xian Jiaotong University Press, 2000 [4] Richard E Sonntag, Claue Borgnakke. *Introduction to engineering thermodynamics*. New York: John Wiley and Sons, Inc, 2001 3. Experiment/computer practice instruction books [1] Self-compiled teaching materials 4. Other materials [1] PPT courseware (self-compiled) [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	Associate Professor SHEN Jingfeng Associate Professor HUANG Yiqing 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, make comprehensive use of machine design theories to innovate mechanism design, and complete related course design exercises, so as to lay the theoretical foundation for the study of follow-up specialized courses.
Type of teaching, contact hours	Target students: sophomores of science and engineering related programs Type of teaching: most of the time is for lectures, and some time is left for classroom discussions and explaining exercises Contact hours: 96 hours Of which, Theoretical teaching: 78 hours Experiment / practice teaching: 18 hour Computer practice: 0 hour Size of class: 40-60 students
Workload	Workload = 180 hours Contact hours = 96 hours 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	Theoretical Mechanics; Mechanics of Materials; Mechanical Engineering Drawing
Module objectives/intended learning outcomes /	Module objectives: 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. • **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. • **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. • **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; 70 self-study hours) **Introduction:** understand the nature, tasks and methods for learning of this course. (to be roughly understood; 2 contact hours) **Chapter 1** Analysis of Planar Mechanism Motion (key content; 6 contact hours and 6 self-study hours)

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

	Chapter 8 Mechanical Seal (to be mastered, 4 contact hours and 4 self-study hours) • Gasket seal; • Packing seal; • Lubricant seal; • Seal ring seal.* **Chapter 9** Riveting, Welding and Bonding Design (to be roughly understood; 6 contact hours and 4 self-study hours) • Riveting; • Welding; • Bonding. **Chapter 10** Friction Wheel Transmission (to be mastered; 4 contact hours and 4 self-study hours) • Transmission design of friction wheel with fixed transmission ratio;** • Friction wheel materials and lubricants. **Chapter 11** Design of Modified Gear and Gearbox (key content; 8 contact hours and 6 self-study hours) • Overview of modified gear; • Geometric calculation of modified gear drive;** • Type of modified gear drive; • Classification of gearboxes; • Gearbox transmission mechanism;** • Structural forms of main parts of gearbox; • Selection of main parameters of gearbox;** • Gearbox control mechanism. **Chapter 12** Couplers, Clutches and Brakes (to be mastered; 6 contact hours and 6 self-study hours) • Couplers;** • Clutches;* • Brakes. **Chapter 13** Spring Design (to be mastered; 6 contact hours and 4 self-study hours) • Spring function and type;* • Spring materials and manufacture;** • Design and calculation of cylindrical helix compression (tension) spring. **Part B Experiment / practice teaching** (18 experiment hours; 14 self-study hours) 1) The drawing experiment of mechanism motion diagram(4 contact hours and 4 self-study hours);** 2) The generating experiment of involute gear(6 contact hours and 4 self-study hours);**

	3) The experiment of shafting structure assembly and analysis(4 contact hours and 4 self-study hours);* 4) The parameters determination experiment of couplers (4 contact hours and 2 self-study hours).** **Part C Computer practice** (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 [1] WANG Xinhua, *Advanced Machine Design*, Chemical Industry Press, 2013 2. Reference books [1] HUANG Xikai, *Principles of Machine (6th edition)*, Beijing: Higher Education Press, 2010 [2] PU Lianggui, *Machine Design (7th edition)*, Beijing: Higher Education Press, 2001 [3] ZOU Huijun, *Principles and Methods of Innovative Machine Design*, Beijing: Higher Education Press, 2008 [4] Robert L. Mott, *Machine Elements in Machine design (Fourth Edition)*, Prentice-Hall, US, 2003

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 Associate Professor CHEN Eryun Associate Professor WANG Haimin Associate Professor YANG Fan Associate Professor WANG Qikun 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 programs Type of teaching: theoretical teaching, computer practice, experiment Contact hours: 96 hours Of which, Theoretical teaching: 64 hours Experiment / practice teaching: 20 hours Computer practice: 12 hours Size of class: 60 students
Workload	Workload= 180 hours Contact hours = 96 hours 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: 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. • **Knowledge:** Master basic concepts of fluid motion; describe basic laws, basic theories and calculation methods of fluid motion. • **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. • **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) **Chapter 1** Fluid and Physical Properties (5 contact hours; 6 self-study hours) • Subjects and Development of Fluid Mechanics Study; Study subjects, research methods and development of fluid mechanics; • Continuous Medium Hypothesis, definition of fluid particles and continuous medium hypothesis;* • Basic Attributes of Fluid, density, viscosity and compressibility of fluid; • Newton inner friction theorem.** **Chapter 2** Fluid Statics (8 contact hours; 9 self-study hours) • Hydrostatic pressure and its characteristics; Characteristics of hydrostatic pressure, basic equation of fluid statics; • 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;** • Relative balance of fluid, pressure distribution law and calculation of relatively balanced fluid; • Static Fluid Forces on Walls, basic methods and relevant calculation for static fluid surface and plane stress.* **Chapter 3** Hydrokinematics (5 contact hours; 6 self-study hours) • Flow field and its description method, two description methods of flow field; basic concepts of material derivative, local derivative and convective derivative;* • Streamline and trace, concepts and relevant features of trace, streamline and flow tube;* • Flow calculation method;** • Definitions of flow field vorticity, vortex line and vortex tube; • Flow pattern of viscous fluid, Reynolds experiment; basic features of laminar flow and turbulent flow, definition and functions of Reynolds number.* **Chapter 4** Analysis and Application of Fluid Mechanics (12 contact hours; 12 self-study hours) • Continuity equation of reynolds transport theory and integral form; • 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;** • 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;** • Momentum equation and application, equation of steady flow; solving one dimensional steady flow problems by using continuity equation, Bernoulli equation and momentum equation;** • Moment of momentum equation of steady flow and its application in impeller machinery. **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;* • Uncompressible laminar flow within circular section tube, stress, speed and distribution features of linear loss of fully developed laminar flow tube; • 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;** • 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; • 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.** **Chapter 6** External Flow Around Uncompressible Viscous Flow (7 contact hours; 7 self-study hours) • Basic concepts and features of boundary layer; definitions of boundary layer thickness, squeezing thickness and momentum deficit thickness; • 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;* • Boundary layer separation and round flow resistance, basic concepts of boundary layer separation; familiar with resistance calculation method for uncompressible viscous round flow objects.** **Chapter 7** Compressible Fluid Mechanics (7 contact hours; 7 self-study hours) • Velocity of sound and Mach number,transmission features of weak orbiting in moving flow; • Basic equation of one-dimensional isentropic pipe flow, isentropic flow and basic equation of one-dimensional isentropic flow;* • 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.** **Chapter 8** Similarity Principle;* (7 contact hours; 7 self-study hours) • Similar flow conditions, basic conditions of flow field similarity and interrelations between similar proportion constants;* • Similarity principle and similarity criterion, physical meaning of commonly used similarity numbers of fluid mechanics;** • Dimensional analysis, dimensional analysis method;* • Approximate model calculation. **Part B Experiment / practice teaching** (20 experiment operation hours; 10 self-study hours) 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.* **Part C Computer practice** (12 computer practice hours; 6 self-study hours) Complete 3 calculation examples of flow around circular cylinder, cavity flow andnumerical simulation of compressor internal flow field with Phoenix Software.*
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 [1] GUI Ketint, WANG Jun, WANG Qiuying. *Engineering Fluid Mechanics* (1st edition). Beijing: Science Press, 2003 2. Reference books [1] KONG Long. *Engineering Fluid Mechanics* (1st edition). Beijing: China Electric Power Press, 1992 [2] ZHOU Guangjong, YAN Zongyi, XU Shixiong. *Fluid Mechanics* (2nd edition). Beijing: Higher Education Press, 2000 [3] Roberson, Emeritus. *Engineering Fluid Mechanics*, 10th Ed, New York: Wiley, 2012. 3. Experiment/computer practice instruction books [1] Self-compiled teaching materials 4. Other materials

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

Computer Modeling Practice

Competence field	Engineering Fundamentals
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	Associate Professor WANG Zilong Lecturer WANG Zhiyun Lecturer CHEN Liu Lecturer HAO Xiaohong Lecturer WEN Zhenzhong
Language	Chinese
Relation to curriculum	This course belongs to Engineering Fundamentals competence field. Before the start of this course, students have already taken basic programming, mathematical and engineering methods. 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: sophomores of energy and power engineering related programs Type of teaching: theoretical teaching, computer practice Contact hours: 48 hours Of which, Theoretical teaching: 24 hours Experiment / practice teaching: 0 hour Computer practice: 24 hours Size of class: No more than 60 students for theoretical teaching; no more than 60 students for computer practice
Workload	Workload= 90 hours Contact hours = 48 hours 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**:** • **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. • **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. • **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) **Chapter 1** Basics of MATLAB Language (8 contact hours; 6 self-study hours) • Language basics of MATLAB;** • Basic arithmetical operation, process structure of MATLAB language;** • Function compiling and debugging; • Two-dimensional graphics plotting, data file reading and writing.** **Chapter 2** Solving Calculus Problems with Computer(4 contact hours; 4 self-study hours) • Analytic solution of calculus;* • Numerical differential and integral.* **Chapter 3** Solving Linear Algebra Problems with Computer(6 contact hours; 4 self-study hours) • Special matrix input;* • Basic analysis of matrix;** • Solution of linear equations.** **Chapter 4** Data Processing and Signal Analysis Fundamentals (6 contact hours; 4 self-study hours) • Data interpolation and fitting, model fitting of known data, signal analysis fundamentals;** • Statistical analysis of data.* **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (24 experiment hours; 24 self-study hours)

	1) Computer practice of MATLAB programming (8 contact hours; 6 self-study hours) • A total of 12 programming exercises targeted at matrix structure, matrix operation and structure practice;** • Function compiling and call, drawing and file.** 2) Computer practice of calculus problem solving(4 contact hours; 6 self-study hours) • A total of 8 programming exercises targeted at limit, derivative, integral, numerical integration and its application in engineering calculation. 3) Computer practice of linear algebra problem (6 contact hours; 6 self-study hours) • A total of 8 programming exercises targeted at special matrix input, matrix analysis, matrix properties, determination and solving of linear equations.* 4) Data processing and signal fundamentals (6 contact hours; 6 self-study hours) • 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 [**1]** *Calculus Problems MATLAB Solving* (2nd edition), XUE Dinyu, Tsinghua University Press, 2008 2. Reference books [**1]** *MATLAB and Scientific Calculation* (2nd edition), WANG Moran, Electronic Industry Press, 2005 [**2]** *MATLAB Principle and Engineering Application*, Edward B Magrab et al. GAO Huisheng trans. Electronic Industry Press, 2002 3. Experiment/computer practice instruction books [1] Self-compiled teaching materials 4. Other materials [**1]** PPT courseware (self-compiled)

Fundamentals of New Energy Theory

Competence field	Engineering Fundamentals
Module designation	Fundamentals of New Energy Theory
Code, if applicable	11001780
Subtitle, if applicable	
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Professor CUI Guomin
Lecturer	Professor DOU Binlin Associate Professor XIE Yingming Associate Professor WANG Zilong Lecturer HAO Xiaohong Lecturer WEN Zhenzhong Lecturer YANG Liang Lecturer ZHANG Guanhua
Language	Chinese
Relation to curriculum	Fundamentals of New Energy Theory is an engineering fundamentals courses for undergraduates of Renewable Energy Engineering program. Theoretical knowledge in new energy is crucial for scientific research and work on energy production, energy management, environmental protection and energy chemical engineering. After completing courses such as Engineering Thermodynamics, Engineering Fluid Mechanics and Heat Transfer, students can commence basic principles and professional applications of new energy including solar energy, wind energy, biomass energy and nuclear power. The course provides a comprehensive and systematic introduction to the status, utilizing principles and technologies of new energy and renewable energy resources. It lays a foundation for application of new energy knowledge in engineering, power generation of new energy resources, design and operation of energy conversion systems.
Type of teaching, contact hours	Target students: juniors of Renewable Energy Engineering program Type of teaching: theoretical teaching, experiment teaching Contact hours: 96 hours Of which Theoretical teaching: 76 hours Experiment / practice teaching: 20 hours Computer practice: 0 hour Size of class: No more than 60 students for theoretical teaching

Workload	Workload= 180 hours Contact hours = 96 hours 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	Engineering Thermodynamics; Engineering Fluid Mechanics; Heat Transfer
Module objectives/intended learning outcomes	Module objectives: The task of this course is to enable students to understand basic theories and professional applications of new energy through teaching and practice. Specific objectives include: • **Knowledge:** Understand basic principles and professional application technologies of new energy such as characteristics and principles of energy production, conversion, storage and utilization through using new energy; master the processes of power, heat and cold generation through new energy conversion; master the design of energy conversion and storage equipment. Through this course, students can explain application principles of new energy technology. • **Skills:** Students acquire basic theoretical and specialized knowledge about new energy engineering; understand engineering application of new energy conversion technology; master methods for designing equipment of energy conversion; be able to analyze energy conversion efficiency and work out rational new energy development plan according to different regional needs and calculate relevant economic benefits. • **Competences:** Students acquire practical abilities in new energy equipment design on the basis of new energy theoretical knowledge; be able to solve problems by using acquired knowledge in future work and study.
Content	**Part A Theoretical teaching** (76 contact hours; 68 self-study hours) **Chapter 1** Introduction (4 contact hours; 2 self-study hours) • Primary concepts of energy; • Introduction of new energy and renewable energy; • Development of new energy and renewable energy.

	Chapter 2 Solar Energy (12 contact hours; 12 self-study hours) • Introduction of solar energy;* • Thermal utilization of solar energy;** • Solar photovoltaic conversion;** • Other solar energy conversions; • Factors influencing solar energy utilization. **Chapter 3** Wind Energy (10 contact hours; 8 self-study hours) • Introduction of wind energy; • Wind energy resources;* • Wind energy utilization;** • Wind power generation market in the world;* • Environmental problem. **Chapter 4** Geothermal Energy (8 contact hours; 8 self-study hours) • Introduction of geothermal energy; • Geothermal energy utilization;** • Restrictions on geothermal energy utilization;* • Development trend of geothermal energy utilization. **Chapter 5** Ocean Energy (6 contact hours; 6 self-study hours) • Introduction ocean energy; • Technologies of ocean energy utilization;* • Trend of ocean energy power generation;* • Tide power plant—Daguanman Tide Power Plant. **Chapter 6** Biomass Energy (8 contact hours; 8 self-study hours) • Introduction of biomass energy; • Direct combustion technology;* • Biomass combustion power generation;* • Biomass pyrolysis and liquefaction technology;* • Biomass gasification technology;* • Methane technology;* • Disposal technology of municipal solid wastes. **Chapter 7** Hydrogen Energy (8 contact hours; 8 self-study hours) • Introduction of hydrogen energy; • Hydrogen preparation, storage and transportation;* • Hydrogen utilization technologies;** • Developing tendency of hydrogen utilization technologies. **Chapter 8** Natural Gas Hydrates (6 contact hours; 4 self-

	study hours) • Introduction of natural gas hydrates; • Physical and chemical properties of natural gas hydrates;* • Exploration technology of natural gas hydrates;** • Environmental impacts of natural gas hydrates. **Chapter 9** Nuclear Energy (10 contact hours; 10 self-study hours) • Introduction of nuclear energy; • Nuclear fuels;* • Nuclear reactors;** • Nuclear power plants;** • Safety of nuclear power plants; • Development trend of nuclear power plants. **Chapter 10** Energy and sustainable development (4 contact hours; 2 self-study hours) • Energy and economy development; • Energy and the environment;* • Energy and safety; • Energy systems and polices for sustainable development. **Part B Experiment / practice teaching** (20 experiment hours; 16 self-study hours) 1) Demonstration of wind power generation equipment (6 experiment hours; 6 self-study hours) 2) Demonstration of continuous flow of biodiesel preparation device (6 experiment hours; 6 self-study hours) 3) Demonstration of natural gas hydrates technology equipment (4 experiment hours; 2 self-study hours) 4) Demonstration of proton exchange membrane fuel cell device (4 experiment hours; 2 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%) Usual performance includes: assignment, attendance rate, and computer practice Experiment score includes: experiment report (50%); and experiment exam (50%)
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks, product model
Reading list	1. Required books [1] LI Chuantong. *New Energy and Renewable Energy Technology* (2nd edition). Nanjing: Southeast University

	Press, 2012 2. Reference books [1] CUI Xiujin, LIU Kuiren, HAN Qing. *New Energy Technology* (2nd edition). Beijing: Chemistry Industry Press, 2010 [2] G. Boyle. Renewable Energy: Power for a Sustainable Future, The 3rd Revised edition. Oxford University Press Oxford, 2012 [3] ZHU Yongqiang. *New Energy and Distributed Power Generation Technology* (1st edition). Beijing: Beijing University Press, 1997 [4] WANG Changgui. *New Energy Power Generation Technology*. Beijing: China Electric Power Press, 2003 3. Experiment/computer practice instruction books [1] Self-compiled teaching materials 4. Other materials [1] PPT courseware (self-compiled)

Applied Physical Chemistry

Competence field	Engineering Fundamentals
Module designation	Applied Physical Chemistry
Code, if applicable	11001212
Subtitle, if applicable	
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Associate Professor MEN Chuanling
Lecturer	Professor DOU Binlin Associate Professor ZHAO Bingtao Associate Professor LI Kequn Associate Professor XIE Yingming Associate Professor WANG Zilong Lecturer HUANG Xiuhui
Language	Chinese
Relation to curriculum	Applied Physical Chemistry is a compulsory curriculum for undergraduates of Renewable Energy Engineering program, but also one of the professional basic courses of environmental science, environmental engineering, and food, biotechnology, etc. Applied Physical Chemistry is a branch of science, from the linkages between chemical and physical phenomena, and to study chemical reactions the most basic laws of universal. This course mainly study the reaction of the following: poly-phase thermodynamics, phase transformation thermodynamics, equilibrium, chemical equilibrium, electrochemistry, chemical kinetics, colloidal chemistry, physical chemistry of surface and interfacial phenomena etc., lay the foundation for subsequent courses.
Type of teaching, contact hours	Target students: juniors of Renewable Energy Engineering program Type of teaching: theoretical teaching Contact hours: 96 hours Theoretical teaching: 96 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: No more than 50 students for theoretical teaching
Workload	Workload=180 hours Contact hours = 96 hours Self-study hours = 84 hours
Credit points	6.0
Requirements according to the	Only students with class attendance rate over 2/3, assignment

examination regulations	completion rate over 2/3 are allowed to take the exam.
Recommended prerequisites	Calculus; College Chemistry; College Physics; Engineering Thermodynamics; Engineering Fluid Mechanics
Module objectives/intended learning outcomes	Module objectives: The task of this course is to enable students to understand basic theories through teaching and practice. Specific objectives include: • **Knowledge:** In thermodynamics of the multicomponent system: master the Raoult's law, Henry's law and its application, understand the concept of partial molar volume, and chemical potential, master of colligative properties and application of dilute solution; In phase equilibrium: Mastering the definition, derivation and application of phase rule, understanding the typical phase diagram and application about one-component and two-component system, understanding leverage rules analysis phase diagram and calculation, master the methods of phase diagram drawn from experimental data. In chemical equilibrium: Master of thermodynamic data is used to calculate the equilibrium constant and equilibrium composition, understanding the derivation and application of isothermal equation, know the impact of the temperature, pressure, composition factors on the balance, and judge the direction of chemical reactions under certain conditions; In electrochemical: understanding the conductivity nature of electrolyte and concept of reversible cell, understand the Nernst equation derivation, master the calculation and application of electromotive force; In interfacial phenomena: Understanding the concept of surface tension, surface Gibbs function and contact with the contact angle, wettability, spreading. Understanding of the thermodynamic properties of curved liquid effect, mastering solution of adsorption, surface active substances and meaning and application the Gibbs adsorption equation, understand the meaning and differences of physical adsorption and chemical adsorption, learn theory and isotherm of Langmuir monolayer adsorption. In colloid: understand the definition of colloid and classification of disperse system. Understand colloidal stability and damage, the type of emulsion and stability. In chemical kinetics:

	understanding the conception of Chemical reaction rate, Reaction rate constant and Order of reaction. Master zero levels, tier I and Tier II response characteristics and its application of rate equations. Understand the typical characteristics of complex reaction. Master the treatment method of balance reactions and the consecutive reaction kinetics of reversible .Understand the meaning and application of the Arrhenius equation. • **Skills:** Learn basic concepts, theories and methods in the classroom and focus on the connotation and extension of knowledge, emphasizing the development of disciplines and the new achievements embodied in the classroom. Extra-curricular exercises is the necessary process to urge the students to master and consolidate the teaching content. The discussions which deepen and expand the content of teaching is the effective ways to improve problem-solving skills for students. **Competences:** Students acquire practical abilities and innovative thinking on the basis of combustion theories and engineering technology knowledge. Through this course of study, students can have more systematic and comprehensive understanding of such knowledge. This course will not only train students ' self-learning ability and the ability to think independently, but also improve reasoning abilities. • **Competences:** Students acquire practical abilities and innovative thinking on the basis of engineering technology knowledge. Through this course of study, students can have more systematic and comprehensive understanding of such knowledge. This course will not only train students ' self-learning ability and the ability to think independently, but also improve reasoning abilities.
Content	**Theoretical teaching** (96 contact hours; 84 self-study hours) **Chapter 1** Introduction (6 contact hours; 4 self-study hours) • Physical chemistry, a ubiquitous discipline; • The requirements and method for learning physical chemistry; • The representation and operation of a physical quantity. **Chapter 2** Multicomponent system thermodynamics (12 contact hours; 10 self-study hours)

	• Partial molar quantity; • Chemical potential; • The chemical potential of gas composition;* • Fugacity and fugacity factor;** • Raoult's law and Henry's law;* • The ideal liquid mixture;* • Ideal dilute solution;* • Activity and activity factor;* • Colligative properties of dilute solution. **Chapter 3** Chemical equilibrium(12 contact hours; 10 self-study hours) • The direction and equilibrium conditions of chemical reaction;* • Isothermal equation and standard equilibrium constant of ideal gas reaction; • The calculation of equilibrium constant and equilibrium composition;** • The influence of temperature on the standard equilibrium constant;** • Other factors on the influence of ideal gas reaction equilibrium;* • The calculation of reaction equilibrium at the same time;* • Chemical equilibrium of real gas reaction; • The chemical equilibrium of mixture and solution. **Chapter 4** Phase equilibrium(12 contact hours; 10 self-study hours) • Phase rule; • The system phase diagram of single component;* • Gas-liquid equilibrium phase diagram of ideal liquid mixtures by two-component system;** • Distillation principles;* • Gas-liquid equilibrium phase diagram of two-component liquids Partially miscible and completely immiscible system;** • Liquid-solid equilibrium phase diagram of two-component solid immiscible system;* • Two-component condensation system phase diagram of generating compounds;** • Liquid-solid equilibrium phase diagram of two-component solid miscible systems;* • Liquid-liquid equilibrium phase diagram of three-component system;

	• Introduction of second-order phase transition. **Chapter 5** Electrochemistry (14 contact hours; 14 self-study hours) • Electrode process, electrolyte solution and Faraday's law; • Ion transport number; • Conductance, conductivity and molar conductivity;* • The activity of electrolytic solution, activity factor and Debye Huckel's limiting law;* • Reversible cell and its electromotive force test; • Thermodynamics of primary cell;** • Electrode potential and Liquid barrier potential;** • Variety of Electrode;* • Design of primary cell; • Decomposition voltage;* • Polarization effect;* • Electrode reaction of electrolyze. **Chapter 6** Interfacial Phenomena (12 contact hours; 10 self-study hours) • Interfacial tension;* • Additional pressure of curved liquid surface and its Consequence; • Solid surface;** • Solid-liquid interface;* • Solution surface.* **Chapter 7** Chemical Kinetics (16 contact hours; 16 self-study hours) • Reaction rate and rate equations of chemical reaction; • Integral form of rate equations; • Determination of rate equations;** • Effect of temperature on reaction rate, activation energy;** • Typical Complex reaction;* • Approximation method of complex reaction rate;* • Chain Reaction; • Collision theory of gas reaction;** • Potential energy surface and transition state theory;** • The reaction solution; • Heterogeneous reaction; • Photochemistry; • Catalytic action feature;* • Single-phase catalytic reaction; • Heterogeneous catalytic reaction;

	• Molecular dynamics;* **Chapter 8** Colloid Chemistry (12 contact hours; 10 self-study hours) • Preparation of sol; • Optical Properties of sol; • Dynamical properties of sol;** • Electrical Properties of sol;* • Stability and coagulation of sol;* • Emulsion, foam, suspension and aerosol; • Osmotic pressure and viscosity of the polymer compound;** • Gelatinization, salting-out of polymer solution and swelling of sol. **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score includes: usual performance (30%); final exam (closed-book written examination) (70%) Usual performance includes: assignment, attendance rate, and classroom interaction.
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks
Reading list	1. Required books [1] LI Songlin, ZHOU Yaping, LIU Junji. *Physical Chemistry*. Beijing: Higher Education Press, 2015 2. Reference books [1] XIAO Yanfan. *Physical Chemistry*. Tianjin: Tianjin University Press, 2004 [2] SUN Dekun, SHEN Wenxia, YAO Tianyang, HOU Wenhua, *Physical Chemistry*. Beijing: Higher Education Press, 2007 [3] Beijing University of Chemical Technology .*example and exercise of Physical Chemistry* Beijing: Machinery Industry Press, 2006 3. Other materials [1] PPT courseware (self-compiled)

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 Professor CHENG Ping Professor YANG Mo Professor LU Mei Professor LI Ling Professor SHAN Yanguang Associate Professor JIA Zhihai Associate Professor YE Li Associate Professor ZHAO Ming Associate Professor XU Hongtao Lecturer HAO Xiaohong
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: juniors of energy and power engineering related programs Type of teaching: theoretical teaching, computer practice, experiment Contact hours: 96 hours Of which, Theoretical teaching: 72 hours Experiment / practice teaching: 12 hours Computer practice: 12 hours 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 Contact hours = 96 hours 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	Calculus; College Physics; Engineering Thermodynamics; Enginerring Fluid Mechanics
Module objectives/intended learning outcomes	Module objectives: 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. • **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. • **Skills:** Lay a foundation for further study and future practical work; improve students' abilities in thinking and practice. • **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) **Chapter 1** Introduction (6 contact hours; 6 self-study hours) • Three ways of heat transfer: conduction, convection and radiation;* • Heat resistance; heat transfer process and coefficient; development history of Heat Transfer. **Chapter 2** Basic Rules of Heat Conduction and Steady Heat Conduction (10 contact hours; 8 self-study hours) • Temperature field; temperature gradient; Fourier's law and heat transfer coefficient;** • Differential equation of heat conduction; initial and boundary conditions;* • Thermal conductivity of monolayer and multilayer flat walls, thermal conductivity of single and multi cylinder wall; fin heat conduction; fin efficiency; • Variable cross-section thermal conductivity, heat source and multi dimension heat conduction. **Chapter 3** Non-steady Heat Conduction (6 contact hours; 6 self-study hours) • Basic concepts of non-steady heat conduction; lumped parameter method;** • Analysis of one dimensional unsteady heat conduction solution;* • Nomograph; • Solving of two-dimensional and three-dimensional unsteady heat conduction problems; • Non steady heat conduction of a semi infinite body. **Chapter 4** Numerical Solution of Heat Conduction Problems (8 contact hours; 6 self-study hours) • Basic ideas of numerical solution of heat conduction problems; • Establishment of discrete equations; solution of algebraic equations; • Numerical solution of unsteady heat conduction problems. **Chapter 5** Heat Convection (12 contact hours; 10 self-study hours) • 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;** • Comparison between momentum transfer and heat transfer, application of similarity theory in convective heat transfer; • Forced convection heat transfer tube characteristic and experimental type;** • Flow around single tube and tube bundle heat release and relations, large space free convection and limited space free convection. **Chapter 6** Boiling and Condensation Heat Transfer (4 contact hours; 4 self-study hours) • Dropwise condensation and film condensation; film condensation heat transfer analysis and experimental correlation, affecting factors of film condensation; • Large container saturated boiling curve, calculation of nucleate boiling, factors affecting boiling heat transfer. **Chapter 7** Basic Law of Radiation and Object Radiation Characteristics (10 contact hours; 8 self-study hours) • 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;** • 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.* **Chapter 8** Calculation of Radiation Heat Transfer (8 contact hours; 8 self-study hours) • Angular coefficient; radiation heat transfer between two solid surfaces separated by heating medium;** • Calculation of radiation heat transfer surface system, network method, radiation heat hardening and weakening; heat shield plate; gas radiation. **Chapter 9** Analysis of Heat Transfer Process and Calculation of Heat Exchanger (8 contact hours; 8 self-study hours) • Composite heat transfer and combined heat transfer surface heat transfer coefficient; • Heat transfer process and calculation of heat transfer coefficient; critical insulation diameter, average

	temperature in the pattern of the heat exchanger and logarithmic pressure;** • Heat calculation of heat exchanger, -NTU method; teat transfer enhancement and insulation technology. **Part B Experiment / practice teaching** (12 experiment hours; 10 self-study hours) 1) Heat conduction experiment: master affecting factors of conduction process; familiar with measurement method of each parameter; 2) Convection heat transfer experiment; master convection process; familiar with testing method of each parameter; 3) Radiation heat transfer experiment: master affecting factors of radiation heat transfer process; familiar with testing method of each parameter. **Part C Computer practice** (12 contact hours; 10 self-study hours) 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
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 [1] YANG Shiming, TAO Wenquan. *Heat Transfer* (4th edition). Beijing: Higher Education Press, 2006. 2. Reference books (English reference books required) [1] YANG Shiming, TAO Wenquan. *Heat Transfer* (3rd edition). Beijing: Higher Education Press, 1988. [2] J.P. Holman. *Heat Transfer*, Seventh. 9th Ed McGraw-Hill New York1999. [3] XIE Shuyi. Vector *Analysis and Field Theory (2nd edition)*. Beijing: Higher Education Press, 1987. [4] TAO Wenquan. *Numerical Heat Transfer*. Xian: Xian Jiaotong University Press, 1988. 3. Experiment/computer practice instruction books [1] Self-compiled teaching materials 4. Other materials

	[**1]** PPT courseware (self-compiled) [**2]** Supplementary heat transfer teaching materials (self-compiled)

Engineering Applications

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	4th semester
Person responsible for the module	Professor CUI Guomin
Lecturer	Professor TAO Leren Processor ZHANG Lixin Lecturer HUANG Xiuhui Lecturer ZHANG Guanhua
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 Renewable Energy Engineering program, realization of automatic operation, optimization and monitoring of power equipments, and develop related scientific experimental research.
Type of teaching, contact hours	Target students: sophomores of energy and power engineering related programs Type of teaching: theoretical teaching, experiment teaching Theoretical teaching: 56 hours Experiment / practice teaching: 8 hours Computer practice: 0 hour Size of class: No more than 60 people for theoretical teaching; no more than 5 people in each group for experiment.
Workload	Workload= 120 hours Contact hours = 64 hours Self-study hours = 56 hours

Credit points	4.0
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**:** Measurement and Control Technology of Power Engineering is a specialized course offered to undergraduates of Renewable Energy Engineering program. With a focus on tmeasurement 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: • **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. • **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. • **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** (56 contact hours; 48 self-study hours) **Chapter 1** Overview (2 contact hours; 2 self-study hours) **Chapter 2** Error Theory and Data Processing (14 contact hours; 12 self-study hours) • Random Error; Systematic Error; Gross Error;** • Error Representation; • Analysis of Measurement Uncertainty (Direct and Indirect Measurement);* • Data Processing of Combined Measurement.

	Chapter 3 Measurement Technology of Power Engineering Basic Quantity and Thermal Instrument (14 contact hours; 12 self-study hours) • Characteristics of Measurement System;** • Temperature Measurement and Instrument;* • Pressure and Speed Measurement and Instrument;* • Flow Measurement and Instrument.* **Chapter 4** Fundamentals of Automatic Control (14 contact hours; 12 self-study hours) • Automatic Control Principle;** • Simple Control System;* • Computer Control System; **Chapter 5** Modern Measurement and Control Technology (12 contact hours; 10 self-study hours) • Modern Measurement and Control System; • Measurement and Control System Design;* • Interference and Suppression Method for Measurement and Control System. **Part B Experiment / practice teaching** (8 experiment hours; 8 self-study hours) 1) I/O channel interface experiment; master exchanging external signals with internal signals of computer; master concept of CAS interface address. 2) 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) 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. 4) 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. **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	5 assignments and 1 final exam; usual performance and attendance account for 30% of final score; final exam accounts for 70%; final exam is closed book written examination
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 [1] ZHANG Yingxin et al. *Fundamentals of Non-electricity Measurement Technology* (1st edition), Beihang University Press, 2002.2 2. Reference books [1] ZHAO Qingguo, CHEN Yongchang, XIA Guodong. *Thermal energy and power engineering Measurement Technology* (1st edition), Chemistry Industry Press, 2006.6 [2] ZHANG Hongjian, MENG Jianbo. *Automatic Detection Technology and Equipment (1st edition)*, Chemistry Industry Press, 2004.7 [3] YE Dajun. *Thermal Machinery Testing Technology*, Machinery Industry Press, 1981 [4] MAN Hong, LIANG Yingchun et al. *Automatic Control Principle*, Tsing Hua University Press [5] *Advances In Automatic Control*, MihailVoicu, Massachusetts: Kluwer Acadamic Publishers, 2004 [6] Temperature Measurement and Control, J.R. Leigh, London: Peter Peregrinus Ltd., 1988 3. Other materials [1] PPT courseware (self-compiled) [2] Power engineering CAE experiment instruction books (school handout)

Pumps and Fans

Competence field	Engineering Applications
Module designation	Pumps and Fans
Code, if applicable	11000020
Subtitle, if applicable	
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Professor LI Chun
Lecturer	Professor LI Chun Professor YU Xiaoming, Associate Professor YE Zhou Associate Professor WANG Qikun
Language	Chinese
Relation to curriculum	Pumps and Fans is an Engineering Applications module, which is associated with all industries of Energy and Power Engineering; therefore, all courses involving power cycle equipment of this program require theoretical support from this course. It is a course for undergraduates of Power Engineering and Renewable Energy Engineering programs. With focus on basic principles, performance, structure, operation regulation and measurement technology of pumps and fans, this course presents engineering application and system optimization knowledge for pumps and fans related courses and Practice Training. The course provides basic knowledge for the following courses: Power-Saving Technology, Thermal Power Plants, Thermodynamic Equipment and System Optimization, Wind Power Generation Technology and Combined-Cycle System.
Type of teaching, contact hours	Target students: juniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching, experiment Contact hours: 64 hours Of which, Theoretical teaching: 60 hours Experiment / practice teaching: 4 hours Computer practice: 0 hour Size of class: No more than 60 students for theoretical teaching
Workload	Workload= 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
Requirements according to the	Complete the following before taking exam. The score is

examination regulations	calculated into usual performance: 1. Water pump performance test experiment; fan performance test experiment; 2. Attendance rate exceed 2/3 of contact hours of theoretical teaching; 3. Assignment completions exceed 2/3 of total amount.
Recommended prerequisites	Engineering Fluid Mechanics; Engineering Thermodynamics
Module objectives/intended learning outcomes	Module objectives: • **Knowledge:** Working principles of common pumps and fans (blade type, volume type) and main parameter definition of pumps and fans; development trend of pumps and fans and their application area; components and functions of pumps and fans; typical structure and characteristics of power type pumps and fans; energy equation (Euler's formula) and its derivation and analysis; head calculation formula and slip factor for finite blade impeller theory; concepts and calculation formula of power, loss and efficiency; performance curve and its analysis of centrifugal pumps and fans; difference between performance curve of axle-flow type pumps and fans and centrifugal pumps and fans; testing method for performance curve; similarity conditions; similarity theory; similarity law; concepts and calculation formula for specific speed; application of specific speed and its impact on performance curve of pumps and fans; concepts of cavitation, vibration and noise and their impact on working of pumps and fans; methods for cavitation prevention, vibration weakening and noise reduction; pipeline characteristics curve and concepts of working point; selection of working mode of pumps and fans; regulation method for operating conditions; causes for major operation problems and solution. • **Skills:** Be able to analyze the impact of flow and geometric parameter on performance of pumps and fans, conduct test of performance of pumps and fans and draw performance curve, correctly select model of pumps and fans and working mode, master regulation method for pumps and fans operation, analyze causes for operation failure of pumps and fans, take correct technical measures to conduct troubleshooting. • **Competences:** Improve abilities in shifting from

	natural phenomena to physical and mathematical model; improve operation and engineer application ability; enhance system optimization and analysis ability so as to lay a foundation for future professional work and scientific research.
Content	**Part A Theoretical teaching** (60 contact hours; 52 self-study hours) **Chapter 1** Introduction (4 contact hours; 2 self-study hours) • Classification of pumps and fans; • Development trend and application area of pumps and fans. **Chapter 2** Structure of Pumps and Fans (4 contact hours; 2 self-study hours) • Functions and types of major components of pumps and fans;** • Typical structure and characteristics of power type pumps and fans.** **Chapter 3** Blade Theory of Pumps and Fans (16 contact hours; 14 self-study hours) • Fluid motion analysis of pumps and fans;* • Blade Theory of centrifugal pumps and fans;** • Blade Theory of axial-flow type pumps and fans.** **Chapter 4** Performance of Pumps and Fans (10 contact hours; 10 self-study hours) • Power, loss and efficiency of pumps and fans;* • Performance curve and analysis of pumps and fans.** **Chapter 5** Application of Similarity Theory in Pumps and Fans (10 contact hours; 10 self-study hours) • Similarity law of pumps and fans;* • Application of specific speed and its impact on performance of pumps and fans.** **Chapter 6** Pump Cavitation (8 contact hours; 8 self-study hours) • Pump cavitation phenomenon and its harm; • Geometric installation height of pump and suction vacuum;* • NPSH of pump and cavitation similarity law;* • Measurements for improving pump anti-cavitation ability. **Chapter 7** Operation Regulation of Pumps and Fans (8 contact hours; 8 self-study hours) • Characteristic curve of pipeline and operating point;* • Joint working of pumps and fans;*

	• Adjustment of operating conditions;* • Problems in operation. **Part B Experiment / practice teaching** (4 contact hours; 4 self-study hours) 1) Water pump performance test experiment; 2) Fan performance test experiment**.** **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Closed book written examination. Final score is composed of usual performance (30%) and final exam (70%)
Media employed	Final score is based on usual performance and final exam. Usual performance (attendance; assignment; classroom performance) (30%); final exam (oral exam) (70%) The form of final exam is oral exam or closed book written examination, which accounts for 70% of the final score.
Reading list	1. Required books [1] GUO Lijun, HE Chuan. *Pumps and Fans* (4th edition), (textbooks of 10th 5-year plan for higher learning), China Electric Power Press, 2004.8 2. Reference books [1] YANG Shicheng, WANG Xikui. *Pumps and Fans* (3rd edition), China Electric Power Press, 20074.1 [2] SHA Yi, WEN Jianlong. *Pumps and Fans*, University of Science and Technology of China, 2005.8 [3] ZHENG Menghai, *Pump Testing Technology*, Machinery Industry Press, 2006.7 3. Experiment/computer practice instruction books [1] Self-compiled teaching materials 4. Other materials [1] PPT courseware (self-compiled)

Thermal Engineering

Competence field	Engineering Applications
Module designation	Thermal Engineering
Code, if applicable	11001560
Subtitle, if applicable	
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Professor LU Mei
Lecturer	Professor LU Mei Professor LI Ling Associate Professor WANG Zilong Lecturer HAO Xiaohong Lecturer ZHANG Guanhua
Language	Chinese
Relation to curriculum	Thermal Engineering is an important specialized course offered to undergraduates of Renewable Energy Engineering program. It focuses on the study on basic laws of thermal energy application, heat transfer laws and reasonable application of energy. By using knowledge of Engineering Thermodynamics, Heat Transfer and Engineering Fluid Mechanics, the course is designed to analyze the basic principles of common power engineering related thermal equipments (such as steam power equipment and heat exchanger etc.) and conduct simple verification and design calculation. It aims to develop students' abilities in solving design and manufacturing problems connected with common thermal equipments in energy and power engineering field, and lay a foundation for equipment design, model selection and system operation of follow-up courses (such as Thermodynamic Equipment and System Optimization, Principles and Design of Heat Exchanger, Principles and Equipment of Refrigeration).
Type of teaching, contact hours	Target students: juniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching, computer practice Contact hours: 64 hours Of which, Theoretical teaching: 54 hours Experiment / practice teaching: 0 hour Computer practice: 10 hour Size of class: No more than 60 students for theoretical teaching; no more than 60 students for computer practice

Workload	Workload= 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
Requirements according to the examination regulations	class attendance rate over 2/3, usual performance meet requirement
Recommended prerequisites	Engineering Thermodynamics; Engineering Fluid Mechanics
Module objectives/intended learning outcomes	Module objectives: Thermal Engineering is an important specialized course offered to juniors of Renewable Energy Engineering program. It is designed to study basic laws of thermal energy application, heat transfer laws and reasonable application of energy. It focuses on study of thermodynamics laws, understanding Energy conservation and energy quality, analysis of heat efficiency of general thermal equipments with relationship between work and heat by using thermodynamics laws, so as to lay a foundation for follow-up courses. • **Knowledge:** Master first and second law of thermodynamics; master basic concepts of heat transfer (including heat conduction, convection and radiation) and simple calculation; understand principles of common thermal equipment such as heat exchanger, steam power device, internal-combustion engine and refrigeration device etc. • **Skills:** Understand Energy conservation and energy quality, calculate relationship between work and heat transfer by using thermodynamics laws, analyze heat efficiency of common thermal equipment (such as steam power device, internal-combustion engine and refrigeration device and heat exchanger); understand basic concepts and calculation methods of Heat Transfer, check and calculate simple problems of common thermal equipment (such as heat exchanger, steam power device and refrigeration device) • **Competences:** On the basis of thermal engineering knowledge, students are able to understand methods for improving heat efficiency of common thermal equipment; be able to analyze and calculate simple engineering problems; develop students abilities in analyze, solve and grasp gist of problems, lay a foundation for equipment design model selection and system operation of follow-up advanced courses.
Content	**Part A Theoretical teaching** (54 contact hours; 48 self-

	study hours) **Chapter 1** Basic Concepts of Thermodynamics (2 contact hours; 2 self-study hours) • Conversion process between heat energy and mechanical energy;* • Thermodynamic system;* • Thermodynamic state and state parameters of working medium.** **Chapter 2** First Law of Thermodynamics (2 contact hours; 2 self-study hours) • Essence of the first law of thermodynamics;* • Energy transfer and conversion;* • Energy equation of closed system;** • Steady flow energy equation and examples of application. **Chapter 3** Ideal Gas and Steam Properties (2 contact hours; 2 self-study hours) • Ideal gas and state equation;** • Calculation formula of specific heat capacity, thermal energy, enthalpy and entropy of ideal gas;* • Thermodynamic processes and polytropic process of ideal gas.* **Chapter 4** Second Law of Thermodynamics (4 contact hours; 2 self-study hours) • Expression of second Law of thermodynamics;* • Carnot cycle and Carnot theorem;* • Leading-out of entropy and entropy equation;** • Principle of entropy increase of isolated system.* **Chapter 5** Steam, Mixed Gas and Wet Air (2 contact hours; 2 self-study hours) • Thermodynamic properties and chart of steam; • Parameter calculation of thermodynamic state of ideal gas mixture; • State parameter of wet air; • Enthalpy humidity chart and application of wet air. **Chapter 6** Flow of Gas and Steam (2 contact hours; 2 self-study hours) • Basic equation of steady flow;** • Conditions for flow rate changes in nozzle; • Adiabatic throttle.** **Chapter 7** Basic Concepts of Heat Transfer (2 contact hours; 2 self-study hours)

	• Subjects and tasks of Heat Transfer; • Three basic ways of heat transfer; • Heat transfer process and heat resistance. **Chapter 8** Heat Conduction (4 contact hours; 4 self-study hours) • Basic concepts of heat conduction;** • Fourier law and heat conduction coefficient;** • Heat conduction through plane wall;** • Heat conduction through cylinder wall;* • Basic concepts of non-steady heat conduction and lumped parameter method. **Chapter 9** Heat Convection (4 contact hours; 4 self-study hours) • Basic concepts of heat convection- Newton's formula;** • Factors affecting heat convection coefficient; • Concepts of speed boundary layer and thermal boundary layer; • Characteristics and experimental correlation of tube forced convection heat transfer;** • Flow around single tube and heat transfer of tube bundle and correlation; • Characteristics of condensation and boiling heat transfer.* **Chapter 10** Radiation Heat Transfer (4 contact hours; 4 self-study hours) • Basic concepts of radiation;** • Basic law for black body radiation;* • Basic law for gray body radiation;* • Radiation heat transfer calculation of gray body surface between angle coefficient and closed space.* **Chapter 11** Heat Transfer Process and Heat Exchanger (4 contact hours; 4 self-study hours) • Heat transfer process; • Intensifying and weakening of heat transfer;* • Classification of heat exchanger;* • Calculation of heat exchanger.** **Chapter 12** Boiler Equipment (6 contact hours; 6 self-study hours) • Composition of boiler equipment;* • Working process and properties of boiler;* • Boiler fuel and burning; • Introduction of classification and layer combustion

	furnace and chamber combustion furnace of boiler; • Boiler form -steam boiler, hot water boiler, waste heat boiler; • Auxiliary heating surface-superheater, economizer, air preheater; • Loss of boiler heat and ways of reduction of heat loss; • Boiler ventilation, smoke purification and water treatment; **Chapter 13** Steam Power Device (4 contact hours; 4 self-study hours) • Influence of Rankine cycle and steam parameter on cycle heat efficiency;** • Heatexchange cycle, reheat cycle and cogeneration cycle;* • Steam power device;* • Working principle of steam turbine and condensing equipment. **Chapter 14** Gas Power Device (6 contact hours; 6 self-study hours) • Classification of internal-combustion engine;* • Basic structure of internal-combustion engine; • Working principle of four-stroke internal-combustion engine and thermal cycle;* • Performance index and load bearing characteristics of internal-combustion engine;* • Heat balance of internal-combustion engine; • Introduction of gas turbine device and gas turbine cycle. **Chapter 15** Air Compressor and Refrigeration Device Cycle (6 contact hours; 5 self-study hours) • Application and classification of air-compressor; • Basic working principle and structure of air-compressor;* • Working process of single piston type air-compressor;* • Power and efficiency of piston type air-compressor;** • Application and classification of refrigeration device;* • Steam compression type refrigeration cycle and heat calculation.** **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (10 contact hours; 8 self-study hours) 1) Heat exchanger design calculation and verification computation by using computer. 2) Calculation of two steam power cycle problems by using

	computer.
Study and examination requirements and forms of examination	Usual performance accounts for 30% of final score (2 computer assignments accounting for 10%); usual performance (20%); final exam (closed book written examination) (70%).
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks.
Reading list	1. Required books [1] *Thermal Engineering*, CHEN Yi, WU Weilong. Higher Education Press, 2004 2. Reference books [1] *Thermal Engineering*, JIANG Hanwen. Higher Education Press [2] M.M. Rathore, *Thermal Engineering*,Tata McGraw-Hill, New Delhi,2010 [3] *Fundamentals of Thermal Engineering*, ZHANG Xuexue et al. Higher Education Press [4] *Fundamentals of Thermal Engineering*, TONG Jungeng, LU Wanchen. Shanghai Jiaotong University Press [5] *Fundamentals of Thermal Engineering Theory*, HAO Yufu et al. Higher Education Press 3. Other materials [1] PPT courseware (self-compiled) [2] Computer practice instruction books (self-compiled)

Energy Management

Competence field	Engineering Applications
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	Associate Professor GUAN Xin
Lecturer	Professor DOU Binlin Associate Professor XIE Yingming Associate Professor MEN Chuanling Associate Professor WANG Zilong Lecturer WEN Zhenzhong Lecturer HUANG 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: juniors of energy and power engineering related programs Type of teaching: theoretical teaching Theoretical teaching: 64 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: No more than 50 students for theoretical teaching
Workload	Workload= 120 hours Contact hours = 64 hours 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 are allowed to take the exam.
Recommended prerequisites	Thermal Engineering; Fundamentals of New Energy Theory;

	Heat Transfer
Module objectives/intended learning outcomes	Module objectives: The task of this course is to enable students to understand energy management and basic theories through teaching. Specific objectives include: • **Knowledge:** Master basic knowledge of energy management, the energy balance of the enterprise and equipment, energy audit, energy system analysis theory, energy system network, input and output analysis, linear programming and optimizing, energy demand forecasting theory of social economy, economic laws of energy engineering and so on • **Skills:** Students acquire basic theoretical and specialized knowledge about energy technology; understand how to make decision of best energy technology solution; acquire deep understanding of the energy situation; be able to analyze the reasonable relationship between 3E (Energy/Economy/Ecology) and solve most problems of them. • **Competences:** Students acquire abilities and innovative thinking of energy technology, energy management and related energy policy research.
Content	**Part A Theoretical teaching** (64 contact hours; 56 self-study hours) **Chapter 1** Introduction (2 contact hours; 2 self-study hours) • Classification and evaluation of the energy; • Energy and human civilization; • Energy situation of world and China; • Energy and the environment; • Energy development strategy. **Chapter 2** Energy Conversion and Utilization (10 contact hours; 10 self-study hours) • The basic principle of energy conversion;* • Energy conversion process;** • New energy power generation technology;* • Energy problem solving method;* • Energy system analysis---Exergie analysis.** **Chapter 3** Energy Saving Technology (10 contact hours; 10 self-study hours) • The use of surplus energy;* • Cascade utilization of thermal energy;** • New technology of waste heat using;** • Energy balance of enterprise management;*

	• Contract energy management;* • Enterprise energy audit.* **Chapter 4** Introduction to Modern Business Management (8 contact hours; 8 self-study hours) • Formation and development of management science; • Concept and functions of management;** • Management of the electric power enterprise;* • Marketing management; • Total quality management;** • Technology innovation and industrial property rights. **Chapter 5** Economic Analysis (10 contact hours; 8 self-study hours) • Time value of money; • Time value of money calculation method;** • Nominal interest rate and real interest rates.* **Chapter 6** Evaluation Principle of Project Economic Benefit (8 contact hours; 6 self-study hours) • Engineering construction project economic evaluation method;* • Economic benefit evaluation of mutually exclusive solution;** • Economic benefit evaluation of non-exclusive solution. **Chapter 7** Depreciation of Fixed Assets and Replacement Decisions (6 contact hours; 6 self-study hours) • Depreciation of fixed assets; • Method of depreciation of the fixed asset;** • Method of replacement decisions.* **Chapter 8** Uncertainty Analysis (6 contact hours; 4 self-study hours) • Break-even analysis;** • Sensitivity analysis;** • Risk analysis.* **Chapter 9** Project Feasibility Study (4 contact hours; 2 self-study hours) • Basis of project construction and market forecast;* • Technical solutions, equipment and engineering solutions; • Investment and cost estimation;* • Environmental assessment of the project; • Feasibility planning outline.* **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination	Final score includes: usual performance (30%); final exam

requirements and forms of examination	(open-book written examination) (70%) Usual performance includes: assignment, attendance rate.
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks
Reading list	1. Required books [1] REN Youzhong. *Energy Engineering Management*. Beijing: China Electric Power Press, 2007 2. Reference books [1] *Petroleum and Chemical Industry Energy Manager Tutorial.* Beijing: Chemical Industry Press, 2007 [2] LONG Minxian, *et al*. *Energy Engineering Management. Guangzhou: South China University of Technology Press, 2000* [3] TANG Xuezhong. *Heat Energy Eonversion and Utilization.* Beijing: Metallurgical Industry Press, 1989 3. Other materials [1] PPT courseware (self-compiled)

Principles and Design of Heat Exchanger

Competence field	Engineering Applications
Module designation	Principles and Design of Heat Exchanger
Code, if applicable	11001600
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Professor CUI Xiaoyu
Lecturer	Professor CUI Xiaoyu Associate Professor XU Hongtao Associate Professor GUAN Xin Associate Professor LI Kequn Associate Professor XIE Yingming Associate Professor ZHAO Bingtao
Language	Chinese / English
Relation to curriculum	As a key course offered by Renewable Energy Engineering program, Principles and Design of Heat Exchanger is composed of two parts. Part one, based on thermal calculation and with heat exchanger as the subject, focuses on the study of working principles of three major types of heat exchange, i.e. wall type, mixed type and regenerative type, as well as heat transfer calculation, structure calculation and flow resistance calculation and design procedure. Part two is designed to adapt to the rapid development of thermal design/analysis technology of modern electrical equipment. It mainly introduces electronic components and equipment and thermal design/analysis technology of system as well as related theories. Heat exchanger is widely used in industrial fields such as energy, power, and machinery, chemical industry, heating ventilation and air-conditioning engineering. This course lays a theoretical foundation for further study of courses such as Thermal Power Plant, Combined Cycle System, Thermal Equipment and System Optimization. It also helps develop abilities in future technical work such as heat transfer, heat exchanger equipment and engineering thermal analysis.
Type of teaching, contact hours	Target students: juniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching Contact hours: 64 hours Of which, Theoretical teaching: 64 hours Experiment / practice teaching: 0 hour

	Computer practice: 0 hour Size of class: No more than 60 students for theoretical teaching
Workload	Workload= 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and having passed Students Project exam are allowed to take the exam.
Recommended prerequisites	Heat Transfer; Engineering Thermodynamics; Fluid Mechanics; Thermal Engineering; Pumps and Fans
Module objectives/intended learning outcomes	Module objectives: Principles and Design of Heat Exchanger is a course offered for juniors of Renewable Energy Engineering program. Its subject is the heat exchange device used in engineering work. Students are expected to learn working principles of heat exchange device, heat transfer calculation, structure calculation and flow resistance calculation and procedure design, experimental methods, methods of enhanced heat transfer, optimization design and performance evaluation. The course also introduces heat transfer related problems during engineering work, including electronic components and equipment and thermal design/analysis technology. Specific objectives include: • **Knowledge:** Structure, working characteristics and heat transfer calculation of all types of heat exchanger; performance experiment of heat exchanger; intensification of heat transfer, performance evaluation and optimization method; electronic components and equipment and thermal design/analysis technology of system as well as related theories. • **Skills:** Master basic principles, design ideas and methods of heat exchange device; enhanced heat transfer methods; theories about thermal analysis/design of engineering equipment. • **Competences:** With the acquired knowledge and abilities, students may engage in work relating to energy, power, machinery, chemical industry, heating ventilation and air-conditioning engineering in the future. Students acquire knowledge and abilities in technical work relating to heat transfer, heat exchange device and engineering thermal analysis. Students are

	able to solve real engineering problems and conduct scientific research.
Content	**Part A Theoretical teaching** (64 contact hours; 56 self-study hours) **Chapter 1** Introduction (2 contact hours; 2 self-study hour) • Introduce the importance, classification and design calculation of heat exchanger. **Chapter 2** Basic Principles (6 contact hours; 4 self-study hours) • Basic equation of thermal calculation;** • Calculation of mean temperature difference;** • Definition of heat transfer efficiency; • Heat transfer efficiency of different flow modes;* • Selection of fluid flow mode. **Chapter 3** Shell-and-tube Type Heat Exchanger (12 contact hours; 10 self-study hours) • Types/standard/structure of shell-and-tube type heat exchanger; • Strucutural calculation of shell-and-tube type heat exchanger; • Heat transfer calculation of shell-and-tube type heat exchanger;** • Flow resistance calculation of shell-and-tube type heat exchanger;* • Rational design and calculation of shell-and-tube type heat exchanger; • Design procedure of shell-and-tube type heat exchanger; • Working characteristics of condenser and evaporator; • Introduction of high/low temperature heat exchanger. **Chapter 4** High Efficient Enclosing Wall Type Heat Exchanger (10 contact hours; 10 self-study hours) • Basic structure/working principles/design calculation of spiral type heat exchanger; structure/working principles of plate type heat exchanger, process combination;** • Heat transfer and pressure reduction calculation;* • Thermal calculation proceduer design of plate type heat exchanger;* • Structure/working principles/design calculation of plate fin type heat exchanger;* • Structure/working principles/type selection of finned tube heat exchanger;

	• Heat transfer and resistance calculation, design of air cooler. **Chapter 5** Direct Contact Heat Exchanger and Regenerative Heat Exchanger (8 contact hours; 6 self-study hours) • Types/structure/working principles of cooling column;* • Thermal calculation of cooling column; ventilation resistance calculation and design calculation; general problems of spray type heat exchanger;** • Working principles of steam-water injection heat exchanger and water-water injection heat exchanger; mixing condenser; • Structure/working principles of rotary type & valve switching type regenerative heat exchanger; • Comparison between regenerative heat exchanger and enclosing wall type heat exchanger;* • Thermal design calculation of regenerative heat exchanger. **Chapter 6** Site Visit of Heat Exchanger and Model(2 contact hours, 2 self-study hour) **Chapter 7** Performance Experiment of Heat Exchanger and Enhanced Heat Exchange (4 contact hours; 2 self-study hours) • Determination of heat transfer coefficient and convective heat exchange coefficient;** • Resistance properties experiment;* • Basic ways of enhanced heat exchange. **Chapter 8** Requirements and Methods for Equipment Thermal Design & Selection of Cooling Method (4 contact hours; 4 self-study hours) • Introduction of optimization design of heat exchanger; • Heat transfer intensification/scaling/corrosion; • Methods for heat transfer enhancement;* • Selection of cooling method. **Chapter 9** Equipment Natural Cooling Design; Fin Type Radiator (6 contact hours; 6 self-study hours) • Radiation cooling of electronic device;* • Phase changing cooling of electronic device; fin type radiator.* **Chapter 10** Heat Pipe Radiator/Thermoelectric Refrigeration/New Development of Thermal Analysis Technology (6 contact hours; 6 self-study hours) • Structure and working characteristics of heat pipe;

	• Heat transfer and flow resistance calculation of heat pipe; work safety check and thermal design;* • Principles of thermoelectric refrigerator; • New development of thermal analysis technology. **Chapter 11** Evaluation and Improvement of Thermal Performance; Computer Aided Thermal Analysis Technology and Design Case (4 contact hours; 4 self-study hours) • Single performance evaluation method for heat exchanger; • Heat transfer quantity and flow resistance loss combined thermal performance evaluation;** • Entropy analysis method; exergy analysis method;* • Thermal performance evaluation of heat exchanger with enforced heat transfer surface-longitudinal comparison method; • Thermal economics analysis method; computer aided thermal analysis technology and design case. **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	2 Students Project, 2 assignments and 1 final exam. Usual performance accounts for 30% of final score; final exam accounts for 70%; final exam is closed book written examination
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks, teachers pointer
Reading list	1. Required books [1] *Principles and Design of Heat Exchanger*. SHI Meizhong, WANG Zhongzheng. Southeast University Press, 2003 [2] *Thermal Design and Analysis Technology of Electronic Equipment* (2nd edition). YU Jianzu. Beijing University of Aeronautics and Astronautics Press, 2008 2. Reference books: [1] *Principles and Calculation of Heat Exchanger*, ZHU Pinguan. Tsinghua University Press, 1987 [2] *Design Manual of Heat Exchanger,* QIAN Songwen. Chemistry Industry Press, 2002 [3] *Principles. Structure. Design of Heat Exchanger.* QIU Shulin, QIAN Binjiang. Shanghai Jiaotong University Press, 1990

	[4] *Thermal Design of Electronic Equipment*. XIE Deren. Southeast University Press, 1989 [5] *Reinforced Heat Transfer and Engineering Application* (1st edition). LIN Zonghu. Machinery Industry Press, 1987 [6] *Heat Exchanger Sourcebook*. Palen J W (ed.), Washington: Hemisphere Publishing Cor., 1986 [7] *Compact Heat Exchangers*, Kays W M and London A L., McGraw-Hill, New York, 1984 3. Other materials [1] PPT courseware (self-compiled) [2] Instruction books for Students Project (self-compiled)

Power-Saving Technology

Competence field	Engineering Applications
Module designation	Power-Saving Technology
Code, if applicable	11000590
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Professor LIU Jianhua
Lecturer	Professor LIU Jianhua Professor CUI Guomin Professor DOU Binlin Associate Professor FAN Fengxian Associate Professor XIE Yingming Associate Professor LIU Yefeng Associate Professor WANG Zilong Lecturer HUANG Xiuhui
Language	Chinese & English
Relation to curriculum	Power-Saving Technology is a course offered to seniors of Renewable Energy Engineering program. After studying Heat Transfer, Engineering Fluid Mechanics, Engineering Thermodynamics, Principles and Design of Heat Exchanger, students can study energy-saving methods, exergy efficiency and exergy loss coefficient, general energy-saving technology, waste heat utilization and recovery, energy-saving measures for thermal system of power plant, ways of energy loss during energy conversion/utilization process and ways of loss reduction for energy-saving perspective. As a link between theoretical study and practical work, the course is an important way of cultivating students' abilities in analyzing and solving product energy-saving problems. It lays a foundation for follow-up courses including Professional Comprehensive Course Design, Internship and Bachelor Thesis.
Type of teaching, contact hours	Target students: seniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching Contact hours: 64 hours Of which, Theoretical teaching: 64 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: No more than 60 students for theoretical teaching

Workload	Workload= 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
Requirements according to the examination regulations	Only students with class attendance rate over 2/3 and having passed quiz of each chapter are allowed to take the exam (closed book written exam)
Recommended prerequisites	Engineering Thermodynamics; Engineering Fluid Mechanics; Heat Transfer; Thermal Engineering; Energy Management; Principles and Design of Heat Exchanger
Module objectives/intended learning outcomes	Module objectives: • **Knowledge:** Basic energy-saving technology; basic technology in thermal power generation and heating (such as heat and power cogeneration, gas and steam combined cycle and heat pump heating etc.); energy saving technology for thermal power generation and heating (such as energy-saving theory for thermal system of power plant, heat pipe technology, energy-saving technology for pumps and fans etc.) • **Skills:** Master energy-saving methods for thermal power generation and heating and development status of new energy; basic principles for energy-saving; energy conversion process; energy transfer process and energy-saving technology for energy utilization process. • **Competences:** Students can acquire understanding of thermodynamic principles of energy-saving, including exergy, exergy calculation for energy, exergy loss and exergy calculation equation, exergy efficiency and exergy loss coefficient of device. Students learn how to reduce system exergy loss by studying system thermodynamic parameter and thermal load.
Content	**Part A Theoretical teaching** (64 contact hours; 56 self-study hours) **Chapter 1** Introduction (4 contact hours; 2 self-study hours) • World and China's energy consumption and resource status; • Development of new energy and energy strategy of China; • Energy saving potential analysis;* • Significance and ways of energy saving;* **Chapter 2** Thermodynamics Principles of Energy Saving

	(10 contact hours; 8 self-study hours) • Basic concepts; • First law of energy and thermodynamics; • Second law of exergy and thermodynamics;** • Exergy calculation of energy;* • Exergy loss and exergy balance equation; • Device exergy efficiency and exergy loss coefficient;* • New development of energy saving theory. **Chapter 3** Universal Energy Saving Technology (6 contact hours; 6 self-study hours) • Heat insulation technology;* • Energy storage technology; • Combustion energy-saving technology. **Chapter 4** Utilization of Waste Heat and Cold Energy Recovery (8 contact hours; 6 self-study hours) • Introduction; • Waste heat calculation;** • Waste heat utilization principles;** • Methods and application examples of use of preheating; • Cold recovery and liquefied natural gas. **Chapter 5** Energy Saving Theory of Power Plant Thermal system (8 contact hours; 6 self-study hours) • Condensing unit equivalent heat drop theory;** • Energy saving theory of reheat unit thermal system;** • Heating unit equivalent heat drop theory;* • Cogeneration and energy saving technology. **Chapter 6** Heat Pipe and Heat Pipe Heat Exchanger (8 contact hours; 8 self-study hours) • Working principles of heat pipe; characteristics of different type of heat pipe;** • Heat pipe cyclic driving power, heat transfer thermal resistance and heat transfer limit;** • Characteristics and application of heat pipe heat exchanger. **Chapter 7** Heat Pump Technology (8 contact hours; 8 self-study hours) • Basic knowledge of heat pump, including classification of heat pump, basic types of common heat pump system and economic indicators of heat pump; • Heat pump principles and theoretic cycle;** • Heat pump refrigerants and main equipment.* **Chapter 8** Fan and Energy Saving of Water Pump (6 contact hours; 6 self-study hours)

	• Working principles of fan and pump; master its performance curve; • Energy saving control method of fan and pump. **Chapter 9** Enterprise Energy Saving (6 contact hours; 6 self-study hours) • Energy management and energy balance of enterprises; • Enterprise energy saving. **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score is based on usual performance and final exam. Usual performance is based on attendance, assignment and classroom performance and accounts for 30% of final score; final exam is presentation and accounts for 70% of final score.
Media employed	Blackboard and multi-media teaching combined
Reading list	1. Required books [1] LI Chongxiang. *Energy Saving Principle and Technology*. Xian, Xian Jiaotong University Press, 2004 2. Reference books [1] LIN Wanchao. *Energy Saving Principles of Heat-engine Plant Heat System*, Xian, Xian Jiaotong University Press, 1994 [2] ZHOU Hongchang, *Energy and Energy Saving Technology*, Shanghai, Tongji University Press, 1996 [3] HUANG Suyi, *Energy and Energy Saving Technology*, Beijing: China Electric Power Press, 2004 [4] LIN Zonghu, *Enhanced Heat Transfer Technology*, Beijing: Chemistry Industry Press, 2007 3. Other materials [1] PPT courseware (self-compiled)

Biomass Conversion and Utilization

Competence field	Engineering Applications
Module designation	Biomass Conversion and Utilization
Code, if applicable	11001770
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate Professor ZHAO Bingtao
Lecturer	Professor CUI Guomin Professor DOU Binlin Associate Professor GUAN Xin Lecturer WEN Zhenzhong Lecturer HAO Xiaohong
Language	Chinese
Relation to curriculum	Biomass Conversion and Utilization is an engineering application course for undergraduates of Renewable Energy Engineering program. It provides comprehensive knowledge of engineering systems that including converting agricultural crops and residues into bioenergy and bio-based products. Technologies such as pre-treatment, thermal, chemical and biochemical methods for converting biomass into gas or liquid products will be discussed in this course. The course will demonstrate the latest biomass characterization techniques, discuss the process of bio-chemical and thermo-chemical types, explain the development of integrated biorefineries, describe how to mitigate the environmental risks when using biomass fuels and introduce many pilot-scale projects and industrial examples.
Type of teaching, contact hours	Target students: juniors of Renewable Energy Engineering program. Type of teaching: theoretical teaching Contact hours: 64 hours Of which Theoretical teaching: 64 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: No more than 50 students for theoretical teaching
Workload	Workload= 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
Requirements according to the	Only 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	College Chemistry; Engineering Thermodynamics; Engineering Fluid Mechanics; Fundamentals of New Energy Theory ; Applied Physical Chemistry; Heat Transfer
Module objectives/intended learning outcomes	Module objectives: The task of this course is to enable students to understand different conversion process of biomass and their utilization through teaching and practice. Specific objectives include: • **Knowledge:** Master basic knowledge of biomass conversion technologies such as biomass briquetting, gasification, liquefaction, biodiesel production, bioethanol synthesis, waste to renewable energy, etc. Understand the mechanism of biomass conversion for renewable products. Through this course, students can understand the conversion process of different biomass and their utilization. • **Skills:** Students acquire basic theoretical and specialized knowledge about biomass conversion and their application in different area; acquire deep understanding of different synthesis process and the mechanism; master different characterization techniques for biomass products; be able to design distributive biomass conversion techniques for special districts. • **Competences:** Students acquire practical abilities and innovative thinking on the basis of biomass conversion theories and engineering technology knowledge.
Content	**Part A Theoretical teaching** (64 contact hours; 56 self-study hours) **Chapter 1** Introduction (2 contact hours; 2 self-study hours) • Concept and classification of biomass • History of biomass conversion technology and their potentials; **Chapter 2** Biomass briquetting technology (6 contact hours; 6 self-study hours) • Concept and mechanism;** • Characterization of briquetting products;** • Cases of products in pilot-scale and industrial scale. **Chapter 3** Direct combustion technologies of biomass based products (6 contact hours; 6 self-study hours) • Combustion mechanism of biomass products;** • Modification of traditional combustor;*

	• Electrical utilization based on biomass combustion; **Chapter 4** Pyrolysis techniques based of solid biomass (6 contact hours; 6 self-study hours) • Pyrolysis mechanism of solid biomass;* • Influenced factor of pyrolysis process;** • Utilization of products based on pyrolysis technology. **Chapter 5** Biomass gasification technology (8 contact hours; 6 self-study hours) • Mechanism of biomass gasification;** • Different influenced factor on gasification;* • Utilization of biomass gasification. • Elimination of tar in the process of gasification. **Chapter 6** Hydrothermal liquefaction of biomass (6 contact hours; 4 self-study hours) • Basic concepts of hydrothermal liquefaction;** • Influenced parameter of hydrothermal liquefaction;* • Pilot & industrial scale of liquefaction products use. **Chapter 7** Bioethanol (6 contact hours; 6 self-study hours) • Synthesis routes and mechanism of bioethanol production by using different feedstocks;** • Economic evaluation of bio-ethanol production.* • Second-generation technology based of lignocellulosic materials. **Chapter 8** Biodiesel (4 contact hours; 4 self-study hours) • Concept of biodiesel;* • Mechanism of biodiesel production;** • New technologies based of heterogeneous catalysis;* • Economic evaluation based of different feedstocks. **Chapter 9** Biogas (6 contact hours; 6 self-study hours) • Concept and property of biogas;* • Synthesis method of biogas; • Outlooks of utilization of biogas station. **Chapter 10** Waste to renewable energy (6 contact hours; 4 self-study hours) • Classification and characterization of wastes;* • Treatment of wastes with different forms;* • Evaluation of the risk based of local environment. **Chapter 11** Bio-jet fuel and bio-hydrogen (4 contact hours; 4 self-study hours) • Synthesis techniques of bio-jet fuel;* • Production of bio-hydrogen and their utilization;* • Case study. **Chapter 12** Valuable products based of biomass conversion

	(4 contact hours; 2 self-study hours) • Classification of biomass based valuable products;* • Evaluation of preparation methods; • Case study. **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score includes: usual performance (30%), final exam (closed-book written examination) (70%) Usual performance includes: assignment and attendance rate.
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks
Reading list	1. Required books [1] CUI Zongjun. *Bioenergy and utilization of waste resources*. Beijing: Chinese Agricultural University Press, 2011 2. Reference books [1] ZHOU Jianbin. *Bioenergy engineering and technology*. Beijing: Chinese Forestry Press, 2011 [2] DONALD L. Klass. *Biomass for Renewable energy, fuels, and chemicals*. Academic Press, 1998. [3] LI Wenzhe. *Bioenergy Engineering*. Beijing: Chinese Agricultural Press, 2013 3. Other materials [1] PPT courseware (self-compiled)

Systems and Equipment of Nuclear Power Plant

Competence field	Engineering Applications
Module designation	Systems and Equipment of Nuclear Power Plant
Code, if applicable	11001670
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate Professor XIE Yingming
Lecturer	Associate Professor MEN Chuanling Associate Professor ZHAO Bintao Lecturer WEN Zhenzhong Lecturer ZHANG Guanhua
Language	Chinese
Relation to curriculum	Systems and Equipment of Nuclear Power Plant is one of the main courses for undergraduates of Renewable Energy Engineering program. This courses mainly focus on structure and characteristics of pressurized water reactor, contents as nuclear island main equipment structure and balance of plant, coolant system,specialized safety facilities, second loop thermal system and safety equipment in conventional island, nuclear steam turbine, thermal-hydraulic analysis and the safety analysis of nuclear power plant. The course systematically introduces construction of nuclear core area, nuclear island and conventional island. It focuses on introduction of basic principle and characteristics, classification and the advantage/disadvantage of different system, economic analysis and safety analysis will be considered as important aspects in utilization. It lays a foundation for the student not only in understanding how nuclear power plant works, but also in considering why we choose these kinds of technic instead of others. Furthermore, to cultivate the ability in analyzing different kinds of emergency events, familiar with structure, system and operation procedure of PWR. This course does not only focus on current power plant issues. Instead, it aims to address the challenging ideas that can be implemented in and used for the development of future nuclear power plants.
Type of teaching, contact hours	Target students: juniors of Renewable Energy Engineering program Type of teaching: theoretical teaching, practice teaching Contact hours: 64 hours Of which Theoretical teaching: 56 hours

	Experiment / practice teaching: 8 hours Computer practice: 0 hour Size of class: No more than 50 students for theoretical teaching
Workload	Workload= 120 hours Contact hours = 64 hours 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 experiments are allowed to take the exam.
Recommended prerequisites	College Physics; Engineering Fluid Mechanics; Engineering Thermodynamics; Fundamentals of New Energy Theory; Heat Transfer; Nuclear Reactor Engineering
Module objectives/intended learning outcomes	Module objectives: The task of this course is to assist students to understand nuclear power plant process system and equipment structure through teaching and practice. Specific objectives include: • **Knowledge:** Master basic knowledge and theories required such as First and Second loop of coolant system and its main composition equipment, operation principle, economic and safety analysis of different systems; understand the nuclear steam turbine, balance of plant, specialized safety facilities, and light water plant development and improvement; master regenerative cycle and reheat cycle in nuclear power plant; master waste treatment and air conditioning technology, safety injection system. Therefore, students can be familiar with equipment structure, system composition and operation procedure of nuclear power plant with PWR through this course. • **Skills:** Students acquire basic principle and specialized knowledge of nuclear power plant as pressurized water reactor; understand main equipment characteristics and its function; acquire deep understanding of economic analysis and safety analysis in different system and facilities; be able to analyze and solve different emergency events, have the ability to operate in primary testing system, master the specification of different equipment and basic operation principle, acquire the ability in analysis system core competence and improvement direction of exist technology. This course will take the student into the world of innovative

	research and development of future plants. • **Competences:** Students acquire practical abilities, innovative thinking and comparative analysis on the system and equipment of nuclear power plant.
Content	**Part A Theoretical teaching** (56 contact hours; 48 self-study hours) **Chapter 1** Introduction (2 contact hours; 2 self-study hours) • Development and utilization history of nuclear power plant; • Review of the current status nuclear power plant in China. **Chapter 2** PWR introduction (2 contact hours; 2 self-study hours) • System construction;* • The plant layout, facilities, safety features and safety design principles; **Chapter 3** Coolent system and equipment of PWR (8 contact hours; 6 self-study hours) • Coolent system of PWR;** • Structure of reactor core;* • Coolent pump;* • Steam generator;* • Pressure regulator;* **Chapter 4** Auxiliary system of nuclear island (8 contact hours; 8 self-study hours) • Chemical and volume control system;* • Reactor boron and water supply system;* • Waste heat removal system;* • Equipment cooling and plant water system • Spent fuel pool and cooling treatment • Waste treatment and air conditioning;** **Chapter 5** Specialized safety facilities (6 contact hours; 6 self-study hours) • Safety injection system;** • Security shell and spray system;* • Security shell isolation and gas/water control. **Chapter 6** Thermodynamics of nulcear power plant (6 contact hours; 4 self-study hours) • Basic concepts of thermodynamics;** • Economic effects and analysis; • Regenerative cycle and reheat cycle in nuclear power plant.** **Chapter 7** Nuclear steam turbine generator set (8 contact

	hours; 4 self-study hours) • Principle of steam turbine and its classification;** • Steam turbine structure;* • Characteristic of steam turbine and adjustment principle; • Moisture separator reheater;** • Condenser and vacuum. **Chapter 8** Second loop thermal system of nuclear power plant (6 contact hours; 6 self-study hours) • Main steam system;* • Condensed water and regenerative system;* • Deaerator; • Steam emission; • Steam generator and water control.* **Chapter 9** Nuclear power plant operation (4 contact hours; 4 self-study hours) • Standard state of power plant;* • Control and protect system; • Start and stop procedures of plant. **Chapter 10** Light water nuclear power plant development and improvement (6 contact hours; 6 self-study hours) • AP1000;* • Enhanced pressure reactor(EPR);* • Advanced boiling water reactor(ABWR); • The Fourth generation nuclear plant system. **Part B Experiment / practice teaching** (8 experiment hours; 8 self-study hours) 1. On site study of Lianyungang Nuclear Power Plant (4 experiment hours; 4 self-study hours); 2. Model studio study of various plant and structure (4 experiment hours; 4 self-study hours). **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score includes usual performance (15%), practice (15%) and final exam (closed-book written examination) (70%). Usual performance includes assignment and attendance rate. Practice score includes practice report (70%) and attendance (30%).
Media employed	Multimedia computers, blackboard, chalks, projector, laser pointers
Reading list	1. Required books [1] ZANG Xinian. *Nuclear Power Plant Systems and Equipment(Second Edition)*. Beijing: Tsinghua University Press, 2010

	2. Reference books [1] JIA Baoshan, *et al*. *Principles of nuclear power plant design and optimization.* Harbin: Harbin Engineering University Press, 2010 [2] XUE Hanjun.*Nuclear Power Equipment.* Beijing: Atomic Energy Press, 1990 [3] SU Linsen. *900MW pressurized water reactor nuclear power plant system and equipment.* Beijing: Atomic Energy Press, 2005 [4] ZHU Jizhou. *Pressurized water reactor nuclear power plant operation.* Beijing: Atomic Energy Press, 2000 3. Experiment/computer practice instruction books [1] Teaching materials (self-compiled) 4. Other materials [1] PPT courseware (self-compiled)

Nuclear Reactor Engineering

Competence field	Engineering Applications
Module designation	Nuclear Reactor Engineering
Code, if applicable	11001680
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate Professor XIE Yingming
Lecturer	Associate Professor XIE Yingming Associate Professor GUAN Xin Associate Professor WANG Zilong Lecturer HAO Xiaohong Lecturer YANG Liang
Language	Chinese
Relation to curriculum	Nuclear Reactor Engineering is a course offered for undergraduates of Renewable Energy Engineering program who have completed courses such as Heat Transfer, Engineering Fluid Mechanics, Engineering Thermodynamic and College Physics. As a multidisciplinary course, Nuclear Reactor Engineering introduces concepts from Engineering Fluid Mechanics and Systems and Equipment of Nuclear Power Plant. These concepts are introduced in different chapters which also link with each other. By taking this course, students may acquire deeper understanding of basic theories such as basic principles of nuclear reactor, structure, design and protection from nuclear radiation. After completing this course, students may further study courses such as Nuclear Power Plant System and Equipment.
Type of teaching, contact hours	Target students: juniors of Renewable Energy Engineering program Type of teaching: theoretical teaching Contact hours: 64 hours Of which, Theoretical teaching: 64 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: No more than 60 students for theoretical teaching
Workload	Workload= 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0

Requirements according to the examination regulations	Only students with class attendance rate over 2/3, and having completed all assignments are allowed to take the exam.
Recommended prerequisites	College Physics; Engineering Thermodyanmics; Fundamentals of Engineering Materials; Fundamentals of New Energy Theory; Heat Transfer
Module objectives/intended learning outcomes	Module objectives: • **Knowledge:** Types and characteristics of nuclear reactor; reaction principle of reactor core; basic structure of reactor core; thermodynamics of reactor core; fluid mechanics; thermal hydraulic design method and nuclear reactor safety. • **Skills:** Basic theories of nuclear reactor; application of nuclear physics, structure, materials, thermodynamics and fluid mechanics in nuclear reactor; design principles and thermal hydraulic analysis calculation of nuclear power reactor. • **Competences:** Develop students' ability in construction, operation, maintenance and design of nuclear reactor in the future.
Content	**Part A Theoretical teaching** (64 contact hours; 56 self-study hours) **Chapter 1** Introduction (6 contact hours; 6 self-study hours) • Introduction; • Pressurized water reactor (PWR);* • Boiling water reactor (BWR);* • Heavy water reactor;* • Gas cooled nuclear reactor;* • Sodium cooled fast reactor;* • Nuclear reactor used by ship;* • Small nuclear reactor with special purpose. **Chapter 2** Nuclear Reactor Physics (10 contact hours; 8 self-study hours) • Fundamentals of Nuclear Physics;** • Nuclear reactor critical theory and reactivity change;** • Neutron kinetics of nuclear reactor.** **Chapter 3** Nuclear Reactors Structure and Materials (10 contact hours; 8 self-study hours) • Pressurized water reactor structure;* • Nuclear reactor materials.* **Chapter 4** Nuclear Reactor Thermodynamics (12 contact hours; 10 self-study hours) • Nuclear reactor heat release;** • Heat conduction of nuclear reactor components;**

	• Transmission and single-phase convective heat transfer;** • Boiling heat transfer of nuclear reactor.** **Chapter 5** Nuclear Reactor Fluid Dynamics (10 contact hours; 10 self-study hours) • Coolant single-phase flow;** • Gas-water two-phase flow;** • Critical flow;** • Two-phase flow instability;* • Natural cycle.* **Chapter 6** Nuclear Reactor Thermal Hydraulic Design (8 contact hours; 6 self-study hours) • Introduction of core thermal hydraulic design; • Single channel model design method;* • Sub channel model design method.* **Chapter 7** Safety of Nuclear Reactor (8 contact hours; 8 self-study hours) • Basic concepts and principles of nuclear reactor safety;** • Nuclear reaction accidents and classification;* • Nuclear reaction accidents;* • Classification of international nuclear event;* • Release and protection of radioactive material in case of accidents.* **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score is based on usual performance and final exam. Usual performance accounts for 30% of final score (including attendance, rasing and answering questions; classroom performance and assignment); Final exam accounts for 70%.
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks, teachers pointer, etc.
Reading list	1. Required books [1] YU Pingan et al. Thermal Analysis of Nuclear Reactor (2nd edition). Atomic Energy Press, Beijing, 1986 2. Reference books [1] REN Gongzu. Thermal Hydraulic Analysis of Power Reactor. Atomic Energy Press, Beijing, 1982 [2] WU Guowei. Reactor Engineering Design. Atomic Energy Press, Beijing, 1982

Wind Power Generation Technology

Competence field	Engineering Applications
Module designation	Wind Power Generation Technology
Code, if applicable	11001750
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Professor LI Chun
Lecturer	Associate ProfessorYE Zhou Associate Professor SUN Xiaojing Associate Professor ZHAO Bingtao Associate Professor MEN Chuanling Lecturer YING Zhi
Language	Chinese
Relation to curriculum	Development and application of wind power involves theories and practical technologies of several disciplines. As an advanced course offered for undergraduates of Renewable Energy Engineering program. Wind Power Generation Technology is linked with several courses including: Theoretical Mechanics; Mechanics of Materials; Electrical Engineering and Electronics; Engineering Thermodynamics; Engineering Fluid Mechanics; Fundamentals of New Energy Theory. By taking this course, students can develop abilities in systematic analysis and innovation and learn more about renewable energy and improve knowledge structure. The course lays a foundation for courses including Innovation & Entrepreneurship Project Training; Professional Comprehensive Course Design and Internship.
Type of teaching, contact hours	Target students: juniors of Renewable Energy Engineering program Type of teaching: theoretical teaching; experiment Contact hours: 48 hours Of which, Theoretical teaching: 44 hours Experiment / practice teaching: 4 hours Computer practice: 0 hour Size of class: No more than 45 students for theoretical teaching
Workload	Workload= 90 hours Contact hours = 48 hours Self-study hours = 42 hours
Credit points	3.0
Requirements according to the	The following, as part of usual performance, shall be

examination regulations	completed before the exam: 1. wind turbine airfoil characteristics experiment/wind turbine aerodynamic performance experiment; 2. class attendance rate over 2/3 of theoretical teaching hours; 3. Assignment completion rate over 2/3
Recommended prerequisites	Engineering Fluid Mechanics; Engineering Thermodynamics; Pumps and Fans; Fundamentals of New Energy Theory
Module objectives/intended learning outcomes	Module objectives: • **Knowledge:** Characteristics of wind energy and its geographical and seasonal distribution; wind turbine aerofoil and its aerodynamic characteristics; Bates theory and blade theory; concept design and power calculation method for horizontal axis wind turbine; basic part structure and adjustment principles of wind turbine; main forms of vertical axis wind turbine; wind power generation and its basic operation forms; technical plans for joint application of wind power and other energy. • **Skills:** Master wind power description and statistics methods, basic theories of airfoil and wind turbine aerodynamics and methods for wind turbine aerodynamic design and load calculation; be able to calculate wind turbine performance under non-stall off-design; master testing method for airfoil properties and wind turbine performance; understand structure/operation/control method of typical wind power; understand ways of direct application of wind energy. • **Competences:** Develop abilities in wind power generation operation and design; improve abilities in system design by using knowledge from different disciplines; cultivate disciplined mindset of energy and environmental sustainable development; improve capability of independent innovation.
Content	**Part A Theoretical teaching** (44 contact hours; 40 self-study hours) **Chapter 1** Introduction of Wind Energy Resources (2 contact hours; 2 self-study hours) • Geographical and seasonal change of wind resources; • Wind speed scale and turbulence characteristics. **Chapter 2** Aerodynamics of Wind Turbine Airfoil (6 contact hours; 6 self-study hours)

	• Geometric parameter of wind turbine airfoil;** • Aerodynamic force on airfoil;** • Elevating force and resistance of airfoil;** • Airfoil series;* • Experimental method for characteristics of airfoil;* **Chapter 3** Aerodynamic Performance of Horizontal Axis Wind Turbine (10 contact hours; 10 self-study hours) • Bates theory;** • Aerodynamic force on airfoil;** • Geometrical features of vane;** • Impact of vane number;** • Aerodynamic force of drift;** • Stalling delay;** • Characteristics curves of constant speed operation;* • Experimental method for aerodynamic performance;* **Chapter 4** Aerodynamic Design of Horizontal Axis Wind Turbine (8 contact hours; 8 self-study hours) • Vane number and determination of diameter of wind wheel;* • Selection of vane airfoil;* • Calculation of vane chord and setting angle;** • Similarity design method for wind wheel.** **Chapter 5** Structural Design of Horizontal Axis Wind Turbine (6 contact hours; 6 self-study hours) • Vane design;** • Hub;* • Pylon;* • Transmission gear;* • Wind device;* • Speed and power adjusting device.* **Chapter 6** Vertical Axis and Other Forms of Wind Turbine (4 contact hours; 2 self-study hours) • Vertical axis wind turbine;** • MAGNUS wind turbine; • Thermal current wind turbine. **Chapter 7** Wind Power Generation (4 contact hours; 4 self-study hours) • Design of rated off-design of wind driven generator;* • Major electrical apparatus of wind power generation;* • Power supply mode of wind driven generator;* • Power determination of wind driven generator;* • Noise of wind driven generator.* **Chapter 8** Other Application Mode of Wind Energy (4

	contact hours; 2 self-study hours) • Wind power pumping; • Wind heat; • Wind energy storage. **Part B Experiment / practice teaching** (4 contact hours; 2 self-study hours) 1) Experiment of features of wind turbine airfoil (2 contact hours; 1 self-study hours); 2) Experiment of aerodynamic performance of wind turbine (2 contact hours; 1 self-study hours); **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Usual performance accounts for 30% of final score; final score accounts for 70% of final score (closed book written examination)
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks, teachers pointer
Reading list	1. Required books GUO Xinsheng. *Wind Energy Application Technology*. Chemistry Industry Press, 2007. 2. Reference books [1] Martin O.L. Hansen. Trans. XIAO Jinsong. *Aerodynamics of Wind Turbine* (2nd edition). China Electrical Power Press, 2009. [2] HE Dexin. *Wind Engineering and Industrial Aerodynamics.* National Defense Industry Press, 2006. [3] I.Paraschivoiu, Wind Turbine Design with Emphasis on Darrieus Concept, cole Polytechnique de Montral, 2002. 3. Experiment instruction books Self-compiled teaching materials 4. Other materials PPT courseware (self-compiled)

Fundamentals of Solar Cell

Competence field	Engineering Applications
Module designation	Fundamentals of Solar Cell
Code, if applicable	11001800
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Associate Professor MEN Chuanling
Lecturer	Associate Professor GUAN Xin Associate Professor XIE Yingming Associate Professor WANG Zilong Lecturer HAO Xiaohong Lecturer YING Zhi
Language	Chinese
Relation to curriculum	Fundamentals of Solar Cell is one of the main courses for undergraduates of Renewable Energy Engineering program. Solar cells are high-tech devices, which directly convert sunlight into electricity. The underlying scientific principles of these devices have been researched for decades with even more to come. This course provides comprehensive fundamental knowledge regarding the fundamental physical processes of solar cells. It also builds the base for all solar cell related modules in the following studies. This course introduces the technology that converts solar energy into electricity. Photovoltaic (PV) devices are presented as advanced semiconductor devices that deliver electricity directly from sunlight. The emphasis is on understanding the working principle of a solar cell, fabrication of solar cells. Students will gain a greater understanding of the principles of the photovoltaic conversion. This course explores the advantages, limitations and challenges of different solar cell technologies, such as crystalline silicon solar cell technology, thin film solar cell technologies and the latest novel solar cell concepts as studied on lab-scale.
Type of teaching, contact hours	Target students: juniors of Renewable Energy Engineering program Type of teaching: theoretical teaching, experiment Contact hours: 64 hours Of which Theoretical teaching: 56 hours Experiment / practice teaching: 8 hours Computer practice: 0 hour Size of class: No more than 60 students for theoretical

	teaching
Workload	Workload= 120 hours Contact hours = 64 hours 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 experiments are allowed to take the exam.
Recommended prerequisites	College Physics; College Chemistry; Electrical Engineering and Electronics; Fundamentals of New Energy Theory; Applied Physical Chemistry
Module objectives/intended learning outcomes	Module objectives: The task of this course is to enable students to understand photovoltaics process and basic theories through teaching and practice. Specific objectives include: • **Knowledge:** Master basic knowledge and theories required by solar cells such as semiconductor devices, physical and chemistry; understanding of the basics for Si-based, CIGS and CdTe thin-film solar cells; understanding the basics of solar cells is an essential prerequisite for all scientific and technological activities in photovoltaics. Participants gain an overview of the photovoltaic energy conversion and a detailed scientific foundation of the underlying principles of solar cells. Experienced engineers will be qualified to design and optimize photovoltaic systems and newcomers will be able to understand and enter the photovoltaics sector. Participants will be proficient in explaining the physical and engineering principles, analyzing and assessing new solar cell concepts as well as latest trends in photovoltaics based on the fundamental principles. • **Skills:** Students acquire basic theoretical and specialized knowledge about the fundamental physical processes of photovoltaic energy conversion; describe the fundamental operating principles of photovoltaic devices; design and optimize photovoltaic systems based on their understanding of the environment and its influence on photovoltaic energy conversion; describe and design photovoltaic systems for optimized energy production, transport and storage. • **Competences:** Students acquire practical abilities and innovative thinking on the basis of solar cell theories

	and engineering technology knowledge.
Content	**Part A Theoretical teaching** (56 contact hours; 48 self-study hours) **Chapter 1** Introduction (4 contact hours; 2 self-study hours) • Development history of semiconductor; • Scientific application and development of solar cells. **Chapter 2** Crystalline Silicon Solar Cells (12 contact hours; 10 self-study hours) • Crystalline Silicon: Manufacture and Properties;** • High-Efficiency Silicon Solar Cell Concepts;** • Thin Silicon Solar Cells.* **Chapter 3** Thin Film Technologies (10 contact hours; 10 self-study hours) • Thin-Film Silicon Solar Cells;* • Amorphous silicon-based film solar cells;** • Microcrystalline silicon-based film solar cells;** **Chapter 4** Compound solar cell (10 contact hours; 10 self-study hours) • II-VI compound semiconductors;* • Copper Indium Gallium Diselenide Thin Film Solar Cells;** • GaAs Solar Cell.; • Chemical vapor deposition; • Liquid phase epitaxy and molecular beam epitaxy;* • Magnetron sputtering technique. **Chapter 5** Dye-sensitized solar cells (12 contact hours; 8 self-study hours) • Dye-sensitized solar cells;** • Organic polymer solar cells.* **Chapter 6** New solar cells. (8 contact hours; 8 self-study hours) • Quantum dot solar cells;** • Quantum well solar cells;* • High efficiency solar cell. **Part B Experiment / practice teaching** (8 experiment hours; 8 self-study hours) 1) Demonstration of solar cell equipment (4 experiment hours; 4 self-study hours) 2) Experimental analysis of solar cells (4 experiment hours; 4 self-study hours) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of	Final score includes usual performance (20%), experiment (10%) and final exam (closed-book written examination)

examination	(70%). Usual performance includes: assignment, attendance rate, and computer practice. Experiment score includes experiment report (50%) and experiment exam (50%).
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks
Reading list	1.Reference books [1] Alan L. Fahrenbruch, Richard H. Bube. *Fundamentals of Solar Cells: Photovoltaic Solar Energy Conversion.* Academic Press, 1983 [2] Jenny Nelson, *The Physics of Solar Cells.* Imperial College Press, 2003 [3] Michael Boxwell. *Solar Electricity Handbook - 2015 Edition: A simple, practical guide to solar energy - designing and installing solar PV systems.* Greenstream Publishing, 2015 2. Experiment/computer practice instruction books [1] Teaching materials (self-compiled) 3. Other materials [1] PPT courseware (self-compiled)

Solar Power Generation and Thermal Utiliation

Competence field	Engineering Applications
Module designation	Solar Power Generation and Thermal Utilization
Code, if applicable	11001140
Subtitle, if applicable	
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Professor DOU Binlin
Lecturer	Associate Professor MEN Chuanling Associate Professor ZHAO Bingtao Associate Professor WANG Zilong Lecturer YANG Liang Lecturer HUANG Xiuhui
Language	Chinese
Relation to curriculum	Solar Power Generation and Thermal Utilization is a courses offered for undergraduates of Renewable Energy Engineering program. After completing courses such as Heat Transfer, Engineering Fluid Mechanics, Engineering Thermodynamics, Fundamentals of New Energy Theory, students may further study thermodynamic theories of solar thermal power generation, types and structure of solar focusing thermal power generation system, light gathering device of solar focusing thermal power generation system, steam generator of solar focusing thermal power generation system, operation and control of solar focusing thermal power generation system, thermos method of solar focusing thermal power generation system and ways of improving scientific aspect and rationality of solar thermal power generation system. As a link between theoretical study and practical work, the course is an important way of cultivating students' abilities in solving problems concerning design of solar thermal power generation system. It lays a foundation for follow-up courses including Professional Comprehensive Course Design, Internship and Bachelor Thesis.
Type of teaching, contact hours	Target students: juniors of Renewable Energy Engineering program Type of teaching: theoretical teaching; experiment Contact hours: 48 hours Of which, Theoretical teaching: 44 hours Experiment / practice teaching: 4 hours Computer practice: 0 hour

	Size of class: No more than 45 students for theoretical teaching
Workload	Workload= 90 hours Contact hours = 48 hours 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 having completed quiz of each chapter are allowed to take the exam.
Recommended prerequisites	College Physics; Engineering Thermodynamics; Engineering Fluid Mechanics; Fundamentals of New Energy Theory; Applied Physical Chemistry; Heat Transfer
Module objectives/intended learning outcomes	Module objectives: The course is designed to allow students to understand basic theories concerning solar thermal power generation. Specific objectives include: • **Knowledge:** Principles of solar energy thermal utilization; solar energy thermal utilization modes including solar collector, vacuum tube solar collector, air solar collector, trough type solar power generation, tower type solar power generation and dish type solar power generation. Analyze route and performance of thermal utilization from the perspective of thermodynamics; learn how to integrate thermodynamic process with thermal utilization equipment; deep understanding of basic principles of solar energy thermal utilization and basic application of equipment. • **Skills:** Understand thermodynamic process of solar collector, distinction and link between actual cycle and theoretical cycle; be able to analyze and calculate collector area and circulating water flow on the basis of thermodynamic process of cycle; be able to design solar collector. • **Competences:** Students understand working principles of equipments of solar energy thermal utilization system, including solar collector, thermodynamic system, steam generator and steam turbine; be able to design a set of solar energy thermal utilization device on the basis of local geographic conditions and required thermal load.
Content	**Part A Theoretical teaching** (44 contact hours; 38 self-study hours) **Chapter 1** Introduction of Energy (2 contact hours; 2 self-

	study hours) • Energy; • Role and status of energy; • Energy and environment; • Sustainable development of energy; • Introduction of renewable energy. **Chapter 2** The Sun and Solar Energy (6 contact hours; 6 self-study hours) • Basic knowledge about the sun; • Radiation spectrum and solar constant;** • Solar energy resources;** • Solar energy utilization.** **Chapter 3** Thermodynamic Basis of Solar Thermal Power Generation (6 contact hours; 4 self-study hours) • Basic concepts and laws of thermodynamics; • Thermodynamic analysis method for energy conversion system;* • Thermal cycle used by solar thermal power generation technology;* • Thermodynamic optimization analysis of solar thermal power generation cycles.* **Chapter 4** Types and Components of Concentrated Solar Thermal Power Generation System (6 contact hours; 6 self-study hours) • Trough type solar thermal power generation system;* • Tower type solar thermal power generation system;* • Dish type solar thermal power generation system;* • Integrated solar thermal power generation system.* **Chapter 5** Light Gathering Device of Solar Focusing Thermal Power Generation System (6 contact hours; 6 self-study hours) • Principles of solar energy light gathering;** • Trough type solar concentrator for heat collection device;** • Tower type solar concentrator for heat collection device;** • Dish type solar concentrator for heat collection device.** **Chapter 6** Steam Generator of Solar Focusing Thermal Power Generation System (6 contact hours; 4 self-study hours) • Introduction; • Design & calculation method for shell-tube type heat

	exchanger;** • Selection of shell-tube type heat exchanger;** • Thermodynamic calculation of steam generator;** • Pressure drop calculation of steam generator.** **Chapter 7** Operation and Control of Concentrated Solar Thermal Power Generation System (3 contact hours; 3 self-study hours) • Introduction; • Tracking control of solar heliostat field;* • Operation and control of trough type Concentrated solar thermal power generation system;* • Operation and control of tower type Concentrated solar thermal power generation system;* • Operation and control of dish type Concentrated solar thermal power generation system.* **Chapter 8** Solar Chimney Power Generation Technology (6 contact hours; 4 self-study hours) • Introduction of solar chimney power generation technology; • Thermal analysis and design of solar chimney power generation system;* • Turbine of solar chimney power generation system;* • Draft tube of solar chimney power generation system;* • Collector of solar chimney power generation system.* **Chapter 9** Thermal Storage of Solar Thermal Power Generation System.(3 contact hours; 3 self-study hours) • Basic principles of thermal storage;* • Thermal storage materials;* • Typical thermal storage system of concentrated solar thermal power generation system. **Part B Experiment / practice teaching** (4 contact hours; 4 self-study hours) 1) Flat-plate solar collector experiment;* (2 contact hours; 2 self-study hours) 2) Trough type solar power generation experiment;* (2 contact hours; 2 self-study hours) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score is based on usual performance and final exam. Usual performance accounts for 30% of final score (including quiz, attendance, classroom performance and assignment); final exam accounts for 70%.
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks

Reading list	1. Required books [1] ZHANG Hefei. Principles and Computer Simulation of Solar *Energy Thermal Utilization*. Xian: Xian Industry University Press, 1990.05 2. Reference books [1] WANG Junyi, XU Renxue. *Solar Energy Utilization Technology.* Beijing: Jindun Publishing House, 2008.01 [2] ZHANG Biguang. *Solar Drying Technology.* Beijing: Chemistry Industry Press, 2007.01 [3] ZHENG Hongfei, HE Kaiyan, CHEN Ziqian. *Solar Desalination Technology.* Beijing: Beijing Institute of Technology Press, 2005.05 [4] XUE Deqian. *Solar Refrigeration Technology.* Beijing: Chemistry Industry Press, 2006.09 [5] WANG Ruzhu, DAI Yanjun. *Solar Refrigeration.* Beijing: Chemistry Industry Press, 2007.01 [6] XIONG Shaozhen, ZHU Meifang. *Foundation and Application of Solar Cell.* Beijing: Science Press, 2009. 10 [7] *Principles of Solar Engineering*, D. Yogi Goswami, Taylor & Francis; 2 edition (January 1, 2000)

Electives

Principles of Steam Turbine

Competence field	Electives
Module designation	Principles of Steam Turbine
Code, if applicable	11001900
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Professor HUANG Diangui
Lecturer	Professor SU Lin Professor DAI Ren Associate Professor ZHAO Zhijun Lecturer HAO Xiaohong Lecturer ZHANG Guanhua
Language	Chinese / English
Relation to curriculum	The course is an elective course for for seniors of Renewable Energy Engineering program. Through this course, students can understand basic work principles and devices of single-stage and multi-stage of steam turbine, calculation method for thermal gas dynamics, and performance of steam turbine system. The acquired knowledge can lay a foundation for future work such as design, research and application of steam turbine.
Type of teaching, contact hours	Target students: seniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching Contact hours: 48 hours Of which, Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: No more than 45 students for theoretical teaching
Workload	Workload= 90 hours Contact hours = 48 hours 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 having completed all assignments are allowed to take the exam.
Recommended prerequisites	Mechanical Engineering Drawing; Engineering Thermodynamics; Engineering Fluid Mechanics; Heat Transfer

Module objectives/intended learning outcomes	Module objectives: The course is designed to help students understand the overall system of steam turbine, working principles and characteristics off-design and major equipment, design method for large-scale power steam turbine, types of steam turbine, and basic principles and methods for operation and testing of steam turbine. The acquired knowledge will lay a foundation for future work such as steam turbine design and power plant administration. • **Knowledge:** Application characteristics, overall structure and development trend of overall system of modern steam turbine and its major equipment; general knowledge of steam turbine operation and issues concerning safe operation. • **Skills:** Master working principle and characteristics of overall system of steam turbine, off-design and major equipment, and basic principles and methods for operation and testing of steam turbine. • **Competences:** Be able to engage in simple work such as steam turbine design and operation/administration work.
Content	**Part A Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1** Working Principles of Steam Turbine Stage (16 contact hours; 14 self-study hours) • Introduction; • Flow process of steam in nozzle; • Dynamic process of steam in movable vane; wheel efficiency and optimum velocity ratio;** • Velocity-compounded stage;** • Cascade test and cascade characteristic curve;* • Determination of major geometric dimensions of flow passage;* • Internal loss and internal efficiency of steam turbine stage;** • Long vane stage (simple radial equilibrium equation; constant circulation flow pattern; introduction of other flow type and full radial equilibrium equation).* **Chapter 2** Multi-stage Steam Turbine (14 contact hours; 12 self-study hours) • Working process of multi-stage steam turbine;* • Heavy heat phenomenonand heavy heat efficiency;** • Loss and shaft seal of multi-stage steam turbine;*

	• Working characteristics of each stage of multi-stage steam turbine;** • Ultimate capacity of steam turbine and measures for increase of ultimate capacity;** • Axial thrust and balance of multi-stage steam turbine;** • Economy of steam turbine unit;* • Thermal design steps of multi-stage steam turbine.* **Chapter 3** Off-design of Steam Turbine (14 contact hours; 12 self-study hours) • Research content off-design; • Detailed calculation method for off-design of steam turbine;** • Off-design of nozzle;* • Reaction degree change of steam turbine stage;* • Flow parameter relation of stage group;* • Off-design of condensing steam turbine;* • Off-design of back pressure type steam turbine;* • Gas distribution system of steam turbine and off-design of regulating stage;*;* • Off-design of incomplete flow passage of steam turbine;* • Off-design of stopped heat regenerative system;* • Off-design of changing parameter.* **Chapter 4** Different Types of Steam Turbine (4 contact hours; 4 self-study hours) • Thermoelectric dual-purpose steam turbine;* • Industrial steam turbine;* • Geothermal steam turbine;* • Nuclear steam turbine;* • Driven feed pump turbine; • Air cooling steam turbine. **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Usual performance accounts for 30% of final score (including attendance, classroom performance and assignment); final exam accounts for 70%; final exam is closed book written examination
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks
Reading list	1. Required books [1] JIAN Tiancong. *Principles of Steam Turbine*. Beijing: China WaterPower Press, 1992 2. Reference books

	[1] WANG Zhongqi, Qinren. *Principles of Turbomachinery*. Beijing: Machinery Industry Press, 1981 [2] CAI Yinian, WANG Biyu. *Steam Turbine Plant.* Beijing: Machinery Industry Press, 1989 [3] SHU Shizhen, ZHU Li, KE Xuanling et al. *Principles of Impeller Machinery*. Beijing: Tsingshu University, 1991 [4] WANG Naining, ZHANG Zhigang. *Thermal Design of Steam Turbine*. Beijing: China WaterPower Press, 1987 [5] Traupel W. *Thermodynamic Turbine* (3rd edition, Vol 1, *Calculation of Thermodynamics and Fluid Mechanics*). Beijing: China WaterPower Press, 1985

Thermodynamic Equipment and System Optimization

Competence field	Electives
Module designation	Thermodynamic Equipment and System Optimization
Code, if applicable	11001460
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Associate Professor LI Kequn
Lecturer	Professor DOU Binlin Professor ZHANG Lixin Associate Professor SU Wenxian Associate Professor WANG Zilong Lecturer WEN Zhenzhong Lecturer YING Zhi
Language	Chinese
Relation to curriculum	By taking this course, students can master basic principles of typical and major thermodynamic equipment as well as mathematical modeling and simulation method, optimization technology for continuous variables and integer variables, content/purpose/method of thermodynamic equipment system optimization from the perspective of system. As a link between theoretical knowledge and practical equipment design and analysis work, the course enables students to integrate previous acquired knowledge regarding Engineering Thermodynamics, Heat Transfer and Engineering Fluid Mechanics with real thermodynamic equipment.
Type of teaching, contact hours	Target students: seniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching Contact hours: 48 hours Of which, Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: No more than 45 students for theoretical teaching
Workload	Workload= 90 hours Contact hours = 48 hours 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, and having attended at least 1

	simulation lecture are allowed to take the exam.
Recommended prerequisites	Computer Modeling Practice, Mechanical Engineering Drawing; Engineering Thermodynamics; Engineering Fluid Mechanics; Heat Transfer
Module objectives/intended learning outcomes	Module objectives: • **Knowledge:** Basic principles and application of typical thermodynamic equipment; system modeling and simulation method; system optimization technology; thermodynamic system optimization technology which is based on efficient use of energy. Main contents include: mathematical modeling of typical thermodynamic equipment which is based on system optimization; optimization technology for continuous variables and integer variables; distributed function system optimization which is based on gas turbine; whole energy system optimization technology which is based on steam turbine • **Skills:** By taking this course, students can master basic principles of typical and major thermodynamic equipment as well as mathematical modeling and simulation method, optimization technology for continuous variables and integer variables, content/purpose/method of thermodynamic equipment system optimization from the perspective of system. • **Competences:** Lay a theoretical foundation for students future study and wok in energy system engineering analysis and design
Content	**Part A Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1** Introduction (4 contact hours; 2 self-study hours) • Introduction of basic concepts of thermodynamic system, significance of thermodynamic system optimization and related research at home and abroad. **Chapter 2** Modeling and Simulation Method for Thermodynamic System (10 contact hours; 10 self-study hours) • Concepts, significance and method of thermodynamic system optimization;* • Static modeling method for thermodynamic system;** • Dynamic modeling method for thermodynamic system;** • Basic principles and methods for sequential modular approach.*

	Chapter 3 Principles and Application of Thermodynamic Equipment (10 contact hours; 10 self-study hours) • Working principles, application and mathematical model of thermodynamic equipment;** • Principles and mathematical model of boiler equipment; principles and mathematical model of steam turbine;* • Dynamic mathematical model of gas turbine;* • Mathematical modeling of heat exchanger;* • Mathematical modeling of pumps and fans;* • Mathematical modeling of valve, pumps and fans;* • Steady mathematical model of refrigeration system.* **Chapter 4** System Optimization Technology (10 contact hours; 10 self-study hours) • Significance and methods of system optimization; basic methods of continuous variables optimization;* • Gradient-based optimization (univariate search technique; conjugate gradient method; mixed penalty function method etc.); optimization independent of gradient (simplex method);** • Basic meaning of integer variable optimization; integer optimization method for branch definition method;* • Physical meaning and strengths of Heuristic optimization method; random search method and genetic algorithm etc.* **Chapter 5** Optimization Content and Method for Thermodynamic System (8 contact hours; 6 self-study hours) • Establishment and physical meaning of object function of thermodynamic system optimization;* • Different structure and system optimization of steam power cycle;** • Different structure and system optimization of gas turbine cycle;* • Gas-steam combined cycle and its industrial application.* **Chapter 6** Gas Turbine Based Distributed Energy Supply System Optimization (6 contact hours; 4 self-study hours) • Basic concepts and application value of distributed energy supply system;* • How to achieve various types of energy supply system optimization by using mixed integer optimization technique;* • Thermodynamic system/process system optimization

	software;* • Design and optimize micro gas turbine power supply system by using EIS software. **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score includes: usual performance (30%); final exam (closed book written examination) (70%) Usual performance: attendance; classroom performance
Media employed	Blackboard, chalks
Reading list	1. Required books [1] Self-compiled books 2. Reference books (English reference books required) [1] WU Chongguang. *Simulation Technology for Process System* (1st edition). Beijing: Sinopec Press,1998 [2] YANG Mingsheng, LUO Changtong. *Maximum Optimization Principle*, Method and Problem Solving Software (1st edition). Beijing: Science Press, 2006 [3] ZHU Xingjian, WANG Xueyu. *Working Principles and Performance of Gas Turbine* (1st edition). Beijing: Science Press, 1992 [4] WANG Zhongqi, QIN Ren. Principles of Turbomachinery. Beijing: Machinery Industry Pres, 1981 [5] J.P. Holman. Heat Transfer, Seventh. 9th Ed McGraw-Hill New York 1999 [6] TAO Wenquan. *Numerical Heat Transfer*. Xian, Xian Jiaotong University Press, 1988

Principles and Equipment of Refrigeration

Competence field	Electives
Module designation	Principles and Equipment of Refrigeration
Code, if applicable	11001620
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Professor ZHANG Hua
Lecturer	Professor SU Lin Professor WU Weidong Associate Professor LIU Yefeng Associate Professor XIE Yingming Associate Professor WANG Zilong Lecturer ZHANG Guanhua
Language	Chinese / English
Relation to curriculum	Principles and Equipment of Refrigeration is a course offered for seniors of Renewable Energy Engineering program. After taking Heat Transfer, Engineering Fluid Mechanics and Engineering Thermodynamics and studying heat transfer theories such as firs/second/third law of thermodynamics, entropy, enthalpy, exergy and anergy, students, by taking this course, can start to learn refrigeration system, working principles of steam refrigerator, thermal physical properties of refrigerant, characteristics analysis and computer calculation of refrigeration cycle, structural characteristics of heat transfer mechanism of refrigeration heat exchanger and design calculation method, working characteristics of compressor/condenser/evaporator/throttle valve and how to improve scientific and rational aspects of refrigeration system. As a link between theoretical study and practical product designing, the course is an important way of cultivating students' abilities in solving problems relating to refrigeration system design.
Type of teaching, contact hours	Target students: seniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching, practice teaching Contact hours: 48 hours Of which, Theoretical teaching: 42hours Experiment / practice teaching: 6 hours Computer practice: 0 hour Size of class: No more than 45 students for theoretical teaching

Workload	Workload= 90 hours Contact hours = 48 hours Self-study hours = 42 hours
Credit points	3.0
Requirements according to the examination regulations	Only students having completed this course and related experiments and passed quiz of each chapter are allowed to take final exam
Recommended prerequisites	Computer Modeling Practice; Engineering Fluid Mechanics; Engineering Thermodynamics; Heat Transfer; Principles and Design of Heat Exchanger
Module objectives/intended learning outcomes	Module objectives: • **Knowledge:** By taking this course, students may learn basic refrigeration cycles including reverse Carnot cycle, Stirling cycle and reverse Brayton cycle and master 6 types of refrigeration modes including compression refrigeration, absorption refrigeration, adsorption type refrigeration, thermoelectric refrigeration, gas vortex refrigeration and gas refrigeration (with vapor compression refrigeration as the main content). Analyzing the route and performance of refrigeration cycle from the perspective of thermodynamics. Combine thermodynamic process with real refrigeration equipment. Basic principles of refrigeration and application of equipment. • **Skills:** Master thermodynamic process of vapor compression refrigeration cycle; understand the distinction and linkage between actual refrigeration cycle and theoretical refrigeration cycle; analyze and calculate heat load of evaporator and condenser on the basis of thermodynamic process of refrigeration cycle; be able to choose the type of compressor and throttle device. • **Competences:** Master working principles of each refrigeration equipment including compressor, evaporator, condenser, throttle device, liquid reservoir, drying/filtering device, gas-liquid separator and oil separator. Students are able to design a set of refrigeration device according to indoor heat load.
Content	**Part A Theoretical teaching** (42 contact hours; 36 self-study hours) **Chapter 1** Introduction (2 contact hours; 2 self-study hours) **Chapter 2** Thermodynamic Basis of Refrigeration (6 contact hours; 6 self-study hours)

	• Phase change refrigeration;** • Adiabatic expansion refrigeration;** • Analysis of characteristic of refrigeration thermodynamics.** **Chapter 3** Refrigerant/Coolant/Lubricant (4 contact hours; 2 self-study hours) • Introduction of refrigerant; • Thermal parameters and calculation method of refrigerant;* • Physical/chemical properties and application of refrigerant;* • Common refrigerant;* • Coolant;* • Lubricant.* **Chapter 4** Single Stage Compression Vapor Refrigeration Cycle (6 contact hours; 6 self-study hours) • Theoretical cycle of single stage compression vapor refrigeration cycle;* • Actual cycle of single stage compression vapor refrigeration cycle;** • Computer calculation of performance of single stage compression vapor refrigeration cycle;** • Characteristics analysis of single stage vapor compression refrigeration cycle;** • Analysis of second law of thermodynamics of refrigeration cycle.** **Chapter 5** Two-stage Compression and Cascade Refrigeration Cycle (6 contact hours; 6 self-study hours) • Introduction; • Two stage compression refrigeration cycle and thermal calculation;* • Analysis of operation characteristics of two stage compression refrigeration cycle;** • Cascade refrigeration cycle.* **Chapter 6** Absorption Refrigeration Cycle and other Refrigeration Methods (6 contact hours; 4 self-study hours) • Basic principles and off-design of absorption refrigerator;** • Thermal characteristics of absorption refrigerator solution cycle;* • Work cycle and thermal calculation of lithium bromide absorption refrigerator;** • Ammonia absorption refrigeration cycle;**

	• Compression air refrigeration cycle;** • Gas vortex refrigeration;** • Thermoelectric refrigeration;* • Solid adsorption refrigeration.* **Chapter 7** Refrigeration Equipment (4 contact hours; 4 self-study hours) • Introduction; • Condenser;** • Evaporator;** • Other refrigeration heat exchanger and auxiliary equipment;** • New types of refrigeration heat exchanger and enhanced heat exchange method;* • Throttle mechanism of refrigeration equipment;* • Pipeline system and insulation of vapor compression refrigeration equipment.* **Chapter 8** Introduction of Refrigeration Device (4 contact hours; 2 self-study hours) • Classification and application of refrigeration device; • System and cooling mode of refrigeration device; • Automatic system of typical refrigeration device. **Chapter 9** Design Calculation of Refrigeration Device (4 contact hours; 4 self-study hours) • Design principle of refrigeration device;* • Calculation of cold load;* • Characteristics analysis of refrigeration device;* • Simulation optimization of refrigeration air-conditioning device and computer aided design. **Part B Experiment / practice teaching** (6 contact hours; 6 self-study hours) 1) Experiment of single stage compression vapor refrigeration cycle;* (2 contact hours; 2 self-study hours) Get familiar with the working procedure of refrigeration system on the basis of refrigeration device experiment. Master working principles of compressor, condenser, evaporator and throttle. Be able to distinguish the working sate of evaporator and condenser. Understand the impact of evaporating temperature or condensing temperature on system. 2) Experiment of double stage compression vapor refrigeration cycle;* (2 contact hours; 2 self-study hours) On the basis of refrigeration device experiment, understand the working procedure of incomplete inter cooling and

	complete inter cooling of two stage compression refrigeration cycle with a focus on understanding of the working state of intercooler as well as the working state of low-medium temperature and high temperature compressor of these two cooling methods. Be able to distinguish the working procedure of two stage refrigeration cycle and cascade refrigeration cycle. 3) Experiment of absorption refrigeration cycle and other refrigeration method;* (2 contact hours; 2 self-study hours) Get familiar with the procedure of absorption refrigeration system and working principles of absorber, generator, evaporator and condenser on the basis of refrigeration device experiment. Be able to distinguish the working state of absorber and producer. **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score is based on usual performance and score of final exam. Usual performance accounts for 40% of final score, including quiz, attendance, raising/answering questions, classroom involvement, and assignment. Final exam accounts for 60% of final score
Media employed	Multimedia computers, projector, laser pointers
Reading list	1. Required books [1] *Refrigeration Principles and Device* (2nd edition). ZHEN Xiande. Machinery Industry Press, 2012 2. Reference books [1] *Refrigeration Principles and Equipment*. WU Yezhen. Machinery Industry Press, 1997 [2] *Instructions on Design of Small-scale Refrigeration Device*. WU Yezhen. Machinery Industry Press, 1998 [3] *Refrigeration Principles and Technology*. WANG Ruzhu, Science Press, 2013 [4] *Refrigeration Technology*, HUA Ze-zhao, Alpha Science International Ltd, 2012. 3. Experiment/computer practice instruction books [1] Self-compiled teaching materials 4. Other materials [1] PPT courseware (self-compiled)

Manufacturing Technology of Thermal Power Machinery

Competence field	Electives
Module designation	Manufacturing Technology of Thermal Power Machinery
Code, if applicable	11000830
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Professor LIU Jianhua
Lecturer	Professor LIU Jianhua Associate Professor YANG Ailing Associate Professor LI Kequn Associate Professor ZHAO Bingtao
Language	Chinese
Relation to curriculum	After learning courses such as Mechanical Engineering Drawing, Machine Design and Thermal Engineering, students of Renewable Energy Engineering program can study manufacturing technology of these energy and power machinery, master typical process such as machinery processing, assembly, welding, casting, forging and pressing, heat processing and nondestructive examination, understand the interrelationship between product structure and manufacturing technology so as to improve the scientific and reasonable aspects of product structure design, and develop abilities in organizing product manufacturing. As a link between theoretical study and practical work, the course is an important way of cultivating students' abilities in solving practical problems connected with product design and manufacturing.
Type of teaching, contact hours	Target students: seniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching, practice teaching Contact hours: 48 hours Of which, Theoretical teaching: 40 hours Experiment / practice teaching: 8 hours Computer practice: 0 hour Size of class: No more than 60 students for theoretical teaching
Workload	Workload= 90 hours Contact hours = 48 hours Self-study hours = 42 hours
Credit points	3.0
Requirements according to the	Only students with class attendance rate over 2/3 are allowed

examination regulations	to take the exam.
Recommended prerequisites	Mechanical Engineering Drawing; Fundamentals of Engineering Materials; Machine Design
Module objectives/intended learning outcomes	Module objectives: Manufacturing Technology of Thermal Power Machinery is a course offered to seniors. It focuses on the study of basic knowledge and the manufacturing process and device of typical equipment such as turbine, refrigeration and air-conditioning devices. The thermal power machinery manufacturing technology introduced by this course can be widely used in other engineering fields. Specific objective include: • **Knowledge:** Maser basic knowledge of Manufacturing Technology of Thermal Power Machinery; familiar with the manufacturing process and device of typical equipment such as boiler, turbine, refrigeration and air-conditioning devices. • **Skills:** Master typical process related with thermal power machinery manufacturing such as machinery processing, assembly, welding, casting, forging and pressing, heat processing and nondestructive examination, understand the interrelationship between product structure and manufacturing technology, be able to design manufacturing process of thermal power machinery correctly. • **Competences:** Through integration of theoretical knowledge and practical work, students are able to improve abilities in design product structure of thermal power machinery, develop abilities in organizing product manufacturing, acquire skills in solving practical problems connected with thermal power machinery design and manufacturing by using acquired knowledge.
Content	**Part A Theoretical teaching** (40 contact hours; 36 self-study hours) **Chapter 1** Basics of Machinery Processing (2 contact hours; 2 self-study hours) • Introduction; • Machining precision and surface quality;* • Dimension chain;* • Fixture. **Chapter 2** Material Cutting, Welding and Non-destructive Inspection;* (2 contact hours; 2 self-study hours)

	• Material cutting;* • Material welding;* • Non-destructive inspection;* • Exercise 1: Basics of manufacturing technology. **Chapter 3** Manufacturing Technology of Turbine Blade (4 contact hours; 4 self-study hours) • Structure and classification of blade;* • Working conditions of blade and material requirement;* • Blank manufacturing of blade;* • Processing technology of blade steam passage;* • Machining process of blade root;* • Leaf blade measurement. **Chapter 4** Manufacturing Process of Turbine Rotor and Impeller (4 contact hours; 2 self-study hours) • Manufacturing technology of turbine rotor;** • Processing technology of turbine blade.** **Chapter 5** Manufacturing technology of Turbine Cylinder (4 contact hours; 4 self-study hours) • Classification of cylinder and main structural form;** • Machining of different types of cylinder;** • Typical procedure during cylinder machining;** • Processing technology of typical turbine cylinder;** • Processing technology of 300MW turbine cylinder. **Chapter 6** Plant Assembly and Site Installation of Steam Turbine (4 contact hours; 4 self-study hours) • Assembly and balancing of steam turbine rotor;* • Plant assembly technology of steam turbine;* • Site installation of steam turbine.* • Exercise 2: Manufacturing technology of steam turbine **Chapter 7** Manufacturing Technology of Boiler Drum (4 contact hours; 4 self-study hours) • Material selection for drum;** • Manufacturing technology of drum ring;** • Manufacturing technology of capped end;** • Connection between drum and pipe fitting;* • Heat treatment during drum manufacturing;* • Inspection and quality control during drum manufacturing. **Chapter 8** Manufacturing Technology of Boiler Pipe (4 contact hours; 2 self-study hours)

	• Pipe line and blanking;** • Curving of pipe;** • Welding of pipe;** • Manufacturing of membrane water wall tube; • Manufacturing technology of serpentine tube; • Manufacturing technology of convection heating surface pipe with extended surface. • Exercise 3: Manufacturing technology of boiler **Chapter 9** Processing and Assembly Process for Refrigeration Compressor (4 contact hours; 4 self-study hours) • Selection of refrigeration compressor materials;** • Technical requirements and procedures for crankshaft processing;** • Technical requirements and procedures for link rod processing;** • Technical requirements and procedures for piston processing;** • Technical requirements and procedures for valve block processing;** • Technical requirements and procedures for machine body processing;** • Machine casing processing;* • Assembly of compressor.* **Chapter 10** Manufacturing Technology of Refrigeration Heat Exchanger (4 contact hours; 4 self-study hours) • Classification, structure and material selection of refrigeration heat exchanger;** • Processing of shell and tube exchanger;** • Processing of whole piece of plate finned tube heat exchanger.** **Chapter 11** Installation and Commissioning of Refrigeration Equipment (4 contact hours; 4 self-study hours) • Basic requirements for installation of refrigeration equipment;* • Installation of refrigeration compressor;* • Installation of refrigeration heat exchange and accessory equipment;* • Pipe installation;* • Performance experiment of compressor;* • Soot blowing and vacuum leak detection of refrigeration system;* • Filling of refrigerant;

	• Commissioning of refrigerator; • Installation of commissioning of small refrigerator;* • Fault analysis and treatment of refrigeration system. • Exercise 4: Exercise class for manufacturing technology of refrigeration equipment **Part B Experiment / practice teaching** (8 contact hours; 6 self-study hours) 1) Manufacturing technology and equipment visit (2 contact hours, 1 self-study hours) 2) Steam turbine structure, manufacturing equipment and manufacturing process visit (4 contact hours, 2 self-study hours) 3) Refrigeration equipment structure, manufacturing equipment and manufacturing process visit (2 contact hours, 2 self-study hours) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	4 assignments and 1 final exam; usual performance accounts for 40% of final score; each assignment accounts for 10%; final exam accounts for 60%; final exam is closed book written examination
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks, teachers pointer, product model
Reading list	1. Required books [**1]** TAO Zhengliang. *Manufacturing Technology of Thermal Power Machinery.* Beijing: Machinery Industry Press, 2006 2. Reference books [**1]** ZHU Qifang. *Manufacturing Technology of Power Machinery and Equipment.* Xian: Xian Jiaotong University Press, 1999 [**2]** CHEN Xi, *Manufacturing Technology of Thermal Power Machinery.* Beijing: Machinery Industry Press, 2000 [**3]** M. P. Groover. *Introduction to Manufacturing Processes*. New York: Wiley, 2011. 3. Other materials [**1]** PPT courseware (self-compiled)

Clean Combustion Technology

Competence field	Electives
Module designation	Clean Combustion Technology
Code, if applicable	11000710
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Professor JIN Jing
Lecturer	Professor DOU Binlin Associate Professor FAN Fengxian Lecturer HAO Xiaohong Lecturer WEN Zhenzhong Lecturer YANG Liang
Language	Chinese
Relation to curriculum	Clean Combustion Technology is an elective course offered for undergraduates of Renewable Energy Engineering program. By taking this course, students can understand the present situation of air pollution in China and the relationship between environmental pollution and industrial combustion, generating mechanism of pollutants during combustion process of fossil fuel (gas, liquid and solid fuel, especially coal), all related pollutant emission control technology and development/application prospect for advanced low pollution combustion technology.
Type of teaching, contact hours	Target students: seniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching Contact hours: 48 hours Of which, Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: No more than 60 students for theoretical teaching
Workload	Workload= 90 hours Contact hours = 48 hours 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	College Physics; College Chemistry; Engineering Thermodynamics; Engineering Fluid Mechanics; Heat Transfer; Applied Physical Chemistry

Module objectives/intended learning outcomes	Module objectives: • **Knowledge:** Characteristics of China's energy structure and present situation of air pollution; relationship between air pollution and combustion products emissions of industrial combustion equipment; generating mechanism of major pollutants during combustion process; purification technology of fuel; clean combustion technology of low SO_x and low NO_x; exhaust gas desulfurization / denitrification / dust removal technology. • **Skills:** Master principles and technology of major pollutants, design and operation of major equipment and practical knowledge of administration. Students are able to engage in scientific research, design/development of products and operational management. • **Competences:** Develop students' all-around abilities; enable students to understand the development trend and application prospect of modern clean combustion technology.
Content	**Part A Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1** Energy Structure and Environmental Problems of China (4 contact hours; 2 self-study hours) • Energy Structure; • Environmental problems in coal exploitation and utilization. **Chapter 2** Major Environmental Problems of Coal Producing Area (4 contact hours; 4 self-study hours) • Main content of air pollution and control;* • Present situation of pollution control and comprehensive control work.* **Chapter 3** Purification of Coal before Combustion (4 contact hours; 4 self-study hours) • Development of coal purification technology;* • Purification method for coal;* • Coal blending and briquette technology.* **Chapter 4** Formation Mechanism of Sulfur Oxides during Coal Combustion (8 contact hours; 8 self-study hours) • Major factors affecting combustion process;** • Combustion process and equipment of solid fuel;** • Formation mechanism of major pollutants during combustion process;**

	• Introduction of desulfurization technology of coal combustion equipment.* **Chapter 5** Formation Mechanism of Nitrogen Oxide during Coal Combustion and Control Technology (10 contact hours; 8 self-study hours) • Formation mechanism of coal burning boiler NO_x;** • Low NO_x technology of coal burning boiler;* • Circulating fluidized bed combustion technology;* • Coal water slurry combustion technology.* **Chapter 6** Dust Removal Technology after Fuel Combustion (4 contact hours; 4 self-study hours) • Introduction of dust removal technology after fuel combustion;* • Exhaust gas removal technology.** **Chapter 7** Coal Gasification and Liquefaction Technology (4 contact hours; 4 self-study hours) • Coal gasification technology;* • Coal liquefaction technology.* **Chapter 8** New Clean Coal Power Generation Technology (6 contact hours; 6 self-study hours) • USC technology;* • Gas - steam combined cycle technology;* • IGCC technology;* • PFBC boiler combined cycle technology; • IGMCFC combined cycle technology. **Chapter 9** Development and Prospects of Clean Coal Technology (4 contact hours; 2 self-study hours) • Development of clean coal technology in the world; • Carbon dioxide and global warming; • Coal based near zero emission polygeneration system. **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score includes: usual performance (30%); final exam (closed book written examination) (70%) Usual performance: attendance; classroom performance
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks
Reading list	1. Required books [1] MAO Jianxiong. *Clean Combustion of Coal.* Beijing: Science Press, 1998 2. Reference books [1] HU Zhengang, HUAN Xinyi. *Introduction of Fuel and Combustion.* Beijing: Tshing Hua University, 1995

	[2] Carl Bozutto. *Clean Combustion Technologies*. Alstom Incorporated, 2009 [3] CAO Zhenyan. *Clean Coal Technology of China.* Beijing: China Materials Press, 1997

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 Professor HUANG Diangui Asociate professor YANG Fan Asociate professor CHEN Eryun Lecturer ZHANG Guanhua
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. 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. 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.
Type of teaching, contact hours	Target students: seniors of energy and power engineering related programs Type of teaching: theoretical teaching, computer practice Contact hours: 48 hours Of which: Theoretical teaching: 24 hours Experiment / practice teaching: 0 hour Computer practice: 24 hours Size of class: No more than 60 students for theoretical teaching; no more than 60 students for computer practice
Workload	Workload= 90 hours Contact hours = 48 hours 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: CFD Numerical Simulation is an elective course offered for 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. • **Knowledge:** Flow conservation equation and numerical discretization method; determination of boundary conditions; method for solving linear equations; processing and analysis of simulation results etc. • **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. • **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) **Chapter 1** Introduction (4 contact hours; 4 self-study hours) • Brief introduction of basic principles, development and application of fluid mechanics; • Fluid mechanics control equation;* • Mathematical properties of fluid mechanics control equation. **Chapter 2** One Dimensional Compressible Flow Differential Method of Euler Equation (8 contact hours; 8 self-study hours) • One-dimensional shock tube problems; • One-dimensional Euler conservation equations;* • Space discretization of convection term;** • Time marching scheme;* • Programming for numerical calculation of one dimensional Euler equation.*

	Chapter 3 Finite Volume Method of 2-D Non-compressible Viscous Flow N-S Equation (8 contact hours; 8 self-study hours) • Control equation of two-dimensional square cavity driven; • Finite volume discretization of two-dimensional N-S equation;** • Staggered mesh;* • Discrete boundary conditions;* • Calculation steps of the Simple algorithm.* **Chapter 4** Preliminary Application of CFD Commercial Software (4 contact hours; 4 self-study hours) • Review of some key problems in calculation fluid mechanics;* • Introduction of mature commercial software; • Application of NUMECA software.* **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (24 contact hours; 18 self-study hours) 1) 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); 2) 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); 3) Two-dimensional simulation of viscous flow with NUMECA (including mesh generation, solving and analysis) (6 contact hours; 4 self-study hours); 4) 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

	2. Reference books [1] *Computational Fluid Mechanics Analysis -- Principles and Application of CFD Software*, WANG Fujun, Tsinghua University Press, 2004 [2] Engineering Fluid Mechanics, GUI Keting, Science Press, 2004 [3] *Numerical Heat Transfer,* TAO Wenquan, Xian Jiaotong University Press, 2001 [4] *Computational Fluid Dynamics: The Basic with Applications*. John D. Anderson Jr.McGraw-Hill, Inc.1995 3. Other materials [1] PPT courseware (self-compiled)

Energy and Environment

Competence field	Electives
Module designation	Energy and Environment
Code, if applicable	11000690
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Associate Professor ZHAO Bingtao
Lecturer	Associate Professor GUAN Xin Associate Professor XIE Yingming Associate Professor WANG Zilong Lecturer YANG Liang Lecturer HUANG Xiuhui Lecturer YING Zhi
Language	Chinese & English
Relation to curriculum	Energy and Environment is an elective course offered to seniors of Renewable Energy Engineering program. After taking courses in Engineering Thermodynamics, Heat Transfer, Engineering Fluid Mechanics and Fundamentals of New Energy Theory, students can, through the study of this course, study the relationship of energy and social economic development, energy flows and supplies, energy production and consumption, fossil fuels and their environment impacts, utilization and environment effects of solar energy, nuclear energy, wind energy, biomass energy, geothermal energy, ocean energy, natural gas hydrates, and consequently, improve scientific and reasonable aspect of pollutant emission and control. As a link between theoretical study and practical work, the course is an important way of cultivating students' abilities in solving problems of environment pollution and resource waste.
Type of teaching, contact hours	Target students: seniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching Contact hours: 48 hours Of which Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: No more than 50 students for theoretical teaching

Workload	Workload= 90 hours Contact hours = 48 hours 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 New Energy Theory; Energy Management
Module objectives/intended learning outcomes	Module objectives: The task of this course is to enable students to understand the environmental problems during using energy and how to develop sustainable energy. Specific objectives include: • **Knowledge:** Understand the relationship of energy and social economic development and the importance of protecting the environment for sustainable development; master basic knowledge required by energy-saving and environmental protection such as origins of fossil fuels, energy production, conversion and utilization, environment impacts of energy supplies and development of clean renewable energy; master principles of improving energy conversion efficiency and saving energy. Through this course, students can find the direction of developing sustainable energy. • **Skills:** Master basic theoretical knowledge about increasing efficiency of energy exploitation, improving technology of energy conversion, reducing energy waste and increasing recycling of energy resources; raise concern about threats to environment and health from energy production and utilization; acquire skills about solving environment problems such as waste gas, waste water and waste residue; master advanced renewable energy technology including system integration and equipment development of renewable energy. • **Competences:** Students can acquire understanding of the whole energy supply system and innovative thinking on achieving sustainable development of energy and environment.
Content	**Part A Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1** Introduction (2 contact hours; 2 self-study hours) • Energy use for industry; • Environmental costs of energy consumption.

	Chapter 2 Energy Flows and Supplies (4 contact hours; 4 self-study hours) • Prologue on energy and sustainability; • Natural energy flows;** • Human energy consumption; • Human energy sources.* **Chapter 3** Fossil Fuels and Their Environmental Impacts (8 contact hours; 8 self-study hours) • Origins of fossil fuels; • Coal and Its environmental impact;** • Petroleum and its environmental impact;** • Natural Gas and its environmental impact.* **Chapter 4** Nuclear Energy and Its Environmental Impacts (6 contact hours; 6 self-study hours) • Introduction to nuclear fission and nuclear fusion; • Nuclear fission fuel;* • Nuclear reactors and nuclear power;** • Attitudes towards nuclear power. **Chapter 5** Solar energy (6 contact hours; 6 self-study hours) • Solar thermal electricity;** • Photovoltaic electricity;** • Efficiency and disadvantages of solar power. **Chapter 6** Wind Energy (6 contact hours; 6 self-study hours) • The history of wind energy; • Wind power plants;** • The environment impact of wind power.* **Chapter 7** Biomass Energy (4 contact hours; 4 self-study hours) • Biomass and utilization of biomass energy;** • Biomass for electricity and its environment impact. **Chapter 8** Ocean Energy (4 contact hours; 2 self-study hours) • Types of ocean energy; • Ocean thermal energy conversion;* • Tidal power and its environment impact.* **Chapter 9** Geothermal Energy (4 contact hours; 2 self-study hours) • Thermal energy in the earth; • Uses of geothermal energy;* • Geothermal power plants;** • Geothermal energy and its environment impact. **Chapter 10** Natural Gas Hydrates (4 contact hours; 2 self-study hours)

	• Natural gas hydrates in the earth; • Exploitation of gas hydrates;** • Application of gas hydrates technology;* • Gas hydrates and its environment impact. **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score is based on usual performance and final exam. Usual performance is based on attendance, assignment and classroom performance and accounts for 30% of final score; final exam is presentation and accounts for 70% of final score.
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks
Reading list	1. Required books [1] ZHOU Naijun. *Energy and the Environment*. Changsha: Central South University Press, 2008 2. Reference books [1] LI Rundong, *et al*. *Introduction to Energy and the Environment*: Beijing: Chemical Industry Press, 2013 [2] FENG Junxiao, *et al*. *Energy and the Environment*. Beijing: Metallurgical Industry Press, 2011 [3] FAY James A, *et al. Energy and the Environment*. New York: Oxford University Press. 2002 3. Other materials [1] PPT courseware (self-compiled)

Thermal Power Plants

Competence field	Electives
Module designation	Thermal Power Plants
Code, if applicable	11000790
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Associate Professor LI Kequn
Lecturer	Associate Professor XIE Yingming Associate Professor GUAN Xin Associate Professor ZHAO Zhijun Associate Professor SUN Xiaojing Lecturer HAO Xiaohong
Language	Chinese
Relation to curriculum	Thermal Power Plant is an elective course for seniors of Renewable Energy Engineering program. It is a comprehensive engineering application course based on courses such as Engineering Thermodynamics, Engineering Fluid Mechanics and Heat Transfer. Through this course, students are able to review previous basic courses, understand the difference and linkage between different courses and the application of each course in actual engineering work, and learn how to use acquired knowledge to solve complex engineering problems. Besides, students can understand basic principles of thermal power plant, develop abilities in conducting thermal system related analysis and calculation work, learn how to analyze ways of improving thermal economy of power plant, learn to explore best ways for thermal system connection, and train students in analyzing and solving engineering technical problems of power plant.
Type of teaching, contact hours	Target students: seniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching Contact hours: 48 hours Of which Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: No more than 50 students for theoretical teaching

Workload	Workload= 90 hours Contact hours = 48 hours 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; Thermal Engineering; Biomass Conversion and Utilization
Module objectives/intended learning outcomes	Module objectives: • **Knowledge:** Theoretical basis of heat conversion of different thermodynamic cycle; basic theories of thermodynamic cycles of large-scale conventional thermal power plants and other thermoelectric generating sets with development prospect; development trend and application prospect of modern technology. • **Skills:** With thermal equipment and thermal system of steam turbine of thermal power plant as the focus and safety, economy, flexibility and environmental-friendliness as the preconditions, students are able to analyze the economic benefits of thermal power plant and develop a concept which emphasizes integration of safety and benefits (economic benefits, social benefits and environmental benefits). Students are able to conduct thermal system related analysis and calculation work, search ways for improving thermal economy of power plant and explore best ways for thermal system connection. • **Competences:** Be able to conduct thermal power generation related work in the future, analyze and solve engineering technical problems of power plant, and find ways to solve engineering technical work so as to lay a foundation for students further study (postgraduate work) and future research work on thermal power generation.
Content	**Part A Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1** Evaluation of Thermal Power Plant (8 contact hours; 6 self-study hours) • Safety of thermal power plant; environmental evaluation of thermal power plant;** • Thermal economic evaluation of thermal power plant; thermal economic performance of condensing power

	plant; index system of technical and economic comparison of power plant & economic benefits;** • Sustainable development of energy and electric power industry in China.* **Chapter 2** Steam Parameter and Cycle of Thermal Power Plant (4 contact hours; 4 self-study hours) • Improve the initial steam parameters; reduce the final steam parameters;** • Water supply extraction cycle; steam reheat cycle; heat and electricity cogeneration cycle.** **Chapter 3** New Type Power Cycle(4 contact hours; 4 self-study hours) • Gas and steam combined cycle; • Nuclear power plant. **Chapter 4** Water Supply Extraction & Heating Cycle (8 contact hours; 8 self-study hours) • Concepts and classification of thermodynamic system;* • Extraction (units) thermodynamic system of principles;* • Operation of extraction heat booster.* **Chapter 5** Feed Water Deaerator and Auxiliary Steam Water System of Power Plant (4 contact hours; 2 self-study hours) • Steam water loss and supplement of thermal power plant; continuous blowdown recovery system of boiler;* • Chemical deoxygenation; thermal deaerator and thermal system of principle; • Operation of deaerator. **Chapter 6** Economy and Heating System of Thermal Power Plant (6 contact hours; 6 self-study hours) • Characteristics of heat load and heat carrier selection; • Main thermal economic indicators of thermal power plant; external heating system of thermal power plant; • Economic analysis of thermal power plant. **Chapter 7** Thermodynamic System of Principle of Thermal Power Plant (10 contact hours; 10 self-study hours) • Formulation of thermodynamic system of principle of thermal power plant;* • Examples of thermodynamic system of principle of thermal power plant.* **Chapter 8** Overall Thermodynamic System of Thermal Power Plant (4 contact hours; 2 self-study hours) • Concepts of overall thermodynamic system of thermal

	power plant; basic knowledge of pipes and valves;* • Main steam system; bypass system; feed water system and feed water pump configuration;extraction system;* • Plant public water system; examples of overall thermodynamic system of thermal power plant.* **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Usual performance accounts for 30% of final score and is based on attendance rate and assignment; final score accounts for 70% of final score (closed book written examination)
Media employed	Multimedia computers, projector
Reading list	1. Required books: [1] *Thermal Power Plant.* ZHENG Tikuan. Beijing: China Electric Power Press, 2001 2. Reference books (English reference book required) [1] *Thermal Power Plant.* YE Tao. Beijing: China Electric Power Press, 2004 [2] *Steam Power Engineering: Thermal and Hydraulic*. Seikan Ishigai. UK: Cambridge University Press, 2009

Gas Turbine Theory and Application

Competence field	Electives
Module designation	**Gas Turbine Theory and Application**
Code, if applicable	11001820
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Professor DAI Ren
Lecturer	Professor DAI Ren Associate Professor ZHAO Zhijun Lecturer CHEN Liu
Language	Chinese
Relation to curriculum	The course focus on issues related to gas turbine including working principles, structure, cycle mode and calculation, off-design characteristics and operation start-up/speed reduction characteristics. The course also introduces classification and application of gas turbine and characteristics of different types of gas turbine. The course, based on courses such as Principles of Steam Turbine, is designed for enhancing students' knowledge and abilities in regard to power machinery.
Type of teaching, contact hours	Target students: seniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching; course practice Contact hours: 48 hours Of which, Theoretical teaching: 44 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Class practice: 4 hours Size of class: 60 students
Workload	Workload= 90 hours Contact hours = 48 hours Self-study hours = 42 hours
Credit points	3.0
Requirements according to the examination regulations	Class attendance rate over 2/3
Recommended prerequisites	Engineering Thermodynamics; Heat Transfer; Engineering Fluid Mechanics; Applied Physical Chemistry
Module objectives/intended learning outcomes	Module objectives: With a focus on practical knowledge, the course mainly introduces power station gas turbine. It also introduces characteristics of marine gas turbine and aero-engine.

	• **Knowledge:** Issues related to gas turbine including working principles, structure, cycle mode and calculation, off-design characteristics and operation start-up/speed reduction characteristics. • **Skills:** On the basis of understanding of gas turbine, master basic theories and principles regarding issues concerning gas turbine such as selection, operation and design. • **Competences:** Acquire a full understanding of principles, structure, operation and application of gas turbine; prepare for future work and technical exchange.
Content	**Part A Theoretical teaching** (44 contact hours; 38 self-study hours) **Chapter 1** Introduction (4 contact hours; 2 self-study hours) • Components of gas turbine device;* • History of gas turbine; • Structural characteristics of modern gas turbine;* • Technical economy of modern gas turbine;* • Major problems and development trend of gas turbines in foreign market.* **Chapter 2** Thermal Cycle of Gas Turbine (12 contact hours; 10 self-study hours) • Thermal cycle of gas turbine;** • Main index of gas turbine cycle;** • Ideal simple cycle of isobaric gas turbine;** • Ideal regenerative gas turbine cycle;** • Ideal intercooled cycle and optimal distribution of pressure ratio;** • Ideal reheat cycle and complex cycle;** • Analysis of difference between gas turbine real cycle and ideal cycle;** • Gas turbine actual cycle performance;** • Impact of shafting scheme on cycle design parameters;* • Aero-engine cycle;* • Closed gas turbine cycle;* • Internal combustion engine gas turbine combined cycle;* • Gas turbine cycle calculation.* **Chapter 3** Gas Turbine Combustion Chamber (6 contact hours; 6 self-study hours) • Basic requirements of isobaric combustion chamber;**

	• Structure and form of combustion chamber;* • Combustion process and combustion chamber air flow organization.* **Chapter 4** Off-design of Gas Turbine Set (10 contact hours; 10 self-study hours) • Significance and purpose of study off-design of gas turbine;** • Calculation of partial loading of gas turbine set;** • Off-design of single-shaft gas turbine;* • Off-design of split-shaft gas turbine;* • Off-design of double-shaft gas turbine set;* • Off-design of three-shaft gas turbine set;* • Impact of backheating, reheating and intercooling on off-design of gas turbine set;** • Impact of climate and altitude on performance of gas turbine;** • Dimensionless similarity network of single-shaft and split-shaft gas turbine set; • Cycle of closed gas turbine. **Chapter 5** Operation and Transient Off-design of Gas Turbine (6 contact hours; 6 self-study hours) • Start-up and acceleration of gas turbine;** • Type of starter machine of gas turbine set;* • Deceleration process of gas turbine;* • Causes of gas turbine fault and treatment;* • Maintenance of gas turbine.* **Chapter 6** Application and Structure of Gas Turbine (6 contact hours; 4 self-study hours) • Classification and application of gas turbine and its relationship with environmental resources;** • Characteristics and requirements of large/medium power generation and machinery power related gas turbine;** • Characteristics and requirements of vehicular gas turbine;** • Models and requirements of aero gas turbine;* • Application of nuclear gas turbine.* **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour) **Part D Classroom exercise** (4 contact hours; 4 self-study hours) (1) Specific power of gas turbine cycle/efficiency calculation/thermal cycle calculation;**

	(2) Calculation off-design of gas turbine;*
Study and examination requirements and forms of examination	Usual performance accounts for 30% of final score (including attendance, classroom performance and assignment); final exam accounts for 70%; final exam is closed book written examination
Media employed	Multimedia computers, projector, laser pointers, blackboard, chalks
Reading list	1. Required books [1] *Gas Turbine Device* (2nd edition). SHEN Bingzheng, HUANG Xichen. Beijing: Machinery Industry Press, 1991 2. Reference books [1] *Gas Turbine and Steam Turbine*. WENG Shilie. Shanghai Jiaotong University Press, 1996 [2] *Principles of Aero Gas Turbine*. PENG Zeyan, LIU Gang. Beijing: National Defense Industry Press, 2000 [3] *Working Principles and Performance of Gas Turbine.* ZHU Xingjian. WANG Xueyu. Beijing: Science Press, 1992 [4] *Basics of Design of Gas Turbine*. ZHONG Fangyuan. Machinery Industry Press, 1987.2 [5] *Gas Turbine Power Generation Device and Application.* LIN Rumo, JIN Hongguang. China Electrical Power Press, 2004.9

Combined-Cycle System

Competence field	Electives
Module designation	Combined-Cycle System
Code, if applicable	11000650
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Professor DAI Ren
Lecturer	Professor DAI Ren Associate Professor WANG Haimin Lecturer CHEN Liu
Language	Chinese
Relation to curriculum	With steam-gas combined cycle system as its subject, Combined-Cycle System is an elective course offered to seniors of Renewable Energy Engineering program and related programs. After completing courses such as Heat Transfer, Engineering Fluid Mechanics, Engineering Thermodynamics, and understanding working principles, structure and design method of major thermal and power machinery such as gas turbine, boiler and turbine, students may further learn how to establish energy efficient power plant by using those devices and system. The course introduces issues concerning combined cycle power plant such as basic concepts of thermodynamics, analysis of cycle parameters and valuation of economy of operation. By taking this course, student may acquire basic knowledge about combined cycle and understand research development of combined cycle. 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.
Type of teaching, contact hours	Target students: seniors of Renewable Energy Engineering program and related programs Type of teaching: theoretical teaching Contact hours: 48 hours Of which, Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: No more than 50 students for theoretical
Workload	Workload= 90 hours Contact hours = 48 hours Self-study hours = 42 hours

Credit points	3.0
Requirements according to the examination regulations	Class attendance rate over 2/3
Recommended prerequisites	Machine Design; Heat Transfer; Engineering Fluid Mechanics; Thermal Engineering; Applied Physical Chemistry; Thermal Engineering
Module objectives/intended learning outcomes	Module objectives: • **Knowledge:** Basic thermodynamic concepts of combined cycle power plant; basic heat transfer theories and parameter analysis of different thermal cycle; different types of combined cycle; thermodynamic concepts of combined cycle and research development of combined cycle; current situation and application prospect of modern technology. • **Skills:** Students are able to evaluate the economy of combined cycle power plant, engage in work related to combined cycle power generation, analyze and solve technical problems of power plant, and find solutions to technical problems in future work. • **Competences:** Lay a foundation for students' future work and research on combine cycle power generation.
Content	**Part A Theoretical teaching** (48 contact hours; 42 self-study hours) **Chapter 1** Basics of Thermodynamics (6 contact hours; 6 self-study hours) • Performance index of power plant;** • Carnot cycle and other cycles;** • Technical measures for increasing cycle heat efficiency;** • Reversibility/availability/usage of cycle. **Chapter 2** Different Types of Combined Cycle (6 contact hours; 6 self-study hours) • Double cycle of single working fluid;** • Closed cycle of multi-working fluid;** • Open/closed cycle of double working fluid;** • Double working fluid & double open cycle.** **Chapter 3** Thermodynamic Concepts of Combined Cycle (6 contact hours; 6 self-study hours) • Series type combined cycle power plant;** • Parallel type combined cycle power plant;** • Series/parallel type combined cycle power plant;** • Open/closed combined cycle power plant;** • Gas/steam combined cycle analysis.**

	Chapter 4 Analysis of Parameter of Combined Cycle (6 contact hours; 6 self-study hours) • Analysis of parameter of combined cycle on the basis of parts performance;** • Analysis of parameter of combined cycle on the basis of major thermal parameters;** **Chapter 5** Analysis of Available Energy Loss (6 contact hours; 4 self-study hours) • Irreversible power loss of parts; analysis of exergy loss of steam double cycle;* • Analysis of exergy loss of CCGT combined cycle (with feed water preheating);* • Analysis of exergy loss of CCGT combined cycle (without feed water preheating);* • Analysis of exergy loss of CCGT combined cycle.* **Chapter 6** Analysis of Economy of Combined Cycle (8 contact hours; 8 self-study hours) • Price of electricity; factor of capital cost;* • Cash flow; examples of comparable prices;* • Analysis of economy of combined cycle.* **Chapter 7** Cases of Combined Cycle Power Plant (6 contact hours; 4 self-study hours) • Mercury steam / water vapor combined cycle; • CCGT power plant;* • IGCC power plant;* • STGC power plant. **Chapter 8** Research Development of Combined Cycle (4 contact hours; 2 self-study hours) • Development of CCGT power plant; • IGCC and other combined cycle; • Heat and power co-generation. **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	Final score is based on usual performance and final exam. Final exam accounts for 70%; final exam is open book written examination. Usual performance accounts for 30% of final score (including attendance, classroom performance and assignment).
Media employed	Multimedia computer
Reading list	1. Required books [1] *Gas-steam Combined Cycle.* JIAO Shujian. Beijing: Machinery Industry Press, 2003 2. Reference books

	[1] *Power Generation Technology of Gas-steam Combined Cycle*. XIANG Wenguo. Beijing: China Electrical Power Press, 2004 [2] *Combined Power Plants: Including Combined Cycle Gas Turbine (CCGT) Plants*. Horlock, J. H. Pergamon Press, 1990 [3] *Coal Gas-steam Combined Cycle Device*. JIAO Shujian. Beijing: Tsinghua University Press, 1994

Foreign Language

Fundamental English

Competence field	Foreign Language
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 Associate Professor LIN Shanling Associate Professor YANG Tao Associate Professor NI Xiujing Associate Professor ZHANG Ziqin Lecturer HU Yinping Lecturer ZHENG Dahu Lecturer ZHANG Wuhan Lecturer WEN Yan Lecturer LIU Sha Lecturer XUE Xiangying Lecturer DENG Yongping Lecturer CHEN Yonggang Lecturer HUANG Chen Lecturer QIAO Xiaohong Lecturer PAN Yuhua Lecturer MA Xiaohong 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 programs 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 programs, 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: freshmen of non-English programs Type of teaching: most of the time is for lectures, and some time is for classroom presentations and discussions Contact hours: 48 hours Of which, Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: 40-60 students
Workload	Workload = 48 hours 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	None
Module objectives/intended learning outcomes /	Module objectives: 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. • **Knowledge:** Pronunciation and spelling rules of English words, grammar rules, discourse rules, English speech and writing styles, intercultural communication principles. • **Skills:** Basic listening, speaking, reading, writing and translation skills. • **Competences:** Being able to express one's opinions both orally and in the written form.
Content	**Part A Theoretical teaching** (48 contact hours) **Chapter 1** Pronunciation Learning (10 contact hours) • Vowels and consonants;* • Pronunciation and spelling rules of English words;* • Reduced sounds;* • Liaison;* • Assimilation;* • Stressed syllables;* • Sentence stress and rhythm;** • Intonation and attitude;* • Pronunciation guides for different dialect speakers. **Chapter 2** How To Expand English Vocabulary (8 contact hours)

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

	attendance, assignments and mid-semester examination; final exam (closed book written examination) accounts for 40%; oral test accounts for 10%.
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	1. Recommended book [1] Qin Xiubai, Jiang Jingyi, *Integrated Course Book 1, New Century College English*, Shanghai Foreign Language Education Press, 2012. 2. Reference books [1] Zheng Shutang, *Listening and Speaking Book 1, New Horizon College English*, Foreign Language Teaching and Research Press, 2011. [2] Shu Dingfang, Fast Reading Book 1, *New Century College English*, Shanghai Foreign Language Education Press, 2012. [3] Huang Yuanshen, Qin Xiubai, Reading Book 1, *New Century College English*, Shanghai Foreign Language Education Press, 2012. [4] Tu Pei, *Practical Course of English Pronunciation*, Foreign Language Teaching and Research Press, 2005. 3. Other resources [1] http://open.163.com/. [2] http://ocw.mit.edu/courses/writing-and-humanistic-studies. [3] http://www.bbc.com/. [4] http://edition.cnn.com/.

Intensive English

Competence field	Foreign Language
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 Lecturer HE Zhengye Lecturer SHI Yili 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: freshmen of non-English programs Type of teaching: most of the time is for lectures, and some time is for classroom discussions and group work Contact hours: 48 hours Of which, Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class:40-60 students
Workload	Workload = 48 hours 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 /	Module objectives: 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. • **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. • **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. • **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) **Chapter 1** Clarification and Orientation (8 contact hours) • Self-introduction;* • 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;** • Orientations on how the goal of English Band 2 is supposed to be achieved and what they are expected to do;* • Sectioning students into groups. **Chapter 2** Routine Lectures (12 contact hours) • Pre-reading assignments; • Checking pre-reading assignments; introduction of back-ground information; explanation of terminologies or peculiar concepts, theme-related discussion;* • Global reading: analysis of the structure of passages, patterns and skills of writing, etc.** • 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;** • After-reading: checking their grasp of required information and knowledge; further discussion of the same topic from a different but related perspective;* • Extensive reading: supplementary reading material with tasks designed for group work or self-study;* • Listening exercises including situation-based and function-based tasks;* **Chapter 3** Mid-term Exam and Preparation & Review(8 contact hours) • Review of the materials learnt so far and key language points and skills;* • Review of the test paper and reflection on the problems to be worked on and plans for future improvement;*

	Chapter 4 Routine Lectures (12 contact hours) • Pre-reading assignments; • Checking pre-reading assignments; introduction of back-ground information; explanation of terminologies or peculiar concepts, theme-related discussion;* • Global reading: analysis of the structure of passages, patterns and skills of writing, etc.;** • 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;** • After-reading: checking their grasp of required information and knowledge ; further discussion of the same topic from a different but related perspective;* • Extensive reading: supplementary reading material with tasks designed for group work or self-study;* • Listening exercises including situation-based and function-based tasks;* **Chapter 5** Review and Oral Exam (8 contact hours) • Review of the materials learnt in the latter half of the semester and key language points and skills and important questions discussed in class;* • Oral exam. **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	After-class exercises should be completed by students independently after each class. Usual performance accounts for 50%, consisting of attendance, assignments and mid-semester examination; final exam (closed book written examination) accounts for 40%; oral test accounts for 10%.
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	1. Recommended book [1] *Longman Dictionary of Contemporary English*, The Commercial Press, first edition,1998. [2] Wang Wenchang, *A Dictionary of English Collocations*, Modern Press, 1994 [3] Ma Degao, *New Requirements for the Vocabulary of CET-4*, Foreign Language Education Press, 2009

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

Interactive Practical English

Competence field	Foreign Language
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 Associate Professor WEI Yongjia Lecturer HE Zhengye Lecturer JIN Zhaohui Lecturer LI Qin Lecturer SHI Yili 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 programs 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: sophomores of non-English programs Type of teaching: Lectures, discussions and students' presentations

	Contact hours: 48 hours Of which, Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour Computer practice: 0 hour Size of class: 40-60 students
Workload	Workload = 48 hours 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; Intensive English
Module objectives/intended learning outcomes /	Module objectives: 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. • **Knowledge:** students are required to master the reading and listening materials the course has provided and obtain the corresponding vocabulary. • **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. • **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. 1) Vocabulary: to master 4500-5000 words and expressions;

	2) Listening: to understand the lecture in the class or on general topics and daily conversations; 3) Speaking: to talk fluently in English with foreigners by using certain conversation strategies, discuss on a topic and give a presentation after preparation; 4) Reading: to understand English articles of medium difficulty, grasp the main idea and details, identify the attitude and comment with effective reading techniques; 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. 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) **Chapter 1** Friendship (6 contact hours) • Background information; • Organization of the passage;** • Text understanding, words and expressions;** • Discussion;**: 1. What are your criteria for making friends? 2. What can we do to keep friendship as long as possible? • Presentation;* • Exercises (self-study);** **Chapter 2** Love (8 contact hours) • Background information; • Organization of the passage;** • Text understanding, words and expressions;** • 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? • Presentation;* • Exercises;** (self-study) **Chapter 3** Happiness (10 contact hours)

	• Background information; • Organization of the passage;** • Text understanding, words and expressions;** • Discussion;**: What do you think are the keys to happiness? Why? • Presentation;* • Exercises (self-study);** **Chapter 4** Health (8 contact hours) • Background information; • Organization of the passage;** • Text understanding, words and expressions;** • Discussion;**: What do you think are the criteria of being healthy? • Presentation;* • Exercises;** (self-study) **Chapter 5** Education (10 contact hours) • Background information; • Organization of the passage;** • Text understanding, words and expressions;** • Discussion:** 1. What is your idea of an ideal university life? 2. How does education improve your life? 3. How does cyber education benefit students? • Presentation;* • Exercises (self-study);** **Chapter 6** Intercultural Communication (6 contact hours) • Background information; • Organization of the passage;** • Text understanding, words and expressions;** • Discussion;**: Do you sometimes find it difficult to adapt to a new environment? Why? Please give some examples. • Presentation;* • Exercises (self-study);** **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination requirements and forms of examination	After-class exercises should be completed by students independently after each class. Usual performance accounts for 50%, consisting of assignments, mid-semester examination discussion, presentation and attendance; final exam (closed book written examination) accounts for 40%; oral test accounts for 10%.

Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	Recommended book [1] Qin Xiu bai, Zhang Fengchun, *Zooming in: An Integrated English Course*, Shanghai Foreign Language Education Press, 2007 [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 [4] Susan Stempleski, Yang Huizhong, *Video Course*, Shanghai Foreign Language Education Press, 2007

Interactive Comprehensive English

Competence field	Foreign Language
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 Lecturer JIN Zhaohui 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 programs. 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: sophomores of non-English programs Type of teaching: Some time is for lectures, and some time is for classroom discussions and presentations. Contact hours: 48 hours Of which, Theoretical teaching: 48 hours Experiment / practice teaching: 0 hour

	Computer practice: 0 hour Size of class: 40-60 students
Workload	Workload = 48 hours 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, 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 /	Module objectives: • **Knowledge:** Students are required to master the reading and listening materials the course has provided and obtain the corresponding vocabulary. • **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: • **Competences:** ■ 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. 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. 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. 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. 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) **Chapter 1** Man and Society (6 contact hours) • Grasp the main idea;** • Appreciate the various techniques employed by the writer;** • 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;** • Do more research on man's footprints on the environment.* **Chapter 2** Man and Technology (6 contact hours) • Understand the main idea;** • Learn to use various resources for information;** • Grasp 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;** • Do more research on the relationship between man

	and technology.* **Chapter 3** Knowledge and Knowledge Transfer (6 contact hours) • Grasp the main idea;** • Learn to use various techniques in writing more effectively and to use keywords for more efficient reading;** • 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;** • Develop the ability of solving problems. **Chapter 4** Work and Career (6 contact hours) • Understand the main idea and structure of the text;** • Appreciate the difference between formal speech and informal speech;** • Grasp 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;** • Do more research on the difference between work and career.* **Chapter 5** Fame and Success (6 contact hours) • Understand the main idea and the structure of the text;** • Learn to memorize words in association;** • Grasp 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;** • Do more research on celebrities' privacy. ;* **Chapter 6** Attitudes to Life (6 contact hours) • Grasp the main idea and the structure of the text;** • Appreciate the various techniques employed by the writer;** • 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;** • Do more research on the meaning of life.* **Chapter 7** Lifestyles (6 contact hours) • Understand the main idea;** • Appreciate the various techniques employed by the

	writer;** • 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;** • Do more research on various lifestyles.* **Chapter 8** Literary Appreciation (6contact hours) • Grasp the main idea and structure of the text;** • Appreciate the writing strategies employed by the author;** • 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;** • Do more research on the role of literature in our life.* **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (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 50%, consisting of assignments, class performance, mid-semester examination and attendance; final exam (closed book written examination) accounts for 30%; oral test accounts for 10%; self-access learning accounts for 10%.
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	1. Recommended book [1] Qin, Xiubai and Liu, Jianbo, *Zooming In: An Integrated English Course (1st edition)*, Shanghai Foreign Language Education Press, 2008 [2] Huang, Yuanshen, *Learning to Read: An English Reading Course 3 (1st edition)*, Shanghai Foreign Language Education Press, 2008 [3] Zheng, Shutang, *New Horizon College English: Speaking, Listening and Viewing 3(2nd edition)*, Foreign Language Teaching and Research Press, 2011

Reading and Writing in Technical English

Competence field	Foreign Language
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
Language	Chinese & English
Relation to curriculum	Reading and Writing in Technical English is a basic course of Renewable Energy 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	Target students: sophomores of science and engineering majors Contact hours: 48 hours Of which, Theoretical teaching: 48 hours Experiment / practice teaching: 0 hours Computer practice: 0 hour Size of class: no more than 60 students for theoretical teaching
Workload	Workload = 48 hours Contact hours = 48 hours 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	Fundamental English; Intensive English
Module objectives/intended learning outcomes	Module objectives: • **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. • **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. • **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) **Chapter 1** Introduction to Thermal Science • Fundamental of Engineering Thermodynamics;* • Fundamental of Fluid mechanics;* • Fundamental of Heat Transfer.* **Reading and Translation** (4 contact hours): Introduction to Thermal Science Fundamental of Engineering Thermodynamics; Fundamental of Fluid Mechanics; Fundamental of Heat Transfer.* **Video watching and practice** (2 contact hours).***** **Chapter 2** 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. **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.* **Video watching and practice** (2 contact hours).*

	Chapter 3 Introduction to Environmental Control and Renewable Energy • Ash Collection, Reducing Sulphurate Oxides and Nitric Oxides Emission;* • Nuclear Energy; • Renewable Energy. Reading and Translation (4 contact hours): Introduction to Environmental Control and Renewable EnergyAsh Collection; Reducing Sulphurate Oxides and Nitric Oxides Emission; Nuclear Energy; Renewable Energy.* Grammar (4 contact hours): grammar for EST writing 1- Sentence writing.** Simulated writing (2 contact hours): 1- Resume.* Video watching and practice (2 contact hours).* **Chapter 4** Introduction to Instrumentation and Process Control • Documentation and symbols; • Essential instrumentation and Controls. Reading and Translation (2 contact hours): Introduction to Instrumentation and Process Control Documentation and symbols; Essential Instrumentation and Controls.* Grammar (2 contact hours): Characteristics of writing in professional English.** Simulated writing (2 contact hours): 2- Cover letter.** Video watching and practice (2 contact hours).** **Chapter 5** Introduction to Air conditioning and Refrigeration • Air conditioning; Refrigeration;** • Cryogenics. Reading and Translation (4 contact hours): Introduction to Air Conditioning and Refrigeration Air conditioning; Refrigeration; Cryogenics.* Grammar (2 contact hours): Writing practice of sentences and paragraphs.** Writing practice (2 contact hours): 3-Abstract I.** Video watching and practice (2 contact hours).** **Chapter 6** Reading of latest professional literature Grammar (2 contact hours): Correction practice.** Writing practice (2 contact hours): 4-Abstract II.* Video watching and practice (2 contact hours).* **Part B Experiment / practice teaching** (0 hour) **Part C Computer practice** (0 hour)
Study and examination	Final score is based on usual performance and final exam.

requirements and forms of examination	Usual performance: literature translation (10%); listening comprehension practice (10%); writing practice (10%); final exam and oral exam account for 70% of final score.
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 [2] YAN Weiping et al. *Specialty English for Thermal Energy and Power Engineering* (3rd edition), China Electric Power Press, 2009 2. Reference books [1] ZHANG Yinping et al. *English for Institutions of Higher Learning* (1st edition), China Architecture & Building Press, 2005 [2] WANG Jianwu et al. *EST Writing: Writing Skills and Model Essays* (1st edition), Xian: Northwestern Polytechnical University, 2000 [3] ASHRAE fundamentals handbook 2001 [4] ASHRAE system and equipment handbook 2000 3. Experiment/computer practice instruction books Self-compiled 4. Other materials [1] PPT courseware (self-compiled) [2] Supplementary reading and writing teaching materials (self-compiled)

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 Renewable Energy 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, Manufacturing Technology of Thermal Power Machinery etc.
Type of teaching, contact hours	Target students: juniors of Renewable Energy Engineering program and related programs Type of teaching: Practice teaching and a small amount of after-school exercises Contact hours: 60 hours Of which, Theoretical teaching: 12 hours Experiment / practice teaching: 40 hours Computer practice: 8 hours (NC technical programming on computer)

	Size of class: 40-60 students
Workload	Workload = 90 hours Contact hours = 60 hours 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 Engineering Drawing, Machine Design
Module objectives/intended learning outcomes /	Module objectives: 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 Principles and Design of Heat Exchanger, Manufacturing Technology of Thermal Power Machinery 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. • **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. • **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. • **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) • Understand the basics of machining, especially turning. • Understand the relationship among parts machining precision, cutting specifications and machining economic efficiency. • Understand the application of NC technology in turning and the concept of turning mechanization and automation production. • Get familiar with the name of horizontal lathe, the major components and their roles. • 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. **Fitter** (Workload = 16 hours, including 2 hours for theoretical teaching, 8 hours for practice teaching and 6 hours for self-study) • Understand the status and importance of fitter in mechanical manufacture and equipment maintenance. • 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. • 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. • Initially establish the concept of machine production process, and have a complete understanding of map reading, parts manufacture, machine assembly and commissioning. **Casting** (Workload = 16 hours, including 1 hour for theoretical teaching, 9 hours for practice teaching and 6 hours for self-study) • Understand the process and characteristics of casting production. • Understand the structure of sand mould, and the relationship among parts, mould and castings. • Be able to correctly adopt common tools for simple two-box hand molding. • Be able to identify casting process drawings and understand the principles of their formulation. • Understand the general process of casting molding. • Understand common casting defects and their causes. • Understand advanced casting methods and their characteristics. • Briefly understand special casting methods and characteristics. • Understand how to select the content of casting process program and the steps. **Heat Treatment** (Workload = 3 hours, including 0.5 hour for theoretical teaching, 1.5 hours for practice teaching and 1 hour for self-study) • Understand the grades, properties and uses of common steel materials. • Understand Rockwell hardness test method commonly used in production. • Understand spark identification method of steel and the spark characteristics of common carbon steel and cast iron. • Understand common heat treatment equipment. • Understand common heat treatment process methods, types, purpose and application. • Understand basic metallographic structure and metallurgical analysis. **Forging** (Workload = 3 hours, including 0.5 hour for theoretical teaching, 1.5 hours for practice teaching and 1

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

	• Be familiar with the name, motion and function of the main components of universal horizontal miller. • Understand the working characteristics of other milling machine tools and their application occasions. **Grinder** (Workload = 4.5 hours, including 0.5 hour for theoretical teaching, 2 hours for practice teaching and 2 hours for self-study) • Understand the basics of grinding, such as grinding characteristics, major grinding motion, wheel selection, commonly used grinder attachment and grinder working range, etc. • Understand the structural features of grinder, and get familiar with the main components of universal cylindrical grinder and their functions. • Understand the methods and working characteristics of cylindrical grinding, plane grinding and internal grinding. **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) • Understand the characteristics, classification and development of non-traditional machining,. • Understand the working principles, process characteristics and applications of EDM wire cutting. • Understand the functions of NC wire cutting manual programming instruction, and be able to carry out simple parts programming. • Be able to implement wire cutting under the guidance of clinical teachers. • Understand the working principles, features and applications of SEDM. **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) • Understand the application of NC technology in milling. • Understand the motion and control mode of NC miller, and the name and role of main control elements. • Understand the basic types of NC millers and their major structural components. • 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. • Understand the differences among NC machining center, NC miller and NC lathe, and the application range and working features of machining center. • Understand the main components of NC machining center. **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) • Understand the basic principles of NC machining and the role of NC technology in turning. • Understand the motion and control mode of NC lathe, and the name and role of main control elements. • Understand the basic types of NC lathes and their major structural components. • Understand the differences between manual programming and automatic programming, and get familiar with the general format of manual programming and the major instructions. • Prepare simple parts machining process under the guidance of clinical teachers, and independently complete program input, feed-simulation and parts turning. • Understand the major differences between full-function NC lathe and ordinary NC lathe. **Technical Measurement** (Workload = 3 hours, including 1 hour for theoretical teaching, 1 hour for practice teaching and 1 hour for self-study) • Understand the application of high-precision measurement equipment. • Understand the basic types and structural components of high-precision measurement equipment. • 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. 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 [1] ZHU Zhen and WU Xiaozhu, *Engineering Practice and Training (2nd edition)*, Shanghai Science and Technology Literature Publishing House, 2006 2. Reference books [1] WU Xiaozhu and ZHU Zhen, *Technical Surveying Practice and Training (1st edition)*, Shanghai Science and Technology Literature Publishing House, 2008 [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	Associate Professor ZHAO Zhijun
Lecturer	Professor CUI Guomin Professor WU Weidong Professor SHAN Yanguang Associate Professor ZHAO Zhijun Associate Professor CHEN Eryun Associate Professor LI Kequn Associate Professor XIE Yingming Associate Professor WANG Zilong Lecturer HAO Xiaohong Lecturer WEN Zhenzhong Lecturer YANG Liang Lecturer HUANG Xiuhui Lecturer YING Zhi Lecturer CHEN Liu Assistant Researcher HU Xiaohong Assistant Experimentalist HANG Xiaohuang Assistant Experimentalist SHENG Jian Assistant Experimentalist TIAN Chang Assistant Experimentalist ZHANG Huichen Assistant Experimentalist ZHOU Yanfang Assistant Experimentalist LEI Mingjing
Language	Chinese
Relation to curriculum	As one of the most important practical courses of Renewable Energy 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 Renewable Energy Engineering program Type of teaching: experimental teaching Contact hours: 64 hours Of which, Theoretical teaching: 0 hour Experiment / practice teaching: 64 hours Computer practice: 0 hour
Workload	Workload= 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
Requirements according to the examination regulations	Complete all required experiments and submit experimental reports.
Recommended prerequisites	Engineering Fluid Mechanics; Heat Transfer; Fundamentals of New Energy Theory; Measurement and Control Technology of Power Engineering; Pumps and Fans; Biomass Conversion and Utilization; Systems and Equipment of Nuclear Power Plant; Nuclear Reactor Engineering; Fundamentals of Solar Cell; Solar Power Generation and Thermal Utilization, etc.
Module objectives/intended learning outcomes	Module objectives: • **Knowledge:** Measurement principles, technology and testing method of specialized experiment of different courses (Measurement and Control Technology of Power Engineering, Pumps and Fans, Thermal Engineering, Principles and Design of Heat Exchanger, Power-Saving Technology, Systems and Equipment of Nuclear Power Plant, Solar Power Generation and Thermal Utilization, etc.) • **Skills:** Students understand the performance/principles/application method of modern testing technology and inspection instrument of all fields of Renewable Energy 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. • **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.
Content	**Part A Theoretical teaching** (0 hour) **Part B Experiment / practice teaching** (64 experiment hours; 56 self-study hours) Experiments of Renewable Energy Engineering program includes 4 basic energy and power experiments (A) and 12 specialized renewable energy experiments (B).

No.	Experiment	Contact hours	Self-study hours
A1	Pump performance test experiment;*	4	4
A2	Steam turbine equipment experiment;*	4	2
A3	Comprehensive heat transfer performance experiment;*	4	4
A4	Different kinds of wall type heat exchanger performance test experiment;*	4	2
B1	Power test experiment of wind turbine;*	4	4
B2	Airfoil structure test experiment of wind turbine;*	4	4
B3	Aerodynamic test experiment of wind turbine;*	4	4
B4	Performance test experiment of solar collector;*	4	2
B5	Efficiency test experiment of solar thermal power generation;*	4	4
B6	Electrical performance test experiment of solar cells;*	4	4
B7	Performance test of nuclear power plant simulation system;*	4	4
B8	Performance test experiment of biodiesel;*	4	4
B9	Efficiency test experiment of biomass gasification;*	4	4
B10	Test experiment of hydrogen production during distilled water electrolysis;*	4	2
B11	Energy efficiency factor and Faraday efficiency factor test experiment of electrolytic bath;*	4	4
B12	Formation kinetic experiment of nautral gas hydrates;*	4	4

Part C Computer practice (0 hour)

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 [1] Energy Power Experimental Teaching Center. Experiment Instruction Books for Power Engineering and Renewable Energy Engineering Programs. USST, 2016 2. Reference books [1] TANG Jinwen. *Thermal Measurement Technology*. Chongqing: Chongqing University Press, 2007 [2] LÜ Chongde. *Measurement and Handling of Thermal Parameter* (2nd edition). Beijing: Tsinghua University Press, 2001 [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	11000271
Subtitle, if applicable	
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Associate Professor ZHAO Bingtao
Lecturer	Professor DOU Binlin Professor CUI Guomin Associate Professor LI Kequn Associate Professor GUAN Xin Associate Professor MEN Chuanling Associate Professor XIE Yingming Associate Professor WANG Zilong Lecturer HAO Xiaohong
Language	Chinese
Relation to curriculum	Professional Comprehensive Course Design is a practical designing course offered for undergraduates of Renewable Energy Engineering program. After completing all engineering courses, students may take this course to conduct theoretical calculation/selection, technical documents development and drawing according to equipment design tasks of different field (heat exchanger, wind turbine, solar collector and nuclear reactor). 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 Renewable Energy Engineering program Type of teaching: practical teaching Contact hours: 4 weeks Theoretical teaching and experiment/practice teaching are arranged by instructors on the basis of each student and its team's specific project situation. Size of class: each instructor teaches 3-5 teams, each group 5-7 students.
Workload	Workload= 120 hours
Credit points	4.0
Requirements according to the	During the course design, students shall participate all the

examination regulations	team meeting, complete all tasks carefully, listen attentively to instructions of teachers.
Recommended prerequisites	Fundamentals of Engineering Drawing; Mechanical Engineering Drawing; Machine Design; Engineering Thermodynamics, Heat Transfer; Engineering Fluid Mechanics; Applied Physical Chemistry; Fundamentals of New Energy Theory
Module objectives/intended learning outcomes	Module objectives: As an important part of practice teaching of the specialty, Professional Comprehensive Course Design is a comprehensive application of the theoretical courses. The object and task of the Professional Comprehensive Course Design 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. • **Knowledge:** Principles of heat exchanger and methods of enhanced heat transfer; priciples of wind turbine and design calculation method, principles of solar collector and thermal calculation method and priciples of nuclear reactor and design calculation method. • **Skills:** Be able to conduct theoretical calculation, selection and design of different types of heat exchanger, wind turbine, solar collector and reactor for industrial production process. • **Competences:** Students master basic principles and methods of major equipment design of each field; develop students 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.
Content	**Practice teaching** (4 weeks) • Select design plan (0.5 weeks) • Conduct design calculation with design materials (1.5 weeks) • Complete drawing and design work (1.5 weeks) • Technique document and defense (0.5 weeks) After completion of design tasks, students shall complete report according to design process, and work out design calculation report in accordance with standard format. Main

	contents of report on Professional Comprehensive Course Design include: 1) Title; 2) Index and requirements; 3) Working principles of plan;* 4) Design calculation process, conditions for calculation and calculation result;** 5) Design selection criteria and major technical decision;** 6) Summary of results;* 7) Design drawing.**
Study and examination requirements and forms of examination	At the end of the course design, every student need to hand in design instruction, which introduce the team work and individual work. And every team gives a final presentation. Evaluation is based on students' performance and the whole team's design work, quality of students' presentation and defense. 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 [1] Qian SW. *Design Manual of Heat Exchanger*. Chemical Industry Press, 2002 [2] David W. *Small Wind Turbines: Analysis, Design, and Application*, Springer–Verlag, 2011 [3] Wang JY, Xu RZ. *Solar Energy Utilization Technology*. Beijing: Jindun Publishing House, 2008 [4] Luyben, William L. *Chemical Reactor Design and Control*. Wiley-Interscience, 2007 2. Reference books [1] SHI Meizhong. *Principles and Design of Heat Exchanger*. Higher Education Press, 1998 3. Other materials [1] Instruction books for Students Project (self-compiled)

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	Associate Professor GUAN Xin
Lecturer	All teaching staffs 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 Renewable Energy 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 from students team or individual and instructions of teachers (select topic and engage in practice independently). The course is focus on developing students engineering practice and innovation abilities.
Type of teaching, contact hours	Target students: seniors of Renewable Energy Engineering program Type of teaching: theoretical and practice teaching Contact hours: 64 hours Of which, Theoretical teaching: 8 hours Experiment / practice teaching: 56 hours Computer practice: 0 hour Size of class: 60 students
Workload	Workload= 120 hours Contact hours = 64 hours Self-study hours = 56 hours
Credit points	4.0
Requirements according to the	Complete proposal report, project design and execution

<table>
<tr><td>examination regulations</td><td>plan; carry out project and complete report; Evaluate team work and reports of other teams</td></tr>
<tr><td>Recommended prerequisites</td><td>Fundamentals of Engineering Drawing; Electrical Engineering and Electronics; Mechanical Engineering Drawing; Machine Design; Computer Modeling Practice; Engineering Fluid Mechanics; Heat Transfer; Fundamentals of New Energy Theory; Measurement and Control Technology of Power Engineering, etc.</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td>Module objectives:
Knowledge: New technology, new methods and new processed related to Renewable Energy Engineering program such as high-efficient energy utilization technology, technology development of renewable energy, high-efficient heat transfer, and energy-saving and emission reduction.
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.
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>Part A Theoretical teaching (8 contact hours; 8 self-study hours)<table><tr><th>No.</th><th>Theoretical teaching</th><th>Contact hours</th><th>Self-study hours</th></tr><tr><td>1</td><td>Innovation teaching module, multi-function experiment teaching module and</td><td>3</td><td>3</td></tr></table></td></tr>
</table>

	simulation experiment teaching platform introduction		
2	Research on topic selection and learning proposal report development	2	2
3	Learning plan development	3	3

Part B Experiment / practice teaching (56 experiment hours; 48 self-study hours)

Experiment 1	Research on topic selection	Contact Hours	Self-study hours
Content and requirement	1. Introduce present situation at home and abroad and development level through literature search and reading (including intellectual and technical standard situation); economic construction and social development requirements 2. Make proposal on innovative topics and technical value of innovation 3. Make proposal on complete innovation plan	12	10
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 1. Whether report conforms to standard; 2. If innovative topics and technical	10	8

		value of innovation convincing 3. If innovation plan is feasible		
	Experiment 3	Implement innovative project and experimental validation	Contact Hours	Self-study hours
	Content and requirements	1. Innovation plan execution 2. Uncertainty analysis of experiment 3. Scientific analysis for innovation plan improvement 4. Patents writing and application 5. Summary of results	24	20
	Experiment 4	Designing entrepreneurial plan with innovation project	Contact Hours	
	Content and requirement	1. Application and market prediction 2. Design execution plan 3. Design finance plan 4. Analysis of economic and social benefits 5. Write up business proposal	10	10
	Part C Computer practice (0 hour)			
Study and examination requirements and forms of examination	Final score is based on usual performance and final exam. Usual performance accounts for 30% of final score (theoretical course; attendance of discussion and experiment classes; completion); final exam is comprised of execution and experimental report (20%) and presentation (50%).			
Media employed	Multimedia computer; projector; product model			

Reading list	1. Required books [1] Handout on energy and environment innovation & entrepreneurship, USST 2. Reference books [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 [2] *Innovation Entrepreneurship and Employment.* FU Yun. Machinery Industry Press, 2009 [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	11100031
Subtitle, if applicable	
Semester(s) in which the module is taught	8th semester
Person responsible for the module	Professor CUI Guomin
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 Renewable Energy 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	Target students: seniors of Renewable Energy Engineering program Type of teaching: practice Contact hours: 10 weeks Theoretical teaching and experiment/practice teaching are arranged by instructors and enterprise technical personnel on the basis of each students specific internship 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. 1: The students should fill in the “Internship Application Form” and “Students External Internship Safety Responsibilty Book”; 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: 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 Renewable Energy Engineering, and understand the production process and technologies of the program. • **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. • **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. • **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	**Internship** (10 weeks) 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. • 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); • Learn about process, main equipment (structure, performance, configuration parameters and working principles), plant layout and operation requirements/skills of each post;**(3 weeks); • 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); • 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) • 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) • 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 [1] Instructors recommend books to students according to specific academic needs 2. Other materials [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	1110010
Subtitle, if applicable	
Semester(s) in which the module is taught	8th semester
Person responsible for the module	Professor CUI Guomin
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 Renewable Energy Engineering program Type of teaching: theoretical teaching; computer practice Contact hours: 12 weeks Theoretical teaching, experiment/practice teaching and computer practice are arranged by instructors on the basis of each students specific project 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: 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. • **Knowledge:** Review and apply what have learned from courses and familiar with literature review and research methodology. • **Skills:** Develop students overall abilities. Students receive comprehensive training required of seniors 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). • **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) • Topic presentation and literature reading & translation;* (2 weeks) 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. • Research, experiment and calculation of topic;** (7 weeks) 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. • Thesis writing and thesis defense;** (3 weeks) 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; evaluation of thesis writing accounts for 20% of final score and thesis defense 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 [1] Instructors recommend books to students according to specific proposal. 2. Other materials [1] PPT courseware (self-compiled) used by teachers and enterprise technical personnel for explanation to students.