10000072 Environmental Sustainability and Renewable Energy 2credits 32hours

Environmental sustainability is one of the biggest issues faced by the mankind at present. This course examines the effects of modern humans on the environment and explores the role of engineering in creating an environmentally sustainable future. The course focuses on key knowledge areas of sustainability theory and practice, including global climate change, ecological footprints, life-cycle assessment, green buildings, and a variety of renewable energy systems (e.g., solar, wind, hydroelectric, and ocean). The course encourages trans-disciplinary thinking as a foundation to foster sustainability. Class projects will require integration of environmental, economic, engineering, and social science knowledge to measure the challenges of sustainability and build solutions.

The course is intended to apply for undergraduate general courses, to help students analyze the global nature of environmental sustainability with a connected and developing perspective, cultivate their international perspectives, enhance their sense of social responsibility, and improve their willingness to avoid adverse impacts on the environment when developing technologies. Class discussions will be included in the course to improve students' logical and critical thinking skills, and English will be used in all lectures, discussions, and assignments to enhance students' ability to communicate internationally.

00030272 Transportation for Tomorrow(C-Campus Course) 2credits 32hours

"Transportation for Tomorrow" course included in Tsinghua-KTH course "Creative Learning" is hosted by both Tsinghua University and KTH. The course is innovative in the teaching mind and approach. Different from the conventional teaching pattern that focuses on transferring knowledge to students, the course is based on exploring and researching by interaction between teachers and students. Students would gather knowledge through discussion in class and self-learning. Teaching group consists of five teachers from Tsinghua – Jianping Wu, Qing Zhou, Runhua Guo, Li Li and Yiman Du – and six teachers from KTH - Niki Kringos, Sebastiaan Meijer, Staffan Hintze, Susanna Toller, Anders Wengelin, Mikael Nybacka.

15 students will be selected from Tsinghua University and KTH respectively. Language capability, capability of independent observation and thinking, teamwork ability constitutes the judging criterion in the selection.

The course aims at training the capability of creative learning within this specific teaching environment. Likewise, the course will build a new type channel of communication between teachers and students providing chances for professors and students to communicate with each other. Teaching pattern is mainly made up by discussion. During the course, training of capability of observation, raising questions, analysis and solving question is focused on.

In the course, students would be categorized into 5-6 groups. Each group has 5-6 students, including 2-3 students from KTH and 2-3 students from Tsinghua University, and they will have a topic related to future transportation. The course lasts 8 weeks. In first 2weeks, students should raise a question through observation and investigation. In weeks 3-6, the topic will be accomplished by discussion in the whole team. Finally, in weeks 7-8, seminar and examination in class will be hosted.

It's a brand new exploring course and significant in training of creative learning of students.

20030134 Structural Mechanics(1)(in English) 4credits 64hours

This course is intended to provide the student majoring in civil engineering skills of structural analysis at an elementary level. It mainly consists of structural geometric construction rules, computational methods for internal forces and deformation. The three major relations: equilibrium, deformation compatibility and stress-deformation conditions are used to study the behavior of structural components under various external loads. Emphasis is placed on the two major methods: the consistent displacement (force) method and the displacement method. The course serves as the basis for further exposure of structural theories to the student majoring in civil engineering.

30030482 Construction Contracts 2credits 32hours

This course aims at introducing pre-contract factors and administration principles of construction contracts. First, this course introduces characteristics of the construction industry and delivery models. Second, the characteristics of the industry determined pre-contract factors including: privity of stakeholders and contract formation processes. Third, this course elaborates core concepts of contract provisions as general guiding principles for post-contractual administration. Lastly, this course introduces key contract administration practices including differing site conditions, cost / time management, and dispute resolution.

30030493 Steel Structure (1) (in English) 3credits 48hours

This course is one of the most important specialised courses for undergraduates majoring in civil engineering. It mainly introduces principles of mechanism and design methods by means of lectures. More specifically, the contents include: i) characteristics and advantages of steel structures, their development and application as well as basic requirements for their design; ii) manufacturing process, mechanical properties and selection of steel structural materials; iii) connections in steel structures, and fundamental behaviour, mechanical analysis, design method and configuration requirements of both welded and bolted connections; iv) failure modes of steel members subjected to axial loadings, design theories of their strength, stiffness, overall and local buckling, as well as design and checking of their cross-sections; v) flexural behaviour of steel members including calculation of their strength, stiffness, flexural-torsional buckling and local buckling within flanges and web, as well as design of cross-sections and configuration requirements of hot-rolled and welded steel beams; vi) mechanical performance of steel members subjected to bending with tension or compression in combination, including calculation method of their strength and buckling and configuration details; vii) typical joints in steel frame structures and their loading capacities, configurations. National standards are also incorporated in this course, including the China's one and the European and American ones.

40030902 Building Materials 2credits 32hours

This course offers a broad introduction to materials used in civil engineering, including cement, concrete, steel, masonry, asphalt concrete, wood and composites. The characteristics of each type of material are discussed in terms of the following aspects: basic structure and properties of the materials, mechanistic behavior of the material and physical properties, environmental influences, engineering applications etc. Acting as a bridge linking fundamental principles to engineering practice, this course emphasizes on the engineering behaviors of these material systems. Understanding of these behaviors will be approached through detailed examination of the materials' microstructural characteristics and the associated structure performance. The students will derive benefit from this course in terms of fundamental principles, experiences, and skills.

40030942 Traffic Analysis and Design 2credits 36hours

The course systematically introduces traffic survey methods, road capacity, traffic flow theory, transport modeling, traffic assignments, traffic flow management and traffic simulation theory and technologies, and preliminary introductions of intelligent transport systems, traffic safety and sustainable development of transport. The course will be given with application examples and coursework to deepen and consolidate knowledge, and through reference reading and interactive classroom discussion to increase students' independent thinking and self-learning ability.

40031122 Steel Structures: Principles and Design (in English) 2credits 32hours

This course is one of the interdisciplinary courses for undergraduates majoring in civil engineering. It mainly

introduces basic principles of steel structures by means of lectures. More specifically, the contents include: i) characteristics and advantages of steel structures, their development and application as well as basic requirements for their design; ii) manufacturing process, mechanical properties and selection of steel structural materials; iii) connections in steel structures and their fundamental behaviour; iv) failure modes of steel members subjected to axial loadings, design theories of their strength, stiffness, overall and local buckling, as well as basic concept and performance; v) flexural behaviour and basic concept of steel members; vi) mechanical performance of steel members subjected to bending with tension or compression in combination, including basic concept and configuration details; vii) typical joints in steel frame structures and their configurations. National standards are also incorporated in this course, including the China's one and the European and American ones.

30040362 Foundation Analysis and Evaluation(in English) 2credits 32hours

This course, together with Soil Mechanics 1 describes the behaviour of engineering soils and simple geotechnical structures such as shallow and piled foundations, retaining walls and slopes.

This course simply introduces students to the subject of geotechnical engineering standing one of the major disciplines in civil engineering analysis (the other being structures, hydraulics) using an up-to-date approach: a simple framework of critical state soil mechanics plus the theoretical methods for stability problem of foundations and geotechnical structures, i.e. upper bound, lower bound (LA) and limit equilibrium methods(LEM).Simple theories and idealization for soil behaviour are maintained throughout this course for the purposes of teaching fundamental principles to students.

30040623 Fluid Mechanics 3credits 60hours

This course focuses on the laws of fluid dynamics and their interactions with the boundaries. The contents of the course include physical and mechanical properties of fluids, hydrostatics, hydrokinematics, hydrodynamics, dimensional analysis and similitude, flows in pressured tubes, and potential flow.The students will also participate in experiments and view videos in this class, which can help them better understand the knowledge and master relevant experimental skills.

40040913 Theories and Applications of Remote Sensing 3credits 48hours

Remote sensing measurement of hydrological variables and processes represents one of the most challenging research problems in Earth science. This course will introduce the basic concepts on remote sensing ranging from visible, near infrared, thermal infrared, microwave, and LIDAR remote sensing, and various orbital satellite platforms/sensors as well. The lecturer will also overview advances in remote sensing hydrology from space-borne observations, state-of-the-art retrieval algorithms for hydrological variables, and ground validation strategies. Various applications of remote sensing to hydrology are treated as they are used to measure different hydrologic variables or processes related to the water and energy cycle (e.g., precipitation, soil moisture, evapotranspiration, runoff, groundwater, and land drainage basin). Each of these hydrologic variables or processes is discussed individually with an emphasis on the use of remote sensing data and its availability. Particular emphasis is also given to science and techniques used for space-borne estimation, validation, and its application in hydrometeorology.

10050022 Global Outlook on Ecology and Environment 2credits 32hours

The Course uses the United Nation Environment's flagship report, the five-yearly Global Environment Outlook 6 (GEO 6) as main referencing material. The lectures is also designed to be made by Chinese scientists participating in the scientific assessment and compilation work of GEO 6 and each lecture will focus on specific topic. The

course will introduce the global environment situations, trends and future scenarios on areas like chemicals and wastes, air, fresh water, marine and offshore area, the land and the problems of soil environment, biodiversity, and environmental/interdisciplinary environmental problems; then analyze driving factors of environmental issues; and elaborate global governance and policy from the perspectives of scenario analysis methods and result-oriented sustainable development path, systematic policy methods and practices of cross-domain environmental issues, resource and energy metabolism, and theory and practice of environmental policy assessment and so on.

30050302 World Environmental and Cultural Practice 2credits 32hours

This course is completely taught in English, which is designed to enhance the English practical ability of undergraduates, improve the understanding of the world environment and culture, and improve the ability of self-learning, active communication and public speaking. This course also aims to help the students build their international vision and team spirit. The whole course consists of 3 programs, Global Environment, World Culture, and International Action. Programs will be conducted in various formats, which include: (1) lectures to introduce not only western cultural and historical knowledge but also state of the art technologies in environmental areas; (2) case studies to enable students to understand well and learn how to solve problems in English; (3) group discussions or activities to enhance the ability of utilizing English in professional fields and communications with people; (4) free-style group exhibitions to emphasize responsibilities in team work.

40050622 Treatment technologies for safe drinking water 2credits 32hours

The course is structured with a main line pertaining to drinking water qualities, and is mainly composed of the removal of individual impurities and contaminants by appropriate unit operations in the conventional treatment process and the advanced treatment process, focusing on the principle as well as the application conditions and treatment performance of each unit operation. Case studies and invited speech by renowned professors will also be included in the course. By taking this course, students should have the “multiple barrier” concept and would be able to select appropriate treatment processes for particular cases.

40050712 Study Abroad Program 12credits 320hours

The undergraduate students in Global Environment Program of School of Environment, Tsinghua University are required to attend the Study Abroad Program during their junior year and complete at least four core courses.

40050752 Low-carbon Technology and Management 2credits 32hours

The whole world is currently committed to adaptation against climate change, extreme disasters, environmental pollutions and exhausting fossil energy by means of establishment of a low-carbon society. Such transmission is certainly necessitated in China, the largest carbon emitter and 2nd biggest economy. Development of low-carbon technologies management system will be the key approach. This course is aimed to train the undergraduate students of SOE in terms of both technological and management knowledge. It is thus a cross-disciplinary course that encourages students to learn independently and collaboratively with the purpose to address complicated issues in energy, resource, environmental, economy and policy areas under the globalization circumstance. This course is not merely lecture and also includes quite a number of curriculum projects that require students to learn more after class and collaborate with team members. In course of the project design, students will be enhanced of abilities including but not limited to scientific writing, public speaking, literature hunting and communication skills. This course will be delivered in pure English environment. Furthermore, the students will be fortunate to stay with world famous experts in low-carbon fields and experience the cutting-edge research. The guest professors may come from Imperial College London, Cambridge, Columbia Uni, Stanford, Ohio State, etc. Low-carbon

technology and management is a fast developing field with frequently updated knowledge and information. This course extremely encourages students to challenge the conventional viewpoints and existing database of knowledge. The lecturer has the responsibility to lead students to think and behave in such creative and originative ways.

40050762 Introduction to International Environmental Law 2credits 40hours

This is a five days intensive course on international environmental law, using Beyerlin and Marauhn's work (International Environmental Law) as a textbook. The course covers the following major themes: History of international environmental law; source of international environment law; major Principles of environmental law; topic Studies (Current international law on Ocean and Marine resources, and Climate Change); law-making and enforcement processes; relationship between international environment law and trade law.

40050773 Sustainability: Environment, Energy and Personal Choices 3credits 48hours

With the growing requirement on environmental resources for the development of human society, global environmental problems have become increasingly prominent. A sustainable society involves not only rethinking of personal choices and behaviors, but also reconfiguring the carbon-based energy economy.

The challenges posed by regional environmental problems and global climate warming implies a sustainable society would need to gradually reduce its dependence on fossil fuels, especially the coal and oil. This course is intended to explore the theories and methods toward a sustainable society from three perspectives, namely environment, energy and personal choices. The course will be taught in English, aiming at training students to think critically to solve the problems innovatively using a variety of approaches from interdisciplinary perspectives. The course will take advantage of internet technology and multimedia classroom to combine onsite classroom teaching and remote interactive teaching from the University of Washington (UW) led by Dr. Kristina M. Straus. Students from Tsinghua are encouraged to communicate with the UW Students, to collaborate with them on the course projects. The overall

goal is to stimulate student interests in learning from both books and practical experiences, and to improve their comprehensive skills of teamwork, communication, critical thinking. This course is divided into two parts. The first one involves students to interact with local and remote teaching teams in class and in their course work. Courses will cover fundamental theories of sustainability, natural capitalism, sustainable food choices, product life cycle analysis, energy consumption, water crisis in the United States, low-carbon economy, development of new energy in China, low-carbon transportation system and other relevant topics. The second part mainly refers to field trip activities either in Beijing or in Seattle.

20120293 Engineering Materials 3credits 58hours

This course combines the fundamental of engineering materials with their applications. By means of lectures, discussion, and lab exercises, the students are enabled to understand the relationships among the four elements of materials science and engineering, i.e., composition and processing, microstructure, property, and performance. The lectures consist of the following three parts.

The first part briefs the atomic-level structures of engineering materials, including the interatomic bonding, crystalline and noncrystalline structures, crystal defects, crystallization, and atomic diffusion.

In the second part, the basic relationship between structures and mechanical properties is introduced. The stress-strain behaviors and strengthening mechanisms of metallic, ceramic and polymeric materials, as well as the fracture failure are correlated with the structures. In addition, the development of equilibrium microstructures in binary alloys (including Fe-C alloys) and ceramics is analyzed with reference to the phase diagrams. Furthermore,

the heat treatments of steels and nonferrous alloys are introduced, and the metastable microstructural development and mechanical property alteration are described.

The third part gives a general introduction about the typical compositions, processing, and applications of structural materials, covering metal alloys, ceramics and glasses, polymers, and composites. The necessity of corrosion and wear control for metal alloys is also included. The physical properties of functional materials are briefed, with a focus on their applications in thermal, semiconducting, dielectric, piezoelectric, magnetic, superconductive, and optical devices.

Finally, case studies are implemented to help the students acquire a comprehensive understanding of the selection of appropriate engineering materials in such challenging areas as aircrafts, spacecrafts, vehicle engines, and gas turbines, etc.

20120314 Fundamentals of Mechanical Design 4credits 78hours

This course focuses on the common basic theory issues in the design of mechanical products. It mainly introduces the design of life of mechanical systems, the design of reliability and durability in imparting the knowledge of kinematics analysis and design of mechanisms, dynamics analysis and design, and the strength of the mechanical structure analysis and design. It is the ultimate goal of this course to cultivate the student's thinking, method and the ability of self-study in the innovative design of mechanical systems so as to improve the student's comprehensive design ability, innovation ability and engineering practice ability.

The structure theory, primary kinematics and dynamics, strength theory of material and structure of the common mechanisms and machines will be taught. At the same time, the student will get the preliminary ability to analyze and use common mechanisms, and will master the basic knowledge of mechanical design through engineering application of the mechanical systems. This course has strong scientificity, comprehensiveness, systematicness and practicalness. It can cultivate the student's comprehensive ability to apply knowledge, and lays a scientific foundation for new science and technology engaged in the production practice for the future work and studying the subsequent specialized courses.

30120403 Micro-Computer Control for Mechanical System 3credits 48hours

This course combines software training with hardware training together, which makes it not only focuses on the practice research of typical parts of

electromechanical control system but also help students to acquire knowledge. In a word, it is a both integrated and practical course which combines the usage of knowledge with the ability to produce knowledge. Additionally, this course focuses on students' self-learning, supplemented with teaching by professors. Students spend 2/3 of credit hours in the practicable manufacture, while professors participate during the process and discuss with students in order to help them solve practical problems, which can improve students' abilities to

self-learning, self-thinking and practice.

30140012 Speciality-reading in English 2credits 32hours

This course focuses on the specialized vocabulary and grammar structures for writing technical English. The instructor gives many typical writing examples of proper grammar and word choice for technical English writing (and for business letters). The students will read many technical papers that are mostly related to thermal engineering, including ASME news articles and research papers. For some of the assignments, students from other departments can select research papers in their fields. The course will also include many technical English writing assignments. The course project is to write a short technical research paper related to their current research or their senior thesis. The course is very technical, so it should only be taken by science or engineering students.

30140362 Numerical Methods in Fluid dynamics and Heat Transfer(in English) 2credits 32hours

This course teaches the fundamentals of the finite difference method for modeling fluid dynamics and heat transfer problems. The course introduces steady-state and transient methods, the SIMPLE method, upwind versus central differencing, turbulence modeling, the effects of mesh quality and convergence characteristics. The course also teaches how to use Fluent to analyze fluid dynamics and heat transfer problems, including many of the special models in Fluent for modeling radiation, flows in porous media, periodic flows and the User Defined Functions. The course includes numerous homework assignments and a final project related to their research work so that the students are very experienced in the use of numerical methods.

30140454 Fluid Mechanics 4credits 64hours

The course is divided into two parts. The first part is on fundamentals of fluid mechanics, whereas the second part is on advanced fluid mechanics.

The objective of the first part is to provide an introduction to the beauty of fluid mechanics. The student will acquire knowledge of frequently encountered fluid phenomena, and has a thorough understanding of the basic equations of fluid flow and the ability of how to apply them to practical problems. The contents include characteristics of various fluids and flows, Fluid statics, Elementary fluid dynamics, Fluid Kinematics, Potential flow, viscous flow, and dimensional analysis.

The objective of the second part is to acquire a deep theoretical base in classical fluid mechanics. The emphasis is mainly on analytical solutions and its physical implications. The contents are: Cartesian Tensors, Low Reynolds number flows,boundary layers, instability, turbulence, and Compressible Flow.

30140463 Measurement and Instrumentation for Energy and Power Systems 3credits 48hours

The course targets basic concepts of measurement, theories and applications of various measurement techniques for key parameters, and instrumentation for energy and thermal engineering systems. Lectures and corresponding laboratories are included.

1) The lectures cover three main sections: First, fundamental theories. This will introduce the basic concepts related to measurements and measurement systems, instrumentation types, performance characteristics, measurement errors/uncertainties and calibration, etc. Along with hands-on experimental sessions, lectures will also cover instruments and methods of data acquisition and signal processing, LabVIEW programming, optical system design, etc. Second section will target measurements of key parameters in energy and power systems, and teaches the principles of the measurement techniques, including temperature measurement and control, pressure and flow measurement, gas density and concentration measurement, location and distance measurement, remote sensing, etc. The third section will introduce frontier technology such as modern sensors and intelligent devices.

2) Lab sessions are planned according to lecture contents and happen in alternating weeks with the lectures. Lab experiments will be organized in groups, and includes the following sessions: 1. Circuits, Electronics, and Data Acquisition with LabVIEW; 2. Basics of Optical System and Optoelectronic Devices; 3. Temperature Measurement and Control; 4. Gas Density and Concentration Measurement; 5. Remote Sensing and Ranging. Comprehensive lab project involving design of experiment and implementation for specific application will be started in latter half of the semester with three subjects to choose from: Subject 1. Combustion (Flame temperature measurement); 2. Heat transfer (Forced convection heat transfer in heat exchanger); 3. Fluid Mechanics (Flow field visualization with PIV).

30140473 Physical Chemistry in Energy Utilization 3credits 48hours

The course is mainly divided into three parts: chemical kinetics, introduction of quantum theory and spectroscopy, and several special topics, which are directly related to applications in the field of energy. These special topics include molecular interactions, molecular reaction dynamics, and processes at solid surfaces. In the part of chemical kinetics, the course will combine with its application in combustion, and introduce some relevant theoretical knowledge and experimental technique.

30140482 Introduction to Scientific Computing 2credits 32hours

The course focuses on the basic concepts in numerical analysis, including solution of ordinary differential equations (ODEs) and partial differential equations (PDEs), interpolation, optimization, parallel computing, and overview of applied computing in science and engineering. The course consists of lectures and homework assignments (programming), with a strong focus on practical exercises.

The lectures cover three main parts. First part is devoted to general overview of scientific computing, its methods and challenges, and energy engineering applications. Second (largest) part provides the theoretical basics of numerical analysis, interpolation, solution of differential equations (ODEs and PDEs), optimization. Examples would include simple solvers for the corresponding problems. Final part focuses on the elements of parallel computing technique (message passing interface, MPI).

40140963 Heat Transfer 3credits 48hours

Heat transfer describes how energy is transferred as the form of heat due to temperature differences. This course utilizes the framework of Thermodynamics and Fluid Mechanics to further illustrate the typical formulations and engineering applications of heat transfer. Topics covered include one-dimensional and two-dimensional conduction, steady state and transient problems, forced and natural convection, heat exchangers, and radiation and their typical engineering applications.

40140982 Technical Writing and Presentation 2credits 32hours

This course teaches engineering students how to become effective in Technical English writing and communications, following basic principles and using practical examples and exercises. It consists of three main parts. Part I will introduce the key features and principles of technical communications. The usage of technical English will be described, in contrast to that of daily English. The techniques of achieving both beauty and effectiveness in technical communications will be taught, starting from technical terminologies to sentences, paragraphs, overall structures to styles. Part II will describe the main types of scientific and technical writing, and the relevant contents and structures. The common features of technical writing will be defined first, followed by detailed techniques for writing laboratory reports, coursework, research reports, research articles and theses. Part III will cover oral and written communications to both specialist groups and the general public. The keys to good communications will be given, with topics ranging from body languages to the use of visuals, in order to achieve a balance between technical contents and styles. Finally, this part will teach how to handle the common types of oral and written communications in the scientific and technical field. Throughout the course, a good balance among technical contents, styles and ethics in technical communications will be emphasized. Students will be encouraged to take an active part in the whole teaching and learning process: teaching classes, tutorials, discussion groups, debates, field trips and so on.

40140993 Research Practice 3credits 48hours

This course aims to develop students' capability to perform scientific research as well as other challenges being considered during the process of conducting research and technology development. Course content includes basic

methodologies of scientific research, invited talks from both industry and academia, revisit of recent research problems, methods, and analyses, introduction to professional ethics in scientific research and engineering, safety and regulations for conducting scientific research. The course will be offered in the forms of lectures, group discussion and interactions, invited talks, conducting actual research problems, and mock procedures and presentations of international conferences for evaluation of final projects.

30220363 Modern Control Systems 3credits 48hours

This course provides the basic knowledge about classical control theory, modern control theory and discrete control theory.

For classical control theory, the following contents will be introduced: system modeling, transfer function and its transformation, concepts and criterion for system stability, time-domain and frequency-domain analysis method for control systems, control system design using time-domain and frequency-domain methods.

For modern control theory, the following contents will be taught: state space model of a control system , observability and controllability of a system, state feedback controller, state observer and implement of a state feedback controller using signals from a state observer, etc.

For discrete control theory, the following contents will be addressed: modeling and analysis methods for discrete control systems, design method for a discrete-data controller, etc.

This course is delivered in English.

30220434 Electric Machinery Fundamentals 4credits 64hours

Electric Machinery Fundamentals focuses on the basic electro-magnetic theory of electric machines. The course covers the fundamentals of transformers, synchronous machines, asynchronous machines and DC machines.

This course is one of the key fundamental courses for students in Electrical Engineering, and is a prerequisite course for many advanced courses.

20230313 Foundation of Solid State Physics 3credits 48hours

Solid-state physics studies the foundations of our world --- solid materials. We start with the introduction of materials science and crystal structures, and analyse the electronic, optical, thermal and magnetic behaviors of solids, based on theories of classical physics, electrodynamics, quantum and statistical mechanics. Emerging applications such as semiconductor diodes, photonic devices and superconductors will also be briefly covered.

30230654 Signals and Systems(in English) 4credits 64hours

This course covers the signal representation/analysis, especially how to represent the complex signals in simple format either in time or frequency domain. Based on that, it also covers how signals behave after passing through various linear, time-invariant systems. It consists of following individual yet highly related sessions including Introduction, time-domain analysis on the linear, time-invariant systems, signal representation in frequency domain (Fourier analysis & Fourier transform), Laplace Transform, Discrete time-domain signals, Z-Transform, Discrete & Fast Fourier transform, the state space analysis of the linear systems, and etc.

This course focuses on the basic theory and analytical method from time-domain to transform domain, from continuous to discrete, from the description of single-input-single-output to the state variables. It will lay down a solid foundation for the further study for courses including Digital Signal Processing, Stochastic Process, Communication Circuit, Principle of Communication.

The requisite courses include calculus, linear algebra, complex variable functions, principles of electric circuits。

30231002 Probability and Stochastic Processes (1) 2credits 32hours

This course covers the basic knowledge of elementary probability without rigorous treatment via measure theoretical tools. It includes probability spaces (sample spaces, sigma fields and probability), random variables with its probability distribution, distribution functions and probability density, independence, conditional probability, discrete random variables (Bernoulli, Binomial, Poisson, Geometrical, Hyper-geometrical, Negative binomial), continuous random variables (Uniform, Exponential, Gaussian), numerical characteristic of random variables (expectation, variation, high-order moments, entropy), transformation of random variables with its derived distribution, conditional expectation and conditional distribution, characteristic functions and basic limit theorems.

30231034 Communications and Networks 4credits 64hours

"Communications and networks" is one of the ten core courses of Dept. EE, Tsinghua University. Based on the systematic roadmaps and scientific theories of course reform progress of Dept. EE, this course focuses on the interactions of information barrier and system, or more specifically, the interactions of data packets and networks. It is a new course that is rebuilt based on the classic course titled principles of the modern commutations. This course system was tested in a small group of students in the spring semester, 2012. Later on, it opens for all students in EE department.

30231053 Electromagnetic Field and Wave 3credits 48hours

Electromagnetic field and wave is the theoretical foundation for the studies of electrical circuits, wave optics and optoelectronics, microwave systems, and provides the basic method and tool for understanding, analyzing, and solving problems involving electromagnetism. The course will introduce vector analysis, Maxwell's equations, Lorentz force, electrostatics and magnetostatics, electrodynamcis and propagation of EM waves, and radiation. Beside basic principles, the course will introduce a number of examples including electrical circuits, optical and RF waveguides, antenna, and electrical measurement in biomedical applications, such that the students can implement the theory to solve real-world problems.

30231063 Fundamentals of Digital Logic and Processors 3credits 48hours

"Fundamental of digital logic and processor" covers basic the concepts of electronic engineering from digital logic circuits to microcomputer processors in a systematic and simplifier manner. The class is divided into two sections. This first section of digital circuits describes how digital circuits work at the gate and flip-flop level and contains the analysis and design of combinational and sequential circuits. The second section describes micro-processor organization and its architecture. It introduces the fundamental concepts such as computer instruction sets, ALU, controller, registers and I/O. A simple processor and a pipeline version will be discussed. The text books, slides, lectures, homework assignments and exams will be in English.

30260112 Integrated Circuit Fabrication Processes 2credits 32hours

Integration density and performance of digital and analog integrated circuits have undergone an astounding revolution in the last few decades. Although innovative circuit and system design can account for some of these performance increases, technology has been the main driving force. This course will examine the basic micro fabrication process technologies that have enabled the integrated circuit revolution and investigate newer technologies. The goal is to first impart a working knowledge of the methods and processes by which micro and nano devices are constructed, and then teach approaches for combining such methods into process sequences that yield arbitrary devices. Although the emphasis in this course is on transistor devices, many of the methods to be taught are also applicable to MEMS and other micro-devices.

This course is designed for students interested in the physical bases and practical methods of silicon VLSI chip fabrication, or the impact of technology on device and circuit design.

30260163 Foundations of Integrated Circuit (1) 3credits 48hours

This course intends to introduce the analysis and design methodologies for the digital circuits and transistor-level digital integrated circuits. Firstly, the design approaches and design flow of digital integrated circuits are presented. Secondly, Boolean logics, PN junction diodes and MOS transistors, CMOS inverters, combinational and sequential circuits are addressed and deeply analyzed. Finally, the big modules like the adders and shifters are introduced. The key points of this course are focusing on the basic circuit unit, logic and circuit design approach and the trade-off strategies among area, speed, power of digital integrated circuits design.

40260223 Communication Systems and Circuits 3credits 48hours

This course gives insights into analog/digital communication systems with practical circuit design examples. Students are expected to learn both system and circuit design perspectives in modern communication IC design.

40260262 Introduction to Quantum Information Science 2credits 32hours

This course will introduce the main ideas and techniques of the field of quantum computation and quantum information. One will learn the background material in computer science, mathematics and physics necessary to understand quantum computation and information. Latest progress in quantum information process will be introduced and discussed as well.

20310464 Fluid Mechanics（in English） 4credits 64hours

Fluid Mechanics course teaches the study of fluid either in motion or at rest and the subsequent effects of the fluid upon the boundaries, which may be either solid surfaces or interfaces with other fluids. Both gases and liquids are classified as fluids, and the number of fluids engineering application is enormous: breathing, blood flow, swimming, pumps, fans, turbines, airplanes, ships, rivers, windmills, pipes, missiles, icebergs, engines, filters, and jets, to name a few.

20310474 Mechanics of Materials（in English） 4credits 64hours

Mechanics of Materials is a basic engineering subject that must be understood by anyone concerned with the strength and physical performance of structures. The subject matter includes such fundamental concepts as stresses and strains, deformations and displacements, elasticity and inelasticity, strain energy, and load-carrying capacity. These concepts underlie the design and analysis of a huge variety of mechanical and structural systems. At the college level, mechanics of materials is usually taught during the sophomore and junior years. The subject is required for most students majoring in mechanical, structural, civil, biomedical, aeronautical, and aerospace engineering. The present course is based on textbooks Mechanics of Materials (7th Edition) by James M. Gere and Barry J. Goodno (Cengage Learning Australia) as well as Engineering Mechanics 2: Mechanics of Materials by Dietmar Gross, Werner Hauger, Joerg Schroeder, Wolfgang Wall, Javier Bonet (Springer Verlag Heidelberg 2011). The main contents include tension, compression and shear; torsion; shear forces and bending moments; stresses in beams; analysis of stress and strain; applications of plane stress; deflections of beams; statically indeterminate beams; torsion of thin walled shafts, energy methods.

20310504 Theoretical Mechanics(in English) 4credits 72hours

A review of vector algebra. Concept of force. Equilibrium of particles. Moments about points and lines, couples

and equivalent force systems. Equilibrium of rigid bodies. Analysis of simple structures such as trusses, frames, and beams. Centroids, centers of gravity, and moments of inertia. Dry friction with applications to wedges, screws, and belts. Method of virtual work, potential energy, and stability.
Vectorial kinematics of particles in space, orthogonal coordinate systems. Relative and constrained motions of particles. Dynamics of particles and the systems of particles, equations of motion, energy and momentum methods. Collisions. Two- and three-dimensional kinematics and dynamics of rigid bodies. Moving frames and relative motion. *Free, forced, and damped vibrations of particles and rigid bodies.

30310942 International Scholar Summer Course 2credits 32hours

International Scholar Summer Course (ISSC) is a compulsory course of the Tsien Excellence in Engineering Program (TEEP). Every year, TEEP invite world leading experts to be TEEP visiting professors, and to give intensive summer courses for two weeks at Tsinghua University. The course is to offer a wide and international scope of modern mechanics and related fast developing interdisciplinary fields, such as Mechanics X Future aerospace engineering, Mechanics X Future life science and healthcare, Mechanics X Future smart technology and Mechanics X Future energy and environment engineering. The ISSC consists of advanced lectures and seminars with specific emphasis on high-quality professional training, cutting edge frontiers and challenging topics.
With the deep engagement of top experts from worldwide, the ISSC is to foster the students to open their horizon on mechanics and related interdisciplinary fields, to develop high-level professional knowledge and skills, to explore the leading frontiers with curiosity and passion, and to prepare their future learning and research such as Open Research for Innovation Challenges (ORIC) project.

40310873 Combustion 3credits 48hours

Introduction to combustions processes and chemical kinetics. Mechanisms of formation of pollutants such as nitrogen oxides, carbon monoxide, soot and unburned hydrocarbons in stationary and vehicular power plants. Premixed and diffusion flame structure and burning rates, spray combustion, single droplet vaporization and combustion, combustion of solid fuels and pollution clean-up devices, gas turbine combustion.

00420183 Game Theory 3credits 48hours

This is an introductory course on the basic concepts of Game Theory. Topics to be covered are:
Games in Extensive Form,
2-person 0-sum games,
Bimatrix games,
Nash Equilibrium,
Correlated equilibrium,
Evolutionary Game Theory,
Repeated Prisoner’s Dilemma,
Bargaining Problems,
Games in Coalition form,
Shapley value,
Nucleolus,
2-side matching problem.

10421305 Calculus A(1) 5credits 80hours

This is the first course in the regular two-semester calculus sequence offered by the Department of Mathematics.

Students entering the sequence usually major in the natural sciences, engineering, economics and other social sciences that require a high mathematical ability. The course undertakes a careful treatment of the mathematical theories about functions of one real variable. The course covers the following topics: (1) Preliminaries: The axioms and properties of real numbers; The limits of numerical sequences. (2) Differentiation Theories: The concept and computation of derivatives; Mean value theorems; L'Hopital's rule; Taylor's theorem; Extrema; Higher order derivatives. (3) Integration Theories: Indefinite integrals; The Fundamental Theorem of Calculus; Riemann integrals and their properties; Computations of definite and indefinite integrals; Applications in Geometry and Physics; Improper integrals. (4) Introduction to Ordinary Differential Equations (ODEs): Basic concepts; Integration method for first order equations; Higher order equations, order reductions; First order ODE systems.

10421315 Calculus A(2) 5credits 80hours

This is the second course in the regular two-semester calculus sequence. It is the continuation of Calculus I (in English) and undertakes a careful treatment of more advanced topics in calculus. Those topics are: (1) Differentiation theory for Functions of Several (real) Variables: basic point-set topology on the n-Dimensional Euclidean space; Limits and Continuity of functions of several real variables; Differentiations, total derivatives, partial derivatives, directional derivatives, gradients; Vector-valued functions; Derivatives of compositions of functions; The Implicit Function Theorem; Taylor's Theorem; Extrema and Conditional Extrema; (2) Integration theory for

multi-variable functions: Riemann Integral for multi-variable functions, iterated integrals, change of variables; applications in geometry and physical sciences. (3) Vectorial Calculus: Parametrization of curves and surfaces, Orientations; Line integrals and Surface integrals; Green's Theorem, Gauss' Theorem, Stokes' Theorem. (4) Series: Numerical series, convergence and divergence, Absolute convergence and conditional convergence, Convergence theorems for series with positive entries; Functional series, uniform convergence, Power series, Fourier series.

10421334 Linear Algebra (English) 4credits 64hours

Linear algebra (English) is a course intended primarily for engineering students. The course covers the theory of systems of linear equations, Gaussian elimination, the theory of matrices and their computations, vector spaces and linear transformations, Euclidean spaces, Gram-Schmidt orthogonalization, eigenvalues and eigenvectors, diagonalization, symmetric matrices and positive-definite matrices, and singular value decomposition.

10421392 Advanced Topics in Linear Algebra (English) 2credits 32hours

Advanced Topics in Linear Algebra (English) is the continuation of Linear Algebra (English). The course begins with complex linear algebra, including Hermitian and unitary transformations, and also the fast Fourier transform. It proceeds to Jordan canonical form, functions of matrices, and their applications in physics, engineering, and computer science. Further topics include dual spaces, tensors and their applications. Additional topics such as projective geometry, functional analysis, numerical analysis of matrices, finite fields, and manifolds, may be included at the discretion of the instructor.

10430344 Physics(1)(in English) 4credits 64hours

We introduce Newtonian mechanics of both mass point and rigid body. After that a basic concept of Lagrangian mechanics will be introduced. Besides those, we will introduce the physics of oscillation, fluid, and waves including travelling wave, standing wave and Doppler effect. In the last several week, we will discuss thermodynamics.

10430354 Physics(2)(in English) 4credits 64hours

In the first half of the semester, we in this class focuses mainly on the theory on the electromagnetism, from Coulomb's Law to Maxwell equation. In the second half of the semester, we will introduce the basic concept of the physical optic, special relativity including Minkowski space-time diagram, and the quantum physics.

20430225 Fundamentals of Physics (1) 5credits 80hours

As the first fundamental course on physics for the physics major and related science or engineering major students, we shall systematically study Mechanics, Special Relativity and Wave Optics, laying a solid foundation for future study of Physics and related subjects.

20430234 Fundamentals of Physics (2) 4credits 64hours

As the seoncd course on the fundamentals of physics, we shall make a systematic and serious introduction on Quantum Mehcanics, its historical developement, basic concepts and important principles and appications in modern physics. The students will have a clear and better understanding on quantum mechanic and quantum physics.

20430265 Fundamentals of Physics (3) 5credits 80hours

As the fundamental course on physics for the physics major and related science or engineering major students, we shall systematically study the fundamental principles of electromagnetism and the general thermodynamics physics, laying a solid foundation for future study of Physics and related subjects.

30430094 General Relativity 4credits 64hours

This course is designed to be an introduction to the theory of General Relativity (GR) as developed by Einstein and those who followed him.

It is designed for advanced undergraduate students (or starting graduate students) who have already completed some basic physics courses, including an introduction to special relativity. I will develop most or all of the additional mathematical tools required basically from scratch.

This is NOT a course on current topics in GR or quantum gravity. Though I plan to touch on some aspects of current research, most of the material covered will be well-established concepts.

The textbook I will mostly follow for this course is “Spacetime and Geometry: An Introduction to General Relativity” by Sean Carroll. There is an Asian edition of this book available for about 70 yuan. I will also draw some material from “A First Course in General Relativity” by Bernard F. Schutz. I will NOT always follow either book line by line.

One semester is NOT long enough to cover well all topics considered standard in GR. So I will mainly discuss: review of special relativity, equivalence principle, manifolds and tensors, EM field tensor, curvature, formulation of Einstein’s field equations, Lagrangian approach, alternative theories to GR, perfect fluids, cosmological constant, Schwarzschild metric and applications, conformal diagrams, black holes in general.

30430224 Applications of General Relativity 4credits 64hours

This course assumes the students are already familiar with Einstein's Field Equation and the physical basis behind them. It is a logic continuation of the course “Introduction to General Relativity”. This course covers in details the most well-known applications of general relativity, such as black hole (including Kerr black hole, Penrose process, Komar energy, and black hole thermodynamics), gravitational lensing, gravitational wave, cosmology (including Robertson-Walker metrics, Friedman equation, inflation, CMB, dark matter, CV violation, and baryon asymmetry),

and even quantum gravity.

30450203 Biochemistry(1)(in English) 3credits 48hours

The main purpose of this course is to teach the students the basic concepts in biochemistry, which includes the structures and functions of proteins, nucleic acids, carbohydrates, lipids and biomembranes. We will also put the emphasis on enzyme kinetics and molecular mechanisms of signal transduction of the cells.Besides lectures, we will also discuss the problems and answer the questions to the students through the websites or one-to-one meeting. There are will be some homework assignments to students after each lecture. We will also recommend some original research articles for students to read to further raise their interests in biochemistry.

30450213 Biochemistry(2)(in English) 3credits 48hours

Biochemistry II is divided into two parts. The first part (Chapter 13-23) is bioenergetics and metabolism, which includes principles of bioenergetics (Chapter 13), catabolism of carbohydrates, lipid acids and amino acids (Chapter 14-18), oxidative phosphorylation and photophosphorylation (Chapter 19), biosynthesis of carbohydrates, lipids and amino acids (Chapter 20-22) and integration and hormonal regulation of mammalian metabolism (Chapter 23). The students are required to be familiar with the major catabolic and anabolic pathways of carbohydrates, lipids and amino acids, as well as the important enzymes and coenzymes involved in these pathways and the regulation of each pathway. The students are also required to know the interconnection and regulation between different catabolic and biosynthetic pathways. The second part (Chapter 24-27) of this course is information pathways. It includes genes and chromosomes (Chapter 24), DNA metabolism (Chapter 25), RNA metabolism (Chapter 26), and protein metabolism (Chapter 27). The students are required to know the structure of genes and chromosomes, the pathways of DNA, RNA and protein metabolism. In addition to lectures, there will be office hours every week to answer the questions the students may have. There will be quizzes, homework and the final exam, which accounts for 20%, 20% and 60% of the final score, respectively.

30450263 Microbiology(in English) 3credits 48hours

Microbiology is a compulsory course for students in biology department。 This course covers multiple disciplines in microorganism， molecular biology， biochemistry， immunology and microbial diseases。 Students taking this course will learn systematic knowledge of microorganism， as well as basic experimental skills。The most popular book Biology of Microorganisms for north American college students is used in this course。 Biology of Microorganisms will be updated every two years。 New knowledge and technique in microbiology will be added in each update 。 It is very helpful for student to improve their knowledge and scientific understanding of microbiology。

30450303 Genetics(in English) 3credits 48hours

This course is designed to introduce genetic principles to students of biology major 。 It aims to cover comprehensively all fields of classical and modern genetics， but skips most topics that have been taught in biochemistry and microbiology。

30450453 Molecular Biology(in English) 3credits 48hours

Molecular Biology is focus with the fuction of biological systerms of the molecular level.Molecular Biology is central to most studies in biology and life sciences and is directly ralated to biomedical research and biotechnology.In this subject,students are intoduced to gene structure and function,DNA replication, transcription and translation; molecular biology; protein structure and its relationship to protein function. Molecular biology

techniques are common methods used in molecular biology, biochemistry, genetics and biophysics which generally involve manipulation and analysis of DNA, RNA, protein, and lipid, which will also be introduced in the course.
Upon successful completion of this subjest students should be able to:
1.use the basic vocabulory of molecular biology to describe the structures and functions of biological macromolecules, in order to demonstrate their knowledge and understanding of the concepts inderluing sutcture-function relationships in cell function,health and disease.
2. apply molecular biology techniques, princilpes and methodologies in addressing research problems.
3. write scientific reports that present coherent evidence-based explanations to communicate to peers.
4. demonstrate indenpendent learing and research skills by locating, interrogting and evaluaing relevant scientific information.
parcipate as an effective team member and collaborate effcetively on selected learing exercises.

40450263 Molecular Basis of Human Diseases(in English) 3credits 48hours

This course aims to provide students with in-depth knowledge of the basic mechanisms of common human diseases such as cancer, diabetes, obesity, atherosclerosis, Alzheimer's disease etc。, and to prepare them for future translational research 。 The course focuses on the current molecular mechanisms underlying the pathogenesis of each disease。 There will be extensive discussion on results from current cutting-edge research。 Prospective students should have basic knowledge of biochemistry, molecular and cell biology and immunology before registering for this course。 Brief knowledge on human physiology and the pathogenesis of each disease will be introduced but students are expected to read extensive reference paper and textbook to understand the content of the lecture。

40450551 Scientific writing 1credits 16hours

This course, consisting mainly of lectures, but also practical work in class and homework, will teach students the characteristics of good academic writing with a specific focus in scientific writing for the life sciences.
The course will also review the main mistakes committed by non-native English speakers and how to avoid them. There will be a discussion of the main parts of an academic paper and of the different functions they accomplish with practical examples and exercises. Finally, tips will be shared on how to approach other forms of scientific communication, such as emails to professors and colleagues, conference posters, presentation slides, letters to editors, etc.

00460063 Global Change and Sustainable Development 3credits 48hours

The course discusses the structure and function of the Earth system, including life and biodiversity, ecological environment, water resources, agriculture and land use, population, cities, energy, climate, economy, health, causes and impacts of natural disasters, etc. at the global scale. It reviews strategies adopted or to be developed under current and future global environmental changes, especially on climate change. The course will engage students in in-depth group discussions on the above issues from multidisciplinary perspectives and train students to analyze global change issues independently.
10 students will be selected from this course based on their performance and interest to participate in the "Travel under the heaven" field studies.

10460043 Sustainability Science 3credits 48hours

Sustainability science is science, technology, and innovation in support of sustainable development—meeting human needs, reducing hunger and poverty, while maintaining the life support systems of the planet. As such, it is

an active pursuit of the scientific community and a rapidly expanding international research activity. But increasingly, it is also a focus for education as courses and degree programs in sustainability, sustainable development, and sustainability science proliferate. For these newly designed courses and programs, and for the many more scholars and scientists who want to explore the inclusion of sustainability science in their ongoing educational activities, there is need for organized teaching materials. This course explores the idea of "sustainable development" its historical context, contemporary understandings, and practical implications Finding ways to improve human well-being over the long run in the face of massive transformations of the earth's environment has emerged as one of the grand challenges facing human beings. "sustainable development" has come to lead several parallel but uneasy lives. It has provided a big umbrella under which important global initiatives have been nurtured, and a lot of learning has occurred. It has proven remarkably open to being adapted to meet the different and changing needs of various countries, cultures, sectors. It has been hijacked to cloak narrowly self-interested agendas in a mantel of trendy legitimacy. Some argue that "sustainable development" has become such a broad idea as to be meaningless. Others see it as a fundamentally important idea essential to society's efforts to cope with the central challenges of our time. This course seeks to examine critically this range of viewpoints, and help you to determine what sustainable development ought to mean for how you live your life.

20470024 General Physics(1)(in English) 4credits 64hours

General physics course for students majoring in science and engineering with interest in physics. This course is Calculus-based. Students are required to actively participate during the lectures. This class will provide with an opportunity to acquire a good understanding of fundamental mechanics and thermodynamics and to learn how to apply the physics knowledge and beyond. The main contents are, mechanical parts, mainly including: displacement, velocity, acceleration, etc; Force, Newton's three laws of motion, force analysis, the center of mass frame of reference, inertia force; Momentum and angular momentum, rigid body motion; Special relativity is introduced, and so on. Thermal parts, mainly including: the temperature and the zeroth law of thermodynamics; Ideal gas state equation of constant pressure and constant volume, isothermal and adiabatic and other basic thermodynamic process; Molecular motion laws; The first law of thermodynamics. The second law of thermodynamics, the heat engine and refrigerator, Carnot cycle; Statistical physics are introduced.

20470034 General Physics(2)(in English) 4credits 64hours

This course is a follow-up course of General Physics I and for undergraduate students with serious interests in physics and interdisciplinary sciences. The main focus of this course is to cover the most important topics in classical electrodynamics including electrostatics, magnetostatics, Maxwell's equations for electromagnetic fields. This course will emphasize both basic concepts and solving practical problems. After completing this course, students are expected to gain a good understanding of basic classical electrodynamics.

20470044 Linear Algebra 4credits 64hours

Linear algebra finds wide applications in various fields, such as computer sciences, physics, mathematics and their interdisciplinary fields. This course introduces the basic concepts and techniques of linear algebra. It includes the study of matrices and their properties, linear transformations and vector spaces. Concrete topics include systems of linear equations, row reduction and Echelon form, vector equations, solution sets of a linear equation, linear independence, linear transformation, the matrix of linear transformation, matrix algebra, characterization of invertible matrices, determinants, subspaces, null spaces, column spaces, bases and dimension, rank, eigenvalues and eigenvectors, diagonalization, inner product, etc. By introducing the concepts through concrete examples, students will learn the basic concepts and methods of linear algebra, and their capacity to think from the linear

algebra perspective will be systematically trained and enhanced.

20470054 Abstract Algebra 4credits 64hours

Abstract algebra studies fundamental algebraic structures of groups, rings and fields, etc. It is the foundation of modern mathematics and has broad and vital applications across different disciplines including computer science, physics, and chemistry.

In this course, the students will learn the basic theory of groups, rings and fields, including subgroups, groups' actions, Sylow theorems, homomorphisms and isomorphism, the fundamental homomorphism theorem, Cauchy's theorem, the fundamental theorem of finitely generated groups, polynomial rings, quotient rings, ideas, the Chinese remainder theorem, Euclidean domains; principal idea domains; unique factorization domains; field extension, algebraic extensions; splitting field, fundamental theorem of algebra, and Galois theory, etc. In addition, this course will also

introduce the basics of lattices and Boolean algebras.

20470073 Introduction to Artificial Intelligence 3credits 48hours

This course aims at providing freshmen students with a broad overview of the Artificial Intelligence field, including computer vision, robotics, reinforcement learning, AI systems, and AI algorithms, motivating them to study the field, and encouraging them to conduct indepth investigation on different areas of the field. It is a required course for freshmen students in the Special Artificial Intelligence Polit Class. Lectures will be given by leading experts in AI areas from both academia and industry.

20470084 Computer Architecture 4credits 64hours

This course introduces modern computer architecture, which focuses on the hardware/software interface and the internal structural organization of computer systems.

It covers the major hardware components and key design techniques in computer architecture, including system performance and efficiency metrics, instructions and instruction set architectures, processor structures, memory hierarchies, IO devices, and hardware specialization techniques. From an architectural perspective, the course focuses on the high-level functionalities and interaction of the system components, and abstracts away the low-level implementation details. It demonstrates how to optimize the performance and efficiency of the software through better understanding the architecture of the hardware. In addition, the course introduces the support for parallelism and specialization in modern computer systems as advanced topics, considering the ubiquity of parallel computing and specialized computing nowadays. The course also briefly introduces several state-of-the-art research advances. The lab assignments involve the assembly-level code analysis and optimization, the processor pipeline simulation, the cache functional implementation, and more. Upon the completion of the course, students will understand the basic concepts and the main functionalities of the system components, as well as how they interact with each other. They will also learn the analysis methodology and the design principles for computer architecture, and be introduced to the tradeoffs between performance, efficiency, and cost in computer systems.

20470112 AI+X Computing Acceleration: From Algorithms Development, Analysis, to Deployment 2credits 32hours

This course is at end of sophomores of Yao class and Zhi class in the summer short semester.

After two years of accumulation of basic knowledge, students have accumulated essential programming experience, basic knowledge and some practice of AI algorithm, computer core courses such as programming language, basic knowledge of digital circuit, computer architecture, etc., and also began to take some courses and

research of AI +X.

The course objective is to connect the courses learned by most students in the past two years to carry out a practical project from development to deployment.

Aiming at the characteristics of AI + X, this course will first give a summing-up and review the basic knowledge to further strengthen the programming foundation, and then divide the students into several groups to jointly complete a project of AI + X computing acceleration. Students will carry out a series of research contents, such as algorithm development, deployment, driver development, bottleneck analysis, accelerated architecture, deployment on the board, etc.

Taking this course, students will be familiar with the whole process development of AI + X systematically, understand the direct gap between algorithm development and actual deployment, lay a good foundation for junior and senior learning and research, and pave the way for further scientific research.

20470132 Type-safe Modern System Practice 2credits 32hours

This course will introduce a few key notions on building large scale systems, including type-safe, front-end and back-end separation, functional programming, event sourcing, microservice, distributed computing, and Kubernetes. Moreover, the students are required to implement a small front-end and back-end system to get their hands dirty.

30470013 Introduction to Computer Science 3credits 48hours

Designed to appeal to a diverse audience, this course examines some of the fundamental ideas of the science of computing. Lectures and hands-on assignments cover a wide variety of topics such as hardware organization, the Internet, computer programming, limits of computing, and graphics. No prerequisite.

30470023 Mathematics for Computer Science 3credits 48hours

This course aims to introduce the fundamental mathematical techniques useful for computer science undergraduate majors, illustrated with a rich spectrum of applications. Modern computer science education requires the students to be equipped with broad knowledge in mathematics, so that they could cope with current and future technological challenges handily and innovatively. In this course, mathematical techniques from algebra, geometry, probability theory, stochastic modeling, and information theory will be covered. These techniques will be applied to algorithmic and design problems in various topics, including internet, cryptography, distributed systems, wireless sensor network, optimization, etc. Finally, this course introduces the students to deep scientific issues in the foundation of computing such as undecidability, complexity, and quantum computers.

30470084 Operating System 4credits 64hours

The purpose of this course is to teach the principles and design of modern operating systems and distributed systems, as well as system programming.

Topics we will cover include concepts of operating systems, networking, database systems and systems programming, including multiple-programing systems (processes, inter-process communication, and synchronization), memory management (segmentation, paging), resource allocation and scheduling, file systems, basic networking (packet switching, file control, reliability), basic databases (transaction, SQL), basic distributed systems (consensus protocols), as well as special topics such as reliability, security, and cloud computing and block chain. Students are expected to complete set of major design and implementation projects.

30470093 Computational Biology 3credits 48hours

To introduce various computational problems for analyzing biological data (e.g. DNA, RNA, protein sequences, and biological networks) and the algorithms for solving these problems. Topics covered include: biological sequence analysis, gene identification, regulatory motif discovery, genome assembly, genome duplication and rearrangements, evolutionary theory, clustering algorithms, and scale-free networks.

30470104 Machine learning 4credits 64hours

Machine learning studies how computers learn from experiences. Combining ideas from theoretical computer science and statistics, researchers have developed many successful learning methods for computer vision, bioinformatics, natural language processing etc.

This course mainly covers the framework of machine learning, classical methods for solving various machine learning problems, and also basic machine learning theory. It includes linear methods, support vector machine, basic optimization and generalization theory, basic neural networks, popular classification/regression methods, clustering methods, nearest neighbor search, useful algebra methods, etc. This course is a basic course for machine learning, but it is challenging.

30470124 Algorithm Design 4credits 64hours

This course gives an introduction to the basics of algorithm, common algorithm design techniques, and the analysis of running time (complexity). The main contents include: tools of algorithm analysis, divide and conquer algorithms, dynamic programming, greedy algorithms etc. algorithm design techniques, and NP complete, randomized algorithms, approximation algorithms and other advanced topics.

30470134 Theory of Computation 4credits 64hours

This course gives an introduction to the basics of computation theory, including: Mathematical Logic, Finite Automata, Context-Free Grammars, Turing machine, undecidablity, and computational intractable topics (NP complete, PSPACE, BPP, interactive proof, etc).

30470154 Game Theory 4credits 64hours

Part One: Normal-form games

Part Two: Extensive games

Part Three: Bayesian games

Part Four: Mechanism design

30470223 Introduction to Computer Networks 3credits 48hours

This course aims at giving a comprehensive introduction to the fundamentals of computer networks and network performance analysis. The course contains two parts. The first part covers various networking topics including network principles, Ethernet, WiFi, routing, inter-networking, transport, WiMax and LTE, QoS, and physical layer knowledge. The second part presents mathematical techniques for modeling, analyzing and designing computer systems, including convex optimization, queueing theory, game theory and stochastic analysis. This course is intended for junior or senior undergraduate students in computer science or electrical engineering.

30470232 The Physics of Information 2credits 32hours

The 21st Century has seen a string of profound discoveries that interface physics, information theory and computer science. This course will introduce undergraduate students this exciting frontier by connecting the various physics and computational ideas they learn in first year. After completion of the course, students will appreciate how

information theoretical principles led to new understanding in physics, and how new physics facilitated new models of computation. Topics include physical consequences of the Church Turing thesis, unravelling Maxwell's Demon through information thermodynamics, and the information theoretic consequences of quantum mechanics.

30470293 Mathematics for Artificial Intelligence 3credits 48hours

This course aims to introduce the fundamental mathematical techniques useful for artificial intelligence undergraduate majors, illustrated with a rich spectrum of applications. Artificial intelligence (AI) has close connections with a great diversity of disciplines and applications. Thus a sound AI education requires the students to be equipped with broad knowledge in mathematics, so that they could cope with current and future technological challenges handily and innovatively. In this course, mathematical techniques from linear algebra, high-dimensional geometry, statistical inference, mathematical optimization, and information theory will be covered. These techniques will be applied to algorithmic and design problems in various topics, including machine learning, massive data, compressed sensing, Bayesian network, drug design, natural language processing, etc. Finally, this course introduces the students to deep scientific issues in the foundation of computing such as complexity theory and quantum artificial intelligence.

30470303 Probability and Statistics 3credits 48hours

Statistical methodsoffer a powerful toolkit to extract useful information from massive and noisy observational data. This course introduces studentstomodern statistical methods and their theoretical foundations in high-dimensional and nonparametric models. In this course, we will covermodern statistical methods developed over the past 20 years, analyzetheir asymptotic properties and probabilistic foundations, and show how these methods can be applied into real data applications. Selected topicsinclude:high-dimensional and nonparametric estimation, minimax lower bound, multiple hypothesis testing, semiparametric models.

30470324 Introduction to Computer Systems 4credits 64hours

This course covers selected elements from different system areas including computer organization, operating systems, and networking. The students will learn the concepts, tools, and design patterns, as well as practice developing real-world applications using the C programming language. The topics we will cover include C and assembly language, computer organization, memory management, virtual memory, process management, operating system kernels, file systems and I/O, networking and socket interfaces, multi-threading and concurrency. We will also cover useful software engineering and system development tools and processes.

30470332 Introduction to Programming in C/C++ 2credits 32hours

This course introduces the basic concepts in programming and object-oriented design. It is designed to be the first programming course for IIIS students. No prior programming experience is expected. We will start with the basic syntax of the C/C++ programming language and gradually extend to more advanced topics such as inheritance, polymorphism, modern C++ features, and program efficiency/performance. Lectures will include frequent live code demos. Students will first learn the concepts/techniques in lectures, and later master them through course projects. Upon successful completion of this course, students should be able to write effective, concise, and efficient C++ programs, and should feel confident taking any higher-level courses in the department.

40470024 Fundamentals of Cryptography 4credits 64hours

In this course we will introduce the basic concepts in modern cryptography. The contents include encryption, pseudorandomness, digital signature, interactive protocols, zero-knowledge proofs, multiparty computation,

homomorphic encryption, and program obfuscation.

40470243 Artificial Intelligence: Principles and Techniques 3credits 48hours

This course will introduce the basic ideas and techniques underlying the design of intelligent computer systems. Specific topics include search, constraint satisfaction, game playing, graphical models, machine learning, Markov decision processes, and reinforcement learning. The main goal of the course is to equip students with the tools to tackle new AI problems you might encounter in life and also to serve as the foundation for further study in any AI area you choose to pursue.

40470284 Quantum Computer Science 4credits 64hours

Quantum computer science is a course offered to undergraduate students with a solid preparation in linear algebra but no-prerequisite on quantum theory.

The course will cover many topics at the forefront of the new field of quantum computer science, including, foundation of quantum mechanics with an emphasis on finite-dimensional quantum systems; Quantum entanglement theory including concept of bipartite and multipartite entanglement and its quantification, many-body entanglement and graph states, quantum teleportation and nonlocality measured by Bell's inequality; Quantum computation model and quantum complexity; Quantum algorithms, including Shor's factorization, quantum search, quantum phase estimation, quantum algorithm for linear systems of equations, and quantum machine learning. Implementation of quantum computation including trapped-ion and superconducting quantum computer. The purpose of this course is to bring the students to the exciting research frontiers of quantum computer science.

40470293 Quantum Communication and Cryptography 3credits 48hours

This course is offered to upper level undergraduate students, junior or senior students in the Yao Class, physics, EE, and computer science departments. The course will cover topics at the forefront of the new field of quantum communication and cryptography, including, for instance, foundation of quantum information, quantum entanglement, quantum cryptography, quantum communication, quantum random number generation, physical implementation of quantum communication and networks. The goal is to help the future researchers to find the interesting topics to work on.

40470313 Causal and Statistical Learning 3credits 48hours

The most significant technological progress in the last decade has occurred on the data-science area. A sequence of methods has been developed and broadly adopted. Why can a data-driven methods perform well in the prediction and causal inference? This is the core thus hottest theoretical problems of the data science.

This course provides the students a road map for studying relative multi-disciplinary theories, tools, and perspectives that are critical for answering the above question. The roadmap, fully accomplished in 2000s, clearly plots the approach and framework of analyzing a statistic learning model's functions from statistical and causal perspective. In the course, we will systematically study the Bayesian causal network theories, statistic inference theory analyzing data's value and the store of information, econometrics theory about causal inference and learning methods. The course emphasizes the interdisciplinary nexus which reveal the fundamental intuition why the data can be used to analyze, estimate, and predict the relations between variables.

Beyond the course instruction, the students are required to read selected frontier research papers, which is related with the course context. The reading will enable the students to link the course material with the research progress and enlighten their creativity and critical thinking.

The course is a preparation for a sequence of advanced courses, such as the theory of probability, the theory of statistics, matching learning, the theory of AI, etc.

40470323 Introduction to Artificial Intelligence Chip：From Verilog to FPGA 3credits 48hours

This is a course focusing both on theoretical and experimental hardware fundamentals. The target is to implement small scale convolution operation in CNN on FPGA. After the course, students should be able to handle:

How to divide control logics and computing logics.

How to implement logics, timing, state-machine etc.

Able to make testbenches.

Able to map to FPGA, and debug on it.

Know basics about back-end about ASIC chip design, like verification, layout

etc.

Able to implement a 3*3 convolution layer, and finish the local memory, global memory.

40470333 Data Mining 3credits 48hours

This course offers a broad coverage of topics in the field of data mining. The first half of the course cover basic data mining concepts including: data preparation, knowledge presentation, classification, clustering, generalization of algorithms, evaluation of credibility, and association analysis. The second half of the course covers some of the more advanced research topics in the field of data mining. This course intends to be a first course on data mining that prepares students for further study, which introduces students to many different topics so that they can pursue their favorite ones on their own after the course.

40470353 Computer Vision 3credits 48hours

This course introduce both of the basics and advances of computer vision. The content ranges from computer vision basics, such as image formation, image processing, to recent development of feature extraction, 3D vision, as well as recent breakthroughs such as deep learning, image recognition and object detection. We emphasize on the foundation of computer vision, but we also teach the most recent technology advancement. We hope the students can have a good understanding of the foundation of computer vision, and at the same time be enthusiastic about the cool stuff in computer vision.

40470363 Deep Learning 3credits 48hours

Deep learning is one of the core techniques in modern AI. It is also the fundamental tool for handling massive data in the “Big Data” era. This course aims to provide a comprehensive overview of the basic ideas, methods and techniques of deep learning. Students will be also asked to use deep learning approaches to solve real-world problems in homework and final project.

The course topics include supervised learning, generative models, sequence models, unsupervised learning, meta-learning, security and explainability.

40470374 Distributed and Blockchain Systems 4credits 64hours

This course introduces the basic concept, principle, mechanism and algorithm of distributed systems and blockchain systems. Specifically, the course covers the clock and communication of distributed systems; distributed consensus; Bitcoin mechanism; mining pools; network communication; payment channel, etc. The course will systematically introduce the design principle of distributed systems and blockchain, and will discuss some advanced topics in practical implementations, including their background, challenges and solutions.

40470382 Multimedia Computing 2credits 32hours

With the development of Internet, multimedia data have become increasingly accessible, such as images, audios, videos, texts, etc; the advances of artificial neural networks have made it easy to process these data. This course covers applications including image and video processing, audio and speech processing, natural language processing. It introduces popular signal processing and machine learning techniques in the artifitial intelligence field, such as data representation, data compression, frequency-domain transformation, convolutional neural networks, sequence models, data synthesis, multimodal fusion, etc. Through lectures and course projects, students learn about the features of different signals, and their common ground. This class can serve as the prerequisite for computer vision and natural language processing classes.

40470396 AI+X 6credits 96hours

This course is a core course in IIIS Zhi Class, which aims for letting students solve interdisciplinary problems using AI techniques, assuming that the students have already taken systematic AI courses. This course contains multiple themes, where each theme contains a few different projects. Students will form teams of size 1-2 people. Each team will pick one project, and solve the specific problems using AI techniques. The goal of this course is to let students finish one AI project from the beginning to the end, understand the potentials and limitations of AI techniques, as well as understand what kind of human/data support are necessary for making AI work. This course assumes that the students have already taken Machine Learning and other related AI course, and also familiar with basic tools (including Python, GitHub, SSH and so on).

40470403 Intelligent Systems and Robotics 3credits 48hours

This course introduces both the theoretical foundations and advanced techniques in the fields of intelligent systems and robotics, from a unified algorithmic view of both the traditional robotic control perspective and the learning perspective. The contents range from robotic system modeling and problem formulation, planning and control, estimation and perception, to adaptive behaviors using both the indirect (model-based learning) methods and direct (model-free learning) methods. The course concludes with an introduction to industrial robotic arms, autonomous vehicles, and other areas.

40470414 Database Systems 4credits 64hours

This course is designed to introduce the fundamental concepts and implementations of modern database management systems. This is not a course that teaches you how to build database applications (e.g., schema design, SQL programming). It is designed as a systems course, with an emphasis on database internals. Topics include relational model and SQL, storage and indexing, query processing and optimization, transactions and concurrency control, distributed and cloud databases, as well as advanced research topics in the field. Students taking this course should have basic knowledge on computer systems. No prior database experience is assumed. The course consists of lectures, written assignments, and projects. Assignments and projects are designed to reinforce what the student learned in lectures and to provide hands-on experience in building a database system. Upon successful completion of this course, the student should feel confident taking a job as a database developer or conducting database-related research in graduate school.

40470423 Natural Language Processing 3credits 48hours

This course will introduce important problems in the field of natural language processing such as language modeling, machine translation, and question answering, as well as core technologies to solve these problems

including attention-based neural networks and language model pretraining. The course will cover basic algorithms, real-world applications, as well as open problems in academic research.

00510232 Management of Technological Innovation 2credits 32hours

This course is about the the fundaments of innovation management. The course includes four parts: (1)theories of innovation; (2)innovation strategy; (3) innovation process; (4)innovation organization.

30510053 Econometrics 3credits 48hours

This course is an introduction to econometrics. It introduces students to multiple regression methods for analyzing the relationship between two or more economic variables. It starts from the simple linear regression to multivariate regression, regression with discrete random variables, instrumental variables, and to regression with panel data, time series data. The objective is to help students understand, evaluate and conduct empirical studies in economics and related disciplines.

30510073 Public Finance 3credits 48hours

Public Finance studies the role of the public sector in the economy. In this course, we will study the economic foundations that justify the existence of the public sector, and the economic theory that describes what the role of the public sector should be. We concern when the governments should intervene the economy and how they should do so, including what options they have and what are the effects of the policies. The focus is on the government taxes and spending activities. We will also look at the governments' policies in the reality, and study how the policies affect individual and corporate decision-making and welfare.

30510273 Data Structures and Algorithms 3credits 48hours

Now we are in an Information era, which roots on a basic fact that, Information Technology (IT) has deeply and widely reshape almost every areas, e.g., production, operation, business, society and personal life. One important characteristic of information era is storing, representing and processing of large-scaled structural data. How to represent and process large-scaled data is the key factor not only for information systems construction, but also for organizations to gain competitive advantages. This course will focus on constructing effective data models using standard data structures as well as efficient processing, which will cultivate the students with the abilities of efficient data modeling and data processing.

The course contents include:

a) Introduction to Data Structures and Analysis;
b) Analysis on Computational Complexity;
c) List, Stack and Queue;
d) Binary Trees;
e) Graphs and Network;
f) Search;
g) Sorting;
h) New techs.

By the end of the course, the students should:

1. Master the major data structures and efficient processing based on C programming;
2. Master the preliminary abilities to model and analyze some real-world applications.
3. Cultivate the ability for further information analysis, design and implementation.

To accomplish this global goal, lecturing is far from enough; case programming and analysis, assignment and

Q&A are also important.

30510393 Auditing(1) 3credits 48hours

This course is designed for students who plan careers in the accounting and finance functions of corporations or government entities or in the consulting/risk management/internal audit services side of public accounting and internal audit outsourcing firms. The course is designed to provide the student with insight about auditing: what it is, why it's important, what it entails, and why users of financial statements should care about it. Its is an introduction to the audit function, audit standards, objectives and procedures, ethical and legal environment, materiality and audit risk, sampling, and reporting.

30510523 Money and Banking 3credits 48hours

This course presents basic concepts and theories in monetary and banking economics. Topics covered in the course include: the structure of financial system, financial market and financial institutions, definition of money and role of bank, Money supply and demand, interest rate such as the determination of short-term interest rates and the structure of interest rate, and exchange rate and determination of exchange rate including PPP, IRP, monetary approach, asset approach, and monetary policies.

30510643 Accounting Information System 3credits 48hours

Information systems (IS) have become a necessity for modern companies to improve business processes, enhance management, innovate business models and build up core competitiveness. Accounting is in general concerned with the identification, collection, processing, analysis and communication of financial information about an organization. Accounting information systems (AIS) is the core subset of IS and the infrastructure for accounting information procession. Accounting departments and accounting professionals are facing the huge opportunities and challenges of adopting and using contemporary AIS application.

This course introduces AIS from both technical and managerial perspectives. The course consists of 4 parts. Part 1 introduces AIS concepts and tools, including introduction to AIS, business processes and AIS data, documenting AIS, and identifying risks and controls in business processes. Part 2 introduces the components of AIS, including understanding and design of accounting data, queries & reports, and forms. Part 3 introduces basic business processes combined with the utilization of an AIS software, including the acquisition cycle and the revenue cycle. Part 4 covers three topics on managing information technology and IS development: IS application and evolution in enterprises, managing and controlling IS, and the introduction to IS development.

The targeting audience of the course is the 3rd year college students majoring in accounting. It requires students to pay both heed to abstract concepts and knowledge as well as tools and skills related to AIS. The objectives of this course is to give students the fundamental knowledge and tools which could help them to understand the concepts and components of AIS, to master the methods and tools to analyse, design and evaluate AIS, to know about a typical AIS software, to comprehend the trend of contemporary AIS application and its effect to accounting professionals.

30510732 General Management 2credits 32hours

Organizations are all around us in society: we study in them, work for them, rely on them for goods and services, and we are often regulated and highly influenced by them. Understanding the management of organizations, therefore, is the key to becoming more effective actors of the organizations we are or will be part of. We will cover three traditional functions of management: planning, organizing, and leading. Overall, this course offers a comprehensive perspective for those interested in management and organizations.

By the end of the course, you will achieve the following:

1 Be familiar with key principles of management and organizations.

2 Develop analytical skills in the diagnosis of organizational & managerial (in)effectiveness.

3 Be able to apply basic principles of management to real-world practices.

30510743 Intermediate Microeconomics 3credits 48hours

The course presents basic theories of microeconomics and its applications. Topics covered include consumer theory, firm theory, market supply and demand, externality and public goods, industrial organization, game theory, information economics, and general equilibrium. The economic modeling methods and analytical tools are emphasized throughout the course.

30510763 Intermediate Macroeconomics 3credits 48hours

We will study the economic issues within a unified framework as possible as we can. At the same time, we will also try to introduce alternative theories and models. The main purpose is to introduce the method to study macroeconomics, not the facts and the theories. We emphasize the micro-foundation, and use the neoclassical economics as the benchmark. Nevertheless, we also introduce the Keynesian economics by introducing some market imperfections such as sticky wage and search in labor market. #We will start with the basic facts and issues in macroeconomics. Then we will introduce the modern approach to address these issues. We will study how different markets work together in general equilibrium. Markets for labor, saving and investment, and financial assets interact to determine the economy’s long-run growth and its fluctuations.

30510812 Marketing Management 2credits 32hours

Marketing is the core of an operating business, and also the management process through which goods and services move from concept to the customer. Marketing is based on thinking about the business in terms of customer needs and their satisfaction. Marketing differs from selling because it has less to do with getting customers to pay for your product as it does developing a demand for that product and fulfilling the customer's needs. Marketing entails planning and executing the conception, pricing, promotion, and distribution of ideas, goods, and services. It starts with identifying and measuring consumers' needs and wants, assessing the competitive environment, selecting the most appropriate customer targets and developing marketing strategy and implementation program for an offering that satisfies consumers' needs better than the competition. Marketing is the art and science of creating customer value and market place exchanges that benefit the organization and its stakeholders.

The objective of this course is to introduce students to the concepts, analyses, and activities that comprise marketing management, and to provide practice in assessing and solving marketing problems. The course is also a foundation for advanced electives in marketing as well as other business/social science disciplines. We will explore the theory and applications of marketing concepts through a mix of cases, discussions, lectures, guest speakers, individual assignments, and group projects. We will draw materials from a variety of sources and settings including services, consumer and business-to-business products.

30510863 Developmental Economics 3credits 48hours

Development economics is a course involving economic problems and policies of those countries that have not yet reached the level of economic well being observed in the western world. At the completion of this course, students will be familiar with theories of development and their applications in the real world. Students will have a

better understanding of a number of topics that shed light on the development process, including poverty, inequality, education, international trade, the role of the government, and population issues. Students will also be trained to conduct their own research by using theories learned in class and analyzing real world data. They will also present their research results in class, which can improve their ability of public speaking and intellectual interactions.

30510883 Economic Growth 3credits 48hours

The aim of the course is to provide students with a rigorous introduction to the empirical facts and theoretical models of economic growth. A recurring theme of this course is the question: "Why are some countries so rich, while some others are so poor?" To answer this question, we will look at various aspects of economic growth, starting from some characteristics and stylized facts of different countries across the world. We will then study some of the main theories and their predictions. Through the study of the course, the students will get familiar with the available cross-country data and use different models as a basis for understanding and distinguishing the various determinants of economic growth.

30510893 Financial Statement Analysis 3credits 48hours

The objectives of this course are to gain a more thorough understanding of financial accounting techniques and to explore the accounting theory underlying such techniques. Assets, revenue recognition, and income items, investments in other companies and stockholders' equity will be covered in this course. Class meetings involve lectures, discussions and exercises. Class attendance is required in this class.

30510962 Financial Institution 2credits 32hours

A well-functioning financial system is crucial to economic growth and development as it promotes efficient capital allocation, provides risk sharing, and reduces transaction costs.This course will discuss the economic foundations of financial markets and management of financial institutions. It will also introduce the development of China's financial system and compare it with its U.S. counterpart.

30510973 Econometrics(1) 3credits 48hours

The purpose of this course is to help students understand how to interpret economic data. It will focus on the issues that arise in using this type of data, and the methodology for solving these problems. The focus of the course is on regression analysis. Specific topics and extensions will include multivariate regression, dummy variables, heteroskedasticity, serial correlation, and instrumental variables. Problem sets will provide practical experience in addressing some of these issues using actual economic data. Chapter 1-8 and selected material in Chapter 10-15 will be covered. In addition, basics of hypothesis testing and model selection methods will be covered.

30510992 Corporate Strategy Management 2credits 32hours

This course introduces the concepts and tools of strategy formulation and competitive analysis. You will learn about why some firms survive and prosper while others do not, and develop critical analysis and communication skills to create and implement firm strategy. The course focuses on the analyses, organizational processes, skills and business judgment managers must use to craft strategies, position their businesses so as to maximize long-term profits upon uncertainty and competition.

Strategic Management is an integrative and interdisciplinary course, which takes a general management perspective. It views the firm as a whole, and examines how policies in each functional area (such as accounting, economics, finance, marketing, and organizational behavior) are integrated into an overall competitive strategy. It

is intended that you develop a “general management point of view” in this course. This point of view is the best vantage point for making decisions that lead to sustainable business performance. The key strategic business decisions of concern involve determining organizational purpose to evolving opportunities, creating competitive advantages, choosing competitive strategies, securing and defending sustainable market positions, and allocating critical resources over long periods. Decisions such as these can only be made effectively by viewing a firm holistically, and over the long term.

30511053 Corporate Finance 3credits 48hours

Firms compete in Consumer & Business Markets to sell their products & services, and they also compete in Capital Markets for the resources required to operate their business. Investors provide the capital (resources) to companies with the expectation that they will earn a competitive return on their capital and compensate them for risk. A consumer or business manager is continuously faced with financial choices and meeting the demands of both of these arenas of competition.

For the consumer these choices include, among others, financing a purchase, saving for retirement and evaluating investment products. For a business manager the choices include deciding which projects to pursue and alternative approaches to provide funds for these projects. Finance is the study of a framework that can be used to evaluate these choices consistent with the necessity of competing for investor capital. Regardless of your ultimate career, a solid understanding of the fundamentals of finance, will serve you well.

30511093 Computer Systems and Networks 3credits 48hours

This course provides a comprehensive introduction to the concepts and principles about computer hardware, operating systems, and computer networking, aiming to facilitate developers and managers of information systems to understand the trade-offs in the construction and application of the information technology infrastructures in a business environment. Topics in the hardware part cover CPU architecture, memory structure, storage, and peripheral

devices. The system software part covers the basic characteristics of main-stream operating systems including Windows and Linux, as well as the major functional modules of modern operating systems. The computer networking part covers topics such the Internet architecture, protocols, technological principles, and typical applications. A systematic view will be adopted to help students master the fundamental knowledge about modern computer systems and networks.

40510093 Topics on International Accounting 3credits 48hours

This course will explain the development of accounting and financial reporting models in the world, and to evaluate the reasons and evolution of international accounting harmonization and convergence; To provide you with the key technical issues in international accounting area and their impact on financial reporting, such as accounting for foreign currency transactions, translation of foreign financial statements and accounting for changing prices; and To describe and analyze some management accounting issues in multinational operations, for instance, the establishment of management control and information systems, international taxation, and international transfer pricing.

Many of the topics in an international accounting course have a domestic counterpart. However, new factors and complications arise in the international arena. Some of these are (1) laws, practices, customs, cultures, and diversity of competitive circumstances; (2) risks associated with fluctuating exchange rates, and differential rates of inflation; and (3) variations in taxes and tax rates. International accounting discusses issues from the perspective

of companies that have internationalized their finance and/or operations. It also has a comparative aspect, comparing accounting across countries. It also deals with convergence of worldwide financial reporting standards.
This course is designed to provide you with an understanding of the significant issues in international accounting. The teaching approach will be mainly classroom lectures with some discussions and presentations

40510193 Management Systems Simulation 3credits 48hours

Many analytical models and mathematical tools have been used in business decision to improve the operational efficiency and help seize the competitive advantage. Since, however, the real world business situation and environment, regarded as a system, is usually complex, which results into that the traditional analytical methods and tools cannot fit properly. This course introduces a new methodology – simulation – into the business management systems. As its name says, in complex systems, where the number of related variables is huge and they are also closely interdependent, simulation method is to mimic the real activities as well as operations in computer environment, using the time-advance mechanism, to generate the evolutionary results over time. In so doing, after enough replications of simulation, statistically reliable results could be derived. Clearly, the computational load is extremely high. But, with mainstream personal computer nowadays, this process could be performed efficiently. In this course, we will cultivate the students with the abilities of modeling, simulation and analysis with computer and software.

This course includes:

a) Basic Concepts on Simulation Modeling;
b) The Simulation Process;
c) Simulation with EXCEL;
d) Input Analysis using Statistics;
e) Random Number Generator
f) Random Variable Generation;
g) Basis of simulation with ARENA;
h) Advanced simulation with ARENA;
i) Output Analysis;
j) Lecture on system dynamics;

To accomplish this global goal, lecturing is far from enough; case programming, modeling and analysis, assignment and Q&A are also important.

40510323 Intermediate Financial Accounting(1) 3credits 48hours

This course will focus on U.S. accounting standards, and the underlying issues of accounting will be incorporated with its actual development in China and international accounting standards. We will also cover various ethical issues related to the use and production of accounting information. All the materials will be taught in the class, and small cases will be discussed to get a better understanding. This course is divided into two parts: the first part gives a brief review of the standard setting process of U.S. GAAP and describes the financial reporting environment. Financial accounting framework and accounting system are also discussed; the second part illustrates the treatment of basic accounting elements, including cash, inventories property, plant and equipment and intangible assets.

40510333 Intermediate Financial Accounting(2) 3credits 48hours

Based on the Intermediate Accounting (1), this course covers detail problems related to liabilities, shareholders'equities, investment and revenue recognition. Meanwhile, this course introduces briefly the income tax, pension and lease problems and accounting treatments on them.

40510343 Managerial Accounting (1) 3credits 48hours

This course covers derivatives such as options, forward contracts, futures contracts, and swaps. By the end of the course you will have a good knowledge of how these contracts work, how they are used, and how they are priced. Derivatives have become an integral part of finance. Whether you end up working for a financial or a non-financial institution you will find the material you learn on this course important.

40510673 Empirical Finance 3credits 48hours

Empirical Finance is a course for senior undergraduate students who are interested in applying real data to test classical asset pricing theories and in the applications of econometric methods to financial problems. This course mainly contains two parts:

40510763 International Economics-Theory and Policy 3credits 48hours

This course aims to provide students with a survey of fundamentals in international economics , i n both theory and empirics . The course consists of two parts: international trade and international finance , with an emphasis on the former . The first part includes topics on why countries trade, what they trade, the benefits and costs of trade, and the mo tivations for and the effects of government trade policies . The second part contains topics on how exchange rates are determined and the effects of global imbalance

40510943 Theory of Industrial Organization 3credits 48hours

Under what circumstances should telecommunication firms be allowed to merge? When are hotel room prices

40510973 Labor Economics 3credits 48hours

This course studies the mechanism of labor markets. It covers the traditional topics in labor economics, which include the theories of labor demand and supply (both static and dynamic), labor market equilibrium, compensating differentials, human capital investments and returns, wage determination and structure, migration, gender and race discrimination, inequality, unionization, efficiency wages and work incentive scheme, and unemployment. It deals with the impacts of wages, prices, profits, working conditions, government policies and the like on the decision makings of firms and workers.

40510992 Enterprise Resource Planning 2credits 32hours

ERP systems are enterprise-wide information systems that integrate various functional operations and streamline business processes. This course aims to introduce the concepts of ERP systems as well as the application, implementation, and management of ERP.

In particular, the course will help you to obtain the knowledge of ERP at three levels.

1. At the system level. Through hands-on experience with SAP in lab sessions, you will learn SAP commands and functions. You will be able to handle basic business processes in the SAP environment.
2. At the business process level. You will learn how functional operations interact and coordinate to complete business processes and how ERP can enable and facilitate business process integration.
3. At the organizational level. You will be able to recognize and understand organizational and managerial issues associated with enterprise systems, such as planning, vendor evaluation and selection, as well as system implementation.

40511003 Environmental and Resource Economics 3credits 48hours

This course is an introduction of Environmental and Natural Resource Economics. The objective of this course is

for students to learn how basic economic theory can be used to understand and analyze environmental pollution and resource degradation problems. The course covers both conceptual and methodological topics and recent applications. Examples of local, regional, national and international environmental and natural resource issues are presented and discussed. The first part of this course is an introduction to the basic principles of environmental and resource economics; cost and benefit analysis. In the second part the focus is on environmental economics and policy, including economics of pollution control, valuing the environment, regional and global air pollution, water pollution and so forth. The third part is focused on natural resource economics, both renewable and non-renewable resources. The last part is on sustainable development and macroeconomic aspect of environmental policy, and Green Accounting.

40511012 Business Case Analysis2credits 32hours

This course is designed for future managers who will face the new, globalized, and borderless world economy. Globalization and technological advances have created exciting opportunities for managers to pursue strategies in markets around the world. These developments also present managers with enormous complexity in terms of understanding diverse economic, political and social environments, managing the organizational tension inherent in coordinating activities worldwide, fostering innovation and cross-national learning, and interacting with employees and partners from diverse cultures.

This course leverages the foundation built in other cornerstone courses to explore topics such as development of globalization, firms' foreign expansion strategies, the challenges of operating in different cultures, the difficulties of designing effective organizational structures for multinational operations, leadership in the global context, and so on.

A balanced approach is taken to this course: on one hand, this course aims to arm students with necessary knowledge and skills by covering key aspects of business case analysis and problem solving. Particularly, a global orientation is reinforced by drawing on worldwide cases or examples; On the other hand, this course will offer students the opportunities of applying the contents of this course through class discussion, case analysis, field study, and communication with diverse types of international institutions. I would strongly encourage active class participation. My experience has been that students generally tend to under- (rather than over-) estimate the worth of what they have to say. Thus, please note that probing questions are as useful a form of class participation as presentations of logical analyses.

40511093 Financial Management 3credits 48hours

Financial strategies encompass those financial decisions that affect the long-run value of the firm. The objective of this course is to build on the concepts of financial management learned in Corporate Finance (1) and other relevant courses to provide a bridge to understanding the underlying principles behind why these decisions are made and to offer explanations for observed behaviors on the part of financial decision makers. Focus will be placed on developing a comprehensive framework of conceptual knowledge that builds on the principle of value maximization. Capital budgeting, business valuation, investment analysis, capital structure, option theory, risk management, and long-term financing are integral parts of this conceptual framework.

40511103 Game Theory 3credits 48hours

Game theory is the foundation of almost all modern economic theory. It is one of the most interesting courses in undergraduate economics. Emerged originally as a field of mathematics, it has been successfully applied to all fields of economics. Furthermore, game theory also plays an increasing role in other social sciences such as philosophy, law and politics, and in natural science such as evolutionary biology and computer science, etc.

This course is an introduction to game theory, which puts emphasis in introducing basic game-theoretic analysis, including the conception, analytic techniques and applications for each type of games.

We will discuss static games with perfect information, static games with imperfect information, and dynamic games with or without perfect information.

Most class sessions will be delivered in English and will consist of both “hands-on” experiences in structured strategic situations as well as lectures about the theory underlying these situations. Student participation is strongly encouraged.

40511133 Econometrics(2) 3credits 48hours

This course aims to equip students with modern econometric tools and modeling methods for them to set up suitable econometric models to do data analysis. Hence the approach of this course will be model-driven and data-driven, which focuses on econometric applications without pursuing technical details. This course will cover some modern topics in both macro-econometrics and micro-econometrics. For macro side, we will introduce the concept of non-stationarity and study the problem of unit-root tests and co-integration test, as well as the famous ECM model. We will also study the vector autoregression models which play an important role in macro applications. For microeconometrics, we will cover several important models in application, namely, binary choice model, discrete choice model, models for count data, sample selection model, and the panel data model. For each model introduced, we will discuss its applicability, limitation, and estimation methods together with inference tools. Since this course focuses on applied side, we will also provide training in econometrics softwares, e.g. STATA/Eviews/R.

40511223 Behavioral Economics 3credits 48hours

Do people really behave according to the standard neoclassical models of economics? Or do we sometimes have self-control problems? Do we care about other people as well as ourselves? Do we suffer from overconfidence? This course will examine the common deviations from neoclassical economic models in real world decision-making. We will then study how economics incorporates insights from psychology in order to more fully account for human economic behavior.

40511263 Fixed Income Securities Analysis 3credits 48hours

This course provides a systematic overview of fixed income securities and analytical tools. In the first part of the course, the students will become familiar with the basics of fixed income, interest rate models, and derivatives. The second part will focus on introducing corporate debts, credit risk modeling and derivatives, including CDS and CDO. The students will understand through practice the available modeling approaches. The course will catch the interaction between finance modeling and the practices in Chinese and overseas markets, such as the US sub-prime mor

40511273 Information Resource Management 3credits 48hours

This class discusses the basic concepts and methods of information resource management, including capturing, representing, organizing, storing, processing and exploiting information.

In particular, the introductory session will provide an overview of the definition and general types of information, the new forms of information in the era of social media, and the definition of information source. Web search engines, as one of the most important channels to obtain information in our daily life, will be discussed.

Then, the class will cover the process of capturing, encoding, and initial processing of different information in digital media, followed by the essence of information management and extraction technologies, such as data warehouse, XML, and the Semantic Web.

However, while more and more available information accelerates the development of new knowledge, issues pertaining to information security become evident too. Hence, this module also briefly explains the concepts of confidentiality, integrity and availability, as well as the mechanisms that provide security in various information systems and applications.

Next, this module focuses on the applications of information resource management technologies in enterprises and in Web 2.0-based e-commerce. First, the information architecture, strategies and services in enterprises will be introduced. Several cases on how information can be a strategic resource for companies will be studied. Second, several applications in Web 2.0-based e-commerce will be discussed in detail.

Last but not least, in view of the abundance of information nowadays, this module will encourage student discussions on the problem of finding the relevant "needle in the haystack" and the problem of information overload.

40511323 Human-Computer Interaction 3credits 48hours

This module is intended for students whose work interacts with user interface issues in the design of software systems. The module stresses the importance of user-centered design and usability in the development of software applications and systems. Students will receive theoretical training on the analysis, design, development, and evaluation of user interfaces. They will also acquire hands-on design skills through a graphical user interface design project. The module takes into account contextual, organizational, and social factors in system design.

40511342 The Business Cycle Analysis 2credits 32hours

This course builds upon the course of Intermediate Macroeconomics as a further exploration of the business cycle analysis of the macroeconomic study. It will introduce how developed and developing economies fluctuate in the short run. The course will combine theoretical and empirical analysis, and cover the business-cycle data analysis, consumption fluctuations, R&D fluctuations, labor(and wage) fluctuations, the role of financial market in the business cycle, as well as the relationship between short-run fluctuations and long-run growth.

40511373 Mathematics of Risk(1) 3credits 48hours

The course provides a rigorous introduction to the basic probability theory and models used in the study of insurance and risk finance. Students are expected to be proficient in differential, integral, and multivariate calculus, and some previous exposure to probability and/or statistics is desirable. The following specific topics will be covered:

Foundations of probability theory
Random variables in insurance
Parametric distributions (univariate and multivariate)
Common probability distributions for loss frequencies
Common probability distributions for loss severities
Convolutions of distribution functions; total-loss models
Alternative characterizations of random variables (survival functions, MGFs, etc.)
Risk measures (value at risk, expected shortfall, ruin probability, etc.)
Transformations of random variables
Effects of insurance-policy restrictions (deductibles, limits, copayments)
Heavy-tailed random variables

40511423 Investment 3credits 48hours

This course will introduce and delineate basic concepts and techniques in investments by examining such topics as risk-return trade off, optimal portfolio construction, Capital Asset Pricing model, APT, Market efficiency, topics related to bonds and futures. On the theoretical side, this course introduces fundamental knowledge for portfolio management and capital asset pricing. On the practical side, this course covers recent topics that are related to investment strategies and portfolio management. A project about portfolio management is specially designed to let students apply the theoretical knowledge into practice.

40511932 International Macroeconomic Theory and Policy 2credits 32hours

This course is a field course in International Macroeconomics. The course develops a theoretical framework for the analysis of the determinants of international capital movements, trade imbalances, and nominal and real exchange rates. The theoretical framework is then used as the basis for the discussion of policy issues such as the emergence of the U.S. as the largest foreign debtor, global trade imbalances, developing-country debt crises, the European financial crisis, exchange-rate-based inflation stabilization, currency unions, debt default, balance-of-payment crises, and the effect of the great recession of 2008 on the world economy.

40641963 Novel, History, Modernity 3credits 48hours

The English novel has long been seen as a literary form both stimulated by and in turn stimulating modern capitalism, that form of economic life described by Max Weber as “labor in the service of a rational organization.” But the novel

has always had a complicated relationship to capitalism, sometimes seeming to supply narratives that supported the ethical disposition Weber outlined, and at other times telling stories that directly challenged that ethical disposition.

This course will focus on four novels and four relevant works of social theory in an effort to explore how literature works both in concert with and as a brake on the “rational organization” that defined modern capitalism for Weber. To exemplify what Weber called the irrational speculation that preceded modern capitalism, we will begin with an examination of Shakespeare’s The Merchant of Venice (1597-1600). Four pairings of novel and social theory then follow: Daniel Defoe’s Robinson Crusoe (1719) with Max Weber’s The Protestant Ethic and the Spirit of Capitalism (1904-5); Thomas Hardy’s Tess of the d’Urbervilles (1891) with Ferdinand Tönnies’s Community and Society (1887); Edith Wharton’s

The House of Mirth (1905) with Thorstein Veblen’s The Theory of the Leisure Class (1899); and Don DeLillo’s White Noise (1985) with Guy Debord’s Society of the Spectacle (1967). Whether there is anything left of Weber’s Protestant ethical disposition once “reality” becomes a genre of television and Debord’s insights have become perfectly appropriate for advertising on Madison Avenue is one of the last questions the course will explore.

40660072 Legal English 2credits 32hours

1. THE U.S. GOVERNMENT SYSTEM

This chapter will introduce students to the terminology used to describe the U.S. system of government. Particular attention will be paid to the various tools available to the legislative, executive, and judicial branches to carry out their responsibilities, as will as to the ways the three branches interest with one another. After completing the chapter, students should be able to describe the way the U.S. government functions.

2. FEDERALISM

This chapter will introduce students to some of the key legal concepts related to the U.S. federal system. Particular

attention will be paid to the Constitutional basis for this system and to how the federal and the state governments limit each other's authority. After completing the chapter, students should have a better understanding of the way these two legal systems in the United States interact and overlap.

3. THE JUDICAL SYSTEM

This chapter will introduce students to the U.S. judicial system. Particular attention will be paid to the federal court system laid out in Article III of the U.S. Constitution. After completing this chapter, students should be able to discuss the basic structure of the U.S. judicial system, as will as the able to reference and describe key mechanisms that allow the judicial system to function.

4. LEGAL METHODOLOGY

This chapter will introduce students to important methodological concepts that underlie legal thought in the United State. Particular attention will be paid to the types of reasoning methods used in legal education and practice. After completing this chapter, students should be able to discuss the various schools of thought regarding how best to deal with legal problems, and which of those schools of thought are the most popular in the U.S. legal community.

40661493 Legal Reasoning 3credits 48hours

The Legal Reasoning Course will teach students to identify, predict, and apply legal rules and principles using legal reasoning and critical thinking skills found in common law systems in order to teach students "how to think like a lawyer." The course will focus on the U.S. Legal System and will include an introduction to the many sources of law in the United States, including case law. Techniques of case and statutory analysis are featured, along with the impact of social, economic, historical, and jurisprudential factors on the development of the law over time. Students will learn how to identify legal issues presented by specific cases, analyze a legal problem, determine the relevant legal rules and apply those rules to specific facts to arrive at a reasonable conclusion in a specific case. This course will be taught in English.

40661512 Comparative Corporate Governance(in English) 2credits 32hours

This course is designed to familiarize students with company and securities laws and underlying policies in China, with an emphasis on the corporate governance structure of publicly-held companies. The course focuses on important governance issues such as controlling shareholders, board of directors, affiliated transactions, domestic and cross-border takeovers. To this end, it also covers securities and investment regulations, such as listing requirements, mandatory disclosure and foreign investment restrictions in the country.

In the beginning of the class, an overview of the regulatory framework and market conditions in Mainland China will be conducted. The other part of the class will be divided into the following units, each in three or four hours: I. Controlling Shareholders, Related-Party Transactions and

40661773 Foundations of Common Law(3) 3credits 48hours

This course aims to introduce students to judicial interpretation of some of the amendments to the United States Constitution that establish many of the very important standards for U.S. federal criminal procedure and state criminal procedure. Throughout this course, students learn to explore the text of the Fourth Amendment, the Fifth Amendment, and the Sixth Amendment as well as their relationship with the everyday exercise of federal and state police power that affects the life of many individuals in the United States of America. Through brief writing, legal research, reading assignments, class discussions, and class presentations on a series of cases, students not only will learn areas of legal reasoning including case analyses, statutory interpretation, issue identification, legal syntheses, but also will appreciate the role of American judiciary in Constitutional interpretation that helps balance the interests of a government and its people.

40661783 Foundations of Common Law(4) 3credits 48hours

This course is essentially designed for junior and senior undergraduate students, who will be introduced to the esential contents of US torts law, i.e.. the subject components of torts (intention and negligence), contributory negligence, causation, damages, to various forms of tortious offenses and the determination of damages, as well as possible defenses thereof. This course mainly consists of the following chapters: introduction, intention (mens rea), negligence, strict liability, product liability, nuisance and trespass, emotional distress, defamation, privacy, etc.

00692001 History and Philosophy of Life Sciences 1credits 16hours

The course is organized by LEI Yi and WANG Wei at Tsinghua University and Professor M. Weisberg, the Chair of the Department of Philosophy at the University of Pennsylvania. We invite a historian of biology to teach history of life sciences in odd years and a philosopher of biology to teach philosophy of life sciences. For example, M. Weisberg taught “Modeling in Biology” in 2014 and M. Dietrich at Dartmouth College taught “History of Genetics” in 2015. We wish to improve students’ historical perspective, philosophical reflection, and critical thinking in life sciences.

00692212 Darwin Revolutions 2credits 32hours

This course focuses on the debate and literature surrounding the Darwinian revolution(s) and the non-Darwinian revolution. We start with the pre-Darwin period and end in the post-modern synthesis period.

Historicizing the Darwinian Revolution allows one to open up the more general history of science questions having to do with the nature of scientific revolutions. Specifically, students were encouraged to think about questions such as: was there only one scientific revolution, the one we identify with the name of Newton and other early modern figures, or have there been multiple scientific revolutions? Darwin has been referred to as the Newton of biology. Does this imply that Newton revolutionized the physical sciences while Darwin revolutionized the life sciences? Relying on two famous texts by two celebrated historians of biology, namely Michael Ruse and Peter Bowler, I hope students would appreciate Darwin’s contribution and legacy with a wider set of cultural understanding.

00692241 Topics in Logic 1credits 16hours

This course will introduce students one topic or research area in philosophical logic and mathematical logic each year. The topic will vary. Through the intensive study, students would get to learn the basic knowledge about the chosen topic, and be able to think from a researcher's point of view.

00692273 International Sinology 3credits 48hours

The course provides an overview of common topics and approaches in International Sinology. It deals with the history of the discipline, issues of historical method and paradigms, and introduces the state of the field in social, material, intellectual and literary history and introduces interdisciplinary and comparative approaches to doing history. The content of the course includes among other things a short history of the discipline and state of the field, comparative approaches to early China, and the writing of a research proposal.

30690524 Logic, Language, and Philosophy 4credits 64hours

This course is designed for students with backgrounds and interests in philosophy, and consists of two parts. The first part of the course introduces fundamental logical notions and methods that have applications in philosophy. Things to be covered include logical systems like propositional logic, predicate logic, epistemic logic, and

dynamic logic, as well as issues like inter-translation of formal and natural languages, inference pattern and calculus, epistemic activity and information flow, and the interaction between logic and games. The second part of the course introduces the students to the application of logic in the study of natural language semantics. It gives an overview of the main tools and theoretical approaches, provides concrete examples of a number of phenomena, and discusses both historical backgrounds as well as some methodological assumptions.

30690552 Foundations of Logic 2credits 32hours

The course gives an overview of classical meta-logical results, in particular, Godel's completeness and incompleteness theorems, Church-Turing's proof of the undecidability of first-order logic, and Tarski's theorem on the undefinability of truth. After a recapitulation of the syntax and semantics of first-order logic, Henkin's proof of completeness, in terms of syntactic models and maximal consistent sets, is presented. Philosophical and logical consequences of the result and its proof are discussed, with some glimpses from model theory. The course then presents the notions of complete and incomplete theories, as well as decidability of theories. After an overview of the philosophical and mathematical background in the early 20th century, including Hilbert's Program, the incompleteness theorems and related results, and the ideas behind their proofs, are presented at an informal level. The remainder of the course fills in some of the details.

The course presentation focuses on important concepts and ideas, philosophical as well as mathematical, but also gives pointers to the technical details.

30690562 Modal Logic and its Applications 2credits 32hours

Among branches of modern logic, modal logic provides a nice balance of expressivity and complexity, allowing it to be applied widely and extensively in many fields ranging from humanities to software design. In this course, ideas and methods of modal logic will be introduced along with its famous applications in modeling time, knowledge, necessity, and social behaviors. In this thread, student will be led into environments similar to research, in which ideas and needs from theoretical side and practical side frequently interact. Pointers will be given to standard textbooks/handbooks as well as notable papers, and with knowledge and skills introduced in this course, students with further interests should in principle be able to explore by their own. This course aims to student who more or less have learnt some logic, but this is not strictly required.

40690952 Logic, Computation and Games 2credits 32hours

This course is an introduction to logic and its interfaces with computation, agency, and games. We cover both classical topics such as propositional logic and predicate logic, but also dynamic logics of programming and action, epistemic logics of information, and logics of games. A running theme will be the use of games in developing logical systems. The style of treatment will be mainly mathematical, though we point out connections with other perspectives.

40691152 History of Analytic Philosophy 2credits 32hours

In this course we will read and discuss some classic works in the history of analytic philosophy, including works by Frege, Russell, the early Wittgenstein, and Austin. Reading materials will all be drawn from analytic philosophy written in (or translated into) English. Lectures will also be in English. Students can complete writing assignments in either English or Chinese, but are encouraged to use English.

40691163 Daoist Philosophy in English Speaking World 3credits 48hours

This course takes students to examine philosophical and Sinological studies on early Daoist texts such as the Laozi

老子, Zhuangzi 庄子, and neglected texts including for example, the Wenzi 文子, He Guanzi 鶡冠子 and Liezi 列子. This course covers the following three main areas: the nature of the texts and their classifications; the main philosophical concerns of the texts; and the relevance of early Daoist ideas to contemporary philosophical debates. Through textual, conceptual and theoretical analysis, this course not only presents students with a comprehensive picture on the research on early Daoism in the West, but also provides textual and methodological training to prepare for contemporary debates in western academia.

40691252 Contemporary Political Philosophy 2credits 32hours

The Course on Contemporary Political Philosophy presents the most important political philosophers of the last decades: J. Rawls, Bourdieu, Charles Taylor, J. Habermas and me. At the same time we discuss the most important concepts of our time: Justice , Pluralism, The Rule of Law, Statehood, Secularization, Globalization and the idea of a global subsidiary and federal legal order.

00701601 Exploring Psychology 1credits 16hours

This course provides a brief introduction to psychology. Topics include history of psychology, research methods, biological bases of behavior, sensation and perception, consciousness, learning and memory, life-span development. Class lectures emphasize an empirical approach to a scientific understanding of human behavior across these diverse domains. In addition to learning basic knowledge about psychology, students will learn how psychologists ask questions, evaluate evidence, and communicate with each other. This course aims to inspire students to reason about current affairs and social phenomenon through the lens of a psychologist. That is, to critically evaluate evidence and to form one's own opinion based on sound reasoning and data.

00701643 Introduction to Cognitive Science 3credits 48hours

How does the mind work? This course introduces students to the field of Cognitive Science, a scientific pursuit that aims to understand the workings of the mind using an interdisciplinary approach, from psychology, linguistics, neuroscience, anthropology, philosophy, to computer science and artificial intelligence. In this course students will be exposed to the problems and questions of cognitive science—what is mind, how it works, why it works that way—and the scientific methods that are used to answer these questions. Students will learn theories and concepts from many disciplines, analyze and discuss evidence from both humans and non-human animals.

10700073 Mind, Individual and Culture 3credits 48hours

This course provides an introduction to the core concepts that form the foundation of the field of psychology. Topics include history of psychology, research methods, biological bases of behavior, sensation and perception, consciousness, learning and memory, life-span development, intelligence, emotion, personality, psychological disorders and treatment. Class lectures emphasize an empirical approach to a scientific understanding of human behavior across these diverse domains. In addition to learning basic knowledge about psychology, students will learn how psychologists ask questions, evaluate evidence, and communicate with each other. This course aims to inspire students to reason about current affairs and social phenomenon through the lens of a psychologist. That is, to critically evaluate evidence and to form one's own opinion based on sound reasoning and data.

30700313 Introductory Psychology 3credits 48hours

What is human consciousness? What is human mind and how is it related to the brain? Why do we act, think, and feel in certain ways? How do we change cognitively, emotionally, and socially over the life span? What are personality disorders and how do they develop at the first place? These are just a few questions among many

others that have fascinated the mankind.

This course helps you to embark on a journey to explore and demystify psychology and the working of the human mind. We will examine biological, psychological, and social bases of human phenomena. You will learn about basic principles of psychology, such as in perception, learning, memory, social behavior, etc. You will also get to learn research methods and major theories of psychology.

40700573 Fundamentals in International Political Economics（in English） 3credits 48hours

This introductory undergraduate course provides an overview of the field of international political economy (IPE) to students who have little to no previous background knowledge. The main aim is to help students to understand the interaction between international political and economic systems, forces and actors. The course asks two main questions: first, how do states, social forces and various kinds of institutions affect the flow of economic resources across national boundaries? Second, how do economic forces constrain the behavior of political actors at the international level? The course will also emphasize the importance of economic and political ideas in understanding both international and domestic political and economic systems

40701261 Consumer Behavior 1credits 16hours

This course is designed to introduce students to the concepts, theories, and research methods of consumer behavior. Topics include consumer perception, learning, motivation, attitude, and so on.

40910222 Sustainable Urbanization in an International Comparative Perspective 2credits 32hours

This course offers students a comparative approach to investigating sustainable cities, focusing on urbanization in the world's two largest economies and biggest emitters of greenhouse gases: China and the United States. Using project-based learning approach, we explore the major drivers of urbanization and initiatives to promote more sustainable growth. We investigate tradeoffs and choices related to land use, construction, disaster preparedness, energy and water resources, and the need to balance economic vitality, environmental quality, cultural heritage, and social equity.

30920013 Observational Astronomy 3credits 48hours

This course covers the essential knowledge, concepts, and methodology for conducting astronomical research using observations. The course also emphasizes the collection, reduction, and interpretation of data within the respective

scientific background and deriving scientific results from data. The content of this course includes:

(1) Essentials of observational astronomy (e.g., coordinates, timing, wavelengths, etc.).

(2) Astronomical telescopes (ground and spaced-based) and making observational plans.

(3) Photometry, imaging, spectroscopy, and time series analysis with optical data.

(4) NIR, high energy, radio, and non-electromagnetic astronomical observations.

(5) Hands-on observations at the NAOC Xinglong Observatory.

This course contains hands-on observations using optical telescopes. Each student will conduct a full observational astronomy project, from selecting targets, planning observations, and conducting observations, to data analysis, interpretation, write-up, and oral presentation.

40920013 Stars and Planets 3credits 48hours

Stars are the objects into which our universe has converted most of its (baryonic) matter. There may be over 10^22 stars in the universe and modern estimates indicate that most of these stars are (or were) accompanied by planets. This course aims to understand key questions as: why do stars have a mass of about 1 solar mass, which conditions

must be met for nuclear fusion, how do planets form, what determines the size and composition of planets, how can we detect exoplanets, when is a planet system stable. The aim of this course is to understand the fundamental properties of stars and planets from elementary physical principles. This course is organized according to several modules:

1. Introduction to key Astronomy concepts
2. Matter under astrophysical conditions
3. Planet and stellar Birth
4. Planet and stellar Evolution and Death
5. Planet and stellar Atmospheres
6. Planet and stellar Dynamics

Student participation and problem sets play an instrumental part throughout the course. The classical instruction will be further supplemented by presentations and a report from students on a topic of their choosing related to the field of stars and planets.

01510701 Introduction to Project Management and Innovative Product Development 1credits 16hours

The course introduces a key concepts of project management, innovation management and product development, and supports students to participate effectively in the creation and realization of business opportunities. Combining business and technology aspects in one program, students will focus on finding new business solutions using applicable innovative technologies.

Students will be able to gain knowledge and skills related to project management, innovation management and product development, and, additionally, gain practical experience through a product development project. Through class discussions and course activities students will be able to gain additional international experience and exposure, as well as improve their English language proficiency.

During the course variety of teaching methods will be used: from basic explanations of terms and concepts, exercises, working on case studies, individual work in finding the application of the presented knowledge and team work on the project. Beyond mere description of theoretical lectures, the emphasis will be on practical work, where students will plan and manage a project.

Sinisa Krajnovic is a global executive with long senior international leadership experience and expertise in Information and Communications Technology (ICT). He is Senior Advisor in McKinsey & Company in Technology, Media & Telecommunications. Since 2018 he is visiting professor at the Tsinghua University School of Economics and Management (TSEM) in China. He was Executive Vice President of Ericsson North East Asia, and global R&D head for 15,000 engineers for global 5G products.

44000523 Medical Molecular Biology 3credits 48hours

Medical Molecular Biology is a course that aims to teach medical students the principles of molecular biology that involves in genes and their activities. Through this course, I will introduce the concepts of molecular biology through the history of the molecular biology field, I will especially stress the importance of logical thinking, and I hope to teach students not the knowledge but also the skills to acquire novel knowledge through molecular biological methodologies. The course includes the following parts: 1) Introduction of the history of Molecular biology, the nature and the function of genes, 2) Methods in Molecular biology, 3) Transcription in bacteria, 4) Transcription in eukaryotes, 5) Translation, 6) Post transcriptional events, 7) DNA replication, recombination and transposition, 8) Genomes.

14700053 A Humanistic Approach to English Literature 3credits 48hours

The course focus on on (a) understanding and appreciation of selected literary works, (b) the skillful art of the use of language in such works, and (c) the cultural implications (philosophical, social, and cultural nuances) of such works. And by such approaches to explicate the art of writing. The course aims at a critical and analytical approach to the study of English literature, and through this approach introducing students to an appreciative understanding of English literature.

14700103 Guided Reading of Literary Works: Modern Fiction 3credits 48hours

Novels are not just storytelling.The structure of the novel is a mode of thinking. The novel is the most basic expression of the people's mind. It is also the tradition of oral inheritance at the beginning of human civilization and history,followed by writing. Therefore, understanding the novel is to understand the human nature and the logic of thinking,as well as the origin of civilization and history.

14720031 Oxford Humanities Tutorial Course 1credits 16hours

This course is an experiment of introducing the Oxford tutorial class mode into Tsinghua's Rixin college. Students are to be divided into several groups. Each group is formed exclusively by one tutor and two students. These individual classrooms are designed to be student-centered. Students propose the fields and topics that they want to study and capable Oxford Tutors are located correspondingly. Reading materials offered in the class are fundamental texts in their respective areas.Classes are held mainly in the form of discussion while teaching will be adjusted whenever necessary. Students are requested to write two essays by the end of the course as well as one reading report each week. Tutors will diagnose these essays carefully. Each student will be given a written-report reviewing their performance and progress by the end of the course.

44720032 Summer English Training 2credits 32hours

This course is supported by the Rixin College and aims to train the first-year student in the college to read and write English texts in a critical way. In surrounding a thematic writing (Disease and Health), this course will equip student with capabilities of writing a critical essay of standard academic English.

14760013 Physics-1 3credits 48hours

This course will cover mechanics, heat, optics, special relativity, waves, fluid and electromagnetism.

34760023 Topology 3credits 48hours

This course discusses point set topology and introductory algebraic topology. Point set topology covers: topological space, continuous maps, subspace, quotient space, product space, connectedness, compactness, countability, Hausdorff space, metric space etc. Introductory algebraic topology covers: path space, fundamental group, homotopy invariance, Seifert-Van Kampen Theorem, covering space, classification of surfaces, basic homology theory etc.

34760083 Physics-2 3credits 48hours

Physics-2 is a continuation of Physics-1, and will cover basic concepts of thermodynamics, light and optics, and modern physics.

44760012 Seminar in Algebra and Number Theory 2credits 32hours

This is a seminar course, discussing important developments and frontier research topics in algebra and number theory. Course syllabus may vary, according to the design of each course instructor.

P4760033 Physics-0 3credits 48hours

This course will cover the basics of mechanics, thermodynamics, waves, special relativity and electromagnetism.

40160522 International Logistics(in English) 2credits 32hours

Discuss and study the issues related to international logistics, understand both the commonalities and differences between international and domestic logistics, and learn to apply these concepts in real world applications.