00000171 Modern Chinese Architecture and Urbanism: Building Types and Aesthetic Styles in the Global Context 1 credits 16 hours

This class introduces the profound socio-political transformation of modern China and related sea change of modern architecture, based up which the students will be guided to identify West-influenced modern Chinese architecture and appreciate architectural aesthetics as well as socio-cultural thought.

As a result of development of foreign concessions in treaty port cities, Western architectural styles, construction methods and new types of buildings emerged promptly. For example, new building types including cathedrals, missionary schools, banks, offices were built along the Bund of Shanghai, while unprecedented artistic styles such as Gothic Revival, Anne Queen Style, Victorian Style, Spanish Style, etc. were closely associated with each building type, which differs a lot from traditional Chinese architectural imagery. How to identify these architectural styles under Western influence? Why were architectural styles associated with certain building types, and what stands behind the physical treatment? Why China Revival that imitated traditional Chinese language such as large sloping roofs emerged since the late 1920s onwards? Using a large amount of visual materials and solid case studies, this class aims to address these questions to chart out the trajectory of development of architectural styles in modern China from a global perspective, with unfamiliar adaptions and modifications.

This class selects 4 building types that have much to do with the daily life of students – campus/educational buildings, residential buildings, institutional buildings and commercial buildings, to illustrate architectural styles culturally assigned to them, both in modern China and abroad. In addition to explicating how to identify the characteristics of these styles, the instructor will also introduce a global comparative method to study socio-cultural change behind visual identities to better understand modern China.

10000072 Environmental Sustainability and Renewable Energy 2 credits 32 hours

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.

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

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.

30030462 Green Transportation System 2 credits 32 hours

This course aims to provide an in-depth overview of the fundamental principles of efficient operations, management, and planning of green transportation systems. In particular, we plan to split the course into four modules: 1) introduction to green transportation systems; 2) planning of green transportation systems; 3) management of vehicle fleet and staffs; 4) operation of green transportation systems. Through in-class lectures, in-class discussions, homework, and group projects, we plan to analyze what transit systems can and cannot do; how to determine the optimal scale and layout of a transit system; and how to practically implement the design and operate the system.

30030482 Construction Contracts 2 credits 32 hours

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) 3 credits 48 hours

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.

30030622 Mathematical Modeling and Data Analysis 2 credits 32 hours

Mathematical modeling and data analysis are key technologies in broad areas of science and engineering. This course will cover numerical methods for mathematical modeling, algorithms for data mining, and statistical and computational inverse problems. Each theoretical lecture will be followed by a computational lab session to implement the formula- and algorithm-based method with a programming language.

30030642 Construction Project Management 2 credits 32 hours

This course offers a thorough and in-depth exploration of the fundamental principles, procedures, and techniques involved in engineering project management. It equips students with a comprehensive understanding of key concepts, enabling them to effectively navigate the complexities of managing engineering projects. The curriculum encompasses a broad range of topics essential for success in this field, including the project life cycle, project

scheduling, project financing, quality management, and project delivery methods. Students will also delve into the intricacies of project organization, budget estimation and assessment, leadership, global culture, supply chain management, and contract management. They can gain crucial insights into effective project planning, execution, monitoring, and early warning mechanisms. Furthermore, the course emphasizes the significance of project environment, health, and safety management, highlighting the importance of maintaining a secure and sustainable work environment. It also addresses the critical aspects of project communication and information management (such as building information modeling), recognizing their pivotal role in fostering collaboration and ensuring project success. Finally, the course also dedicates attention to human resources and team building, underscoring the significance of building cohesive and high-performing project teams. By refining and extending students ' knowledge in these areas, they will emerge equipped with the skills and expertise necessary to excel in the dynamic field of engineering project management.

40030902 Building Materials 2 credits 32 hours

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 2 credits 36 hours

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.

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

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 3 credits 60 hours

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 3 credits 48 hours

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.

00050283 Carbon Neutral Society: Energy, Environment and Behavior 3 credits 48 hours

China announced the goal of achieving carbon neutrality by 2060, the process of which is an extensive and profound systematic change, involving concept reconstruction, value revaluation, industrial reconstruction, and a wide range of socio-economic impacts. This demands for an interdisciplinary course across natural science, engineering, and social science to address this issue. This course aims to build the vision of a future carbon-neutral society from a systematic perspective, and help students rethink the impact of climate change, the role of traditional energy, emerging technology challenges, and the importance of active response from behaviors of production, transportation, and individual activities.

The course starts with the basics of climate change and the key characteristics of a carbon-neutral society. Then, it addresses three themes, namely energy, environment and behavior, which includes: 1) the role and challenges of coal, oil and gas during the zero-emission transformation, 2) the challenges of the large-scale development of renewable energy, 3) the synergies of atmospheric pollution reduction, circular economy and carbon emission reduction, and 4) the carbon footprints of behavior in industrial production, transportation, and personal consumption.

This course is taught entirely in English and incorporates a flipped classroom format to encourage students to communicate and discuss. This course aims to cultivate students' critical thinking and use analytical methods to solve problems creatively from an interdisciplinary perspective. Through the integration of field trips, experiments and in-class discussion and presentation, the overall goal is to stimulate students' interest in further problem-finding and learning from practical experience, and to improve comprehension skills in cross-cultural teamwork, communication, and critical thinking, based on enhanced carbon-neutral cognition.

10050022 Global Outlook on Ecology and Environment 2 credits 32 hours

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.

40050622 Treatment technologies for safe drinking water 2 credits 32 hours

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.

40050642 Solid Waste Management 2 credits 32 hours

Solid waste management issues include waste recycling and reduction, facility sitting and capacity, regulatory compliance, environmental sustainability and public opinion. This course will cover all aspects of solid waste management including waste generation, source reduction, collection, transportation, recycling and resource recovery, biological treatment, thermal treatment, and burial in landfills. Regulations and policy relevant to solid waste will also be discussed. Students are expected to integrate technical, analysis, regulatory and policy considerations in solid waste management.

40050712 Study Abroad Program 12 credits 320 hours

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 2 credits 32 hours

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 2 credits 40 hours

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.

20120293 Engineering Materials 3 credits 58 hours

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.

30120324 Design and Manufacturing (1) 4 credits 96 hours

This course focuses on cultivating the creativity of student for mechanical system and structure design. Design is the core, and analysis and calculation server the design. This course mainly introduces the engineering design method of mechanical system, mechanism innovation and creative conceiving method, process and the theory, and the design and calculation of general mechanical structures. After studying the course and practicing in fabricating engineering, the student not only grasp the primary knowledge of mechanical engineering design but also improve his or her knowledge from design to manufacturing and the practical ability.

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

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.

00140162 Carbon Neutrality and Carbon Cycle 2 credits 32 hours

The world is facing a serious of climate change problems, such as the intensified greenhouse effect and frequent extreme weather. Therefore, China and other countries in the world have proposed carbon neutral development goals, and strive to achieve low carbon or zero carbon emissions. This course makes full use of the advantages of interdisciplinary in the field of energy and environment, teaches the concept and principle of carbon neutrality, and enables students to understand the natural carbon conversion (such as photosynthesis and ocean acidification) and artificial carbon conversion (such as the use of fossil fuels and carbon dioxide capture and utilization), so as to understand the technology and prospects of carbon neutrality, analyze its difficulties and challenges, establish the awareness of low-carbon development, and lay the foundation for future technical and management work in energy, environment, and policy.

This course is taught in English. The ratio of lecture to seminar/practice is about 1:1. Students are encouraged to express and participate, stimulate their logical and critical thinking. The preparation after the class and the participation in the class are important evaluation indicators. This course will invite relevant experts inside and outside the university to participate in discussions on related topics. At the same time, it will include two visit or practice sessions (such as visits to related research centers and labs) and discuss with corresponding experts.

30140012 Speciality-reading in English 2 credits 32 hours

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) 2 credits 32 hours

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.

30140444 Thermodynamics 4 credits 64 hours

The course material covers the following aspects: basic concepts and basic principles, properties of matters and the evaluation of properties, thermodynamic processes and cycles, and introduction to chemical-thermodynamics. The course content includes: thermodynamic systems, states and processes, state variables and process variables, equilibrium and quasi-equilibrium processes, energy and energy transfer, the first law of thermodynamics, properties of pure matter and the evaluation of properties, ideal gas equation of state, first-law analysis of closed systems, control volume and mass conservation, first-law analysis of control volumes, steady-flow devices, transient processes and analysis, the second law of thermodynamics, Carnot cycle, Clausius inequality, entropy and entropy balance, isentropic processes, thermodynamic property relations, reversible and irreversible processes, gas power cycles (Brayton cycle, Otto cycle, Diesel cycle), vapor power cycles,

refrigeration and heat-pump cycles, ideal gas mixture, reacting gas mixture, enthalpy of formation, enthalpy of combustion and heating values, chemical equilibrium.

30140454 Fluid Mechanics 4 credits 64 hours

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 3 credits 48 hours

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 3 credits 48 hours

The course is mainly divided into four parts: basic quantum theory, the structure of matter, spectroscopy, and several special topics directly related to applications in the energy field. The special topics include molecular interactions, molecular reaction dynamics, and characters and reactions of surfaces/interfaces, and in these special topics, relevant theoretical knowledge, technique, and application will be introduced.

30140482 Introduction to Scientific Computing 2 credits 32 hours

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 3 credits 48 hours

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 2 credits 32 hours

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 3 credits 48 hours

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.

40160522 International Logistics(in English) 2 credits 32 hours

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.

30220363 Automatic Control Systems 3 credits 48 hours

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 4 credits 64 hours

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.

30220593 High Voltage Engineering （English） 3 credits 60 hours

The High Voltage Engineering Course corresponds to the secondary discipline of electrical engineering - high voltage and insulation technology. It teaches various types of insulation and insulation monitoring, high voltage generation and measurement, overvoltage and its protection, and other high-voltage engineering-related content.It corresponds to the High Voltage Engineering Chinese course that has been opened. The content will keep the same and the progress is the same.

20230313 Foundation of Solid State Physics 3 credits 48 hours

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) 4 credits 64 hours

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) 2 credits 32 hours

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 4 credits 64 hours

“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 3 credits 48 hours

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 3 credits 48 hours

“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.

40231253 Media and Cognition 3 credits 48 hours

With the background of cognitive science and media information technology, the course “media and cognition” introduces the research objects, objectives, methods and latest research progress in the field of media and information technology, including the interdisciplinary integration of digital media, intelligent systems, cognitive science and psychology, so that students can learn about its development history, research status and future topics

from the perspective of the integration of science, engineering and literature, which paves the way for high-level and innovative research in the future. The core contents and knowledge points of the course are as follows: digital media and information history of cognitive science intelligent information system acquisition of visual information acquisition of auditory information acquisition of multi-mode information neural structure perception and perception attention, memory and decision-making feature extraction feature dimensional reduction machine learning and modeling deep neural network attention mechanism meta learning target detection and recognition object segmentation and understanding neural network programming architecture intelligent unmanned system brain science and brain computer interface virtual reality and meta universe;international cross academic frontier, etc

40240513 Computer Network 3 credits 48 hours

This is an undergraduate level course on computer networking. Principles and architecture of computer networking are introduced. We will study the algorithms and protocols in various layers of computer networking, including physical layer, data link layer, network layer, transport layer and application layer.

40240945 Computer Science Training Summer School 5 credits 100 hours

Recent years have witnessed the technique revolution of large language models (LLMs) from BERT and GPT in 2018 to ChatGPT in 2022, and various innovative applications are explored in different domains. This summer school will provide a thorough tutorial of large language models and the pre-training-fine-tuning paradigm, from general and essential concepts, such as pre-training, fine-tuning, and alignment, to advanced and cutting-edge algorithms, such as cross-modal learning, tool learning, embodied learning, and multi-agent AI. The pre-training techniques may feature many applications such as natural language processing, computer vision, knowledge graph, social media analysis, robotics, and AI for science.

40260262 Introduction to Quantum Information Science 2 credits 32 hours

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） 4 credits 64 hours

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） 4 credits 64 hours

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) 4 credits 72 hours

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.

40310873 Combustion 3 credits 48 hours

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.

30310942 International Scholar Summer Course 2 credits 32 hours

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.

10421055 Calculus A(1) 5 credits 80 hours

Real number set and its properties, sequences and one varible functions, limits and continuity, the properties of continuous functions; derivatives and differentials, the chain rule, higher derivatives; mean value theorems and applications: L'Hospital rules, Taylor's formula, maximum/minimum value problems; integration: theory and calculation, Newton-Leibniz formula, indefinite integrals, definite integrals, applications to geometry and physics; improper integrals: definition and test; differential equations: 1st order equations and elementary resolution, higher order equations, linear equations and resolution, linear systems.

10421324 Linear Algebra 4 credits 64 hours

Linear algebra 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.

10421334 Linear Algebra (English) 4 credits 64 hours

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.

30430224 Applications of General Relativity 4 credits 64 hours

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.

20430225 Fundamentals of Physics (1) 5 credits 80 hours

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 Optical Interference, laying a solid foundation for future study of Physics and related subjects.

20430234 Fundamentals of Physics (2) 4 credits 64 hours

As the seoncd course on the fundamentals of physics, we shall systematically study Optical Diffraction, Polarization, and Fourier Optics. We also shall make a systematic and serious introduction on Quantum Mechanics, its historical development, basic concepts and important principles and applications in modern physics. The students will have a clear and better understanding on quantum mechanics and quantum physics.

20430265 Fundamentals of Physics (3) 5 credits 80 hours

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.

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

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) 4 credits 64 hours

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.

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

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) 3 credits 48 hours

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) 3 credits 48 hours

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) 3 credits 48 hours

This course is designed to introduce genetic principles to students majoring in biology and medicine. 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) 3 credits 48 hours

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.

30450533 Molecular Biology （H） 3 credits 48 hours

Molecular biology is the scientific study of genes and their activities at the molecular level. This is an honor course for Zhili College. This course will comprehensively elucidate the core concepts of molecular biology from a genomic perspective. It will extensively focus on the fundamental theories and key techniques of molecular biology, while prominently presenting the cutting-edge advancements and dynamics in the field, particularly the latest developments in genome and proteome research. This course emphasizes deriving knowledge from original sources, grasping the forefront of research. While conveying systematic knowledge, it will guide students in understanding how to dissect the mysteries of life at the molecular level.
The main contents of the course:
Part I (First Eight Weeks):
Major techniques for studying genes and their activities.
Significant events and milestones in the development of molecular biology.
Mechanisms of DNA replication and repair in prokaryotic and eukaryotic organisms.
Transcription in prokaryotic organisms and its regulation.
Part II (Second Eight Weeks): In-depth exploration of the following topics:
Transcription in eukaryotic organisms and its regulatory mechanisms.
Importance of interactions between DNA and proteins during transcription.
Epigenetic regulation in eukaryotic organisms.
Post-transcriptional processing of RNA and its significance.
Eukaryotic translation initiation and its regulation.
Our aim is to equip students with an in-depth comprehension of the core concepts and essential techniques of molecular biology, cultivating their ability to apply acquired knowledge to solving challenges in life sciences. Concurrently, we encourage students to stay abreast of the latest advancements in the field, continually expanding their understanding of molecular biology.

00460182 Global Biodiversity Conservation 2 credits 32 hours

The content of this course mainly covers the scientific foundation and practical methods of global biodiversity conservation. The course will focus on introducing the theoretical basis of biodiversity, the current situation of global biodiversity and its economic, political, and social influencing factors, the global framework for biodiversity conservation action, main stakeholders, major conservation measures and effectiveness, and challenges faced by us.

30470013 Introduction to Computer Science 3 credits 48 hours

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.

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

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.

40470024 Fundamentals of Cryptography 4 credits 64 hours

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.

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

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 4 credits 64 hours

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 4 credits 64 hours

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.

20470062 Algebra and Computation 2 credits 33 hours

Algebra has found deep and beautiful applications in computation theory. For example, group theory plays a critical role in Babai's recent breakthrough on graph isomorphism testing. As another example, several important results in algebraic circuit complexity rely crucially on insights from algebraic geometry. As a third example, the recent development in geometric complexity theory reveals a deep connection between invariant theory and algorithms. In this course, we introduce these important topics at the intersection of algebra and computation theory, namely isomorphism testing, algebraic circuit complexity, and geometric complexity.

For each topic, we will introduce the background, the connection with algebra, the algebraic theory required, and how to apply such theory to algorithm and complexity. This course requires the student to have basic knowledge on algorithm and computation theory, as well as mathematical maturity, but does not assume knowledge on algebra.

20470084 Computer Architecture 4 credits 64 hours

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, and memory hierarchies. 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 several advanced topics such as virtualization, security, and specialization, as well as 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.

30470104 Machine learning 4 credits 64 hours

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.

20470112 AI+X Computing Acceleration: From Algorithms Development, Analysis, to Deployment

2 credits 32 hours

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.

30470113 Advanced Computer Graphics 3 credits 48 hours

This course is an elective course for undergraduate students at the Institute for Interdisciplinary Information Sciences, Tsinghua University. Its purpose is to introduce fundamental concepts, theories, methods, and systems of computer graphics. The main topics include geometric processing, 3D transformations, rasterization, shading, texturing, ray tracing, physical simulation, computer animation, color models, and the application of deep learning in computer graphics.

20470123 Electronics for Experimental Physics 3 credits 48 hours

The first 6 weeks of this course focus on the theories and principles of the electronic technologies used in quantum information experiments, which include: basic electronics, digital logic, key control technologies in experiments, PID locking technology, photoelectric detection, etc. The following 5 weeks will focus on the training of experimental techniques in lab, including: how to use the common equipment in lab, programming of FPGA, the implementation of PID controller, photoelectric detection. Besides, in last 8 weeks of the course, the students will be involved into different cutting-edge projects in CQI labs. The students will be divided into different groups and tackle the real-world tasks in the lab. These projects will demonstrate the frontier of the experimental quantum information science to the students.

30470124 Algorithm Design 4 credits 64 hours

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.

20470132 Type-safe Modern System Practice 2 credits 32 hours

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.

30470134 Theory of Computation 4 credits 64 hours

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, fine-grained complexity, etc).

30470154 Game Theory 4 credits 64 hours

Part One: Normal-form games

Part Two: Extensive games

Part Three: Bayesian games

Part Four: Mechanism design

30470223 Introduction to Computer Networks 3 credits 48 hours

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.

40470243 Artificial Intelligence: Principles and Techniques 3 credits 48 hours

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.

30470283 Introduction to Optimization Theory 3 credits 48 hours

As a basic part, this course first introduces the concept of linear programming with concrete examples, analyzes its geometrical properties, and elaborates the important duality theory. Then three important methods solving linear programming, the simplex method, the ellipsoid method, and interior point method, will be introduced, and examples that reveal their differences will be given. The next topics are sensitivity analysis and robust optimization that are involved in linear programming. As an application of the above knowledge, the problem of network flows will be analyzed carefully. To broaden the scope of considered optimization problems, we then turn to convex optimization, a larger class having linear programming as a special case. After studying its geometrical characters and duality theory, we introduce Newton’s method and gradient descent method that are often used to solve convex optimizations, which will be compared with interior point method introduced earlier. Lastly, an important case of convex optimization, semidefinite programming, will be highlighted, where a lot of examples raised in quantum computing will be analyzed.

40470284 Quantum Computer Science 4 credits 64 hours

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 3 credits 48 hours

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.

30470303 Probability and Statistics 3 credits 48 hours

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.

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

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.

30470324 Introduction to Computer Systems 4 credits 64 hours

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++ 2 credits 32 hours

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.

40470353 Computer Vision 3 credits 48 hours

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.

30470354 Mathematics for Computer Science and Artificial Intelligence 4 credits 64 hours

This course aims to introduce fundamental mathematical techniques to undergraduate students majoring in AI and CS, with applications in algorithm design and analyses. Modern computer science and artificial intelligence education requires students to master broad mathematical knowledge and be able to flexibly and innovatively solve technological challenges. Toward this goal, in this course we cover mathematical skills including algebra, geometry, probability theory, stochastic models, mathematical optimization, and information theory. These skills will be applied to problems and algorithm design in different topics, such as machine learning, big data, cryptography, distributed systems, algorithm design and optimization, etc. Finally, the course introduces students to more advanced topics, such as complexity, cryptography, reinforcement learning, etc.

40470363 Deep Learning 3 credits 48 hours

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.

40470396 AI+X 6 credits 96 hours

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 3 credits 48 hours

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 4 credits 64 hours

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 3 credits 48 hours

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.

40470434 Operating Systems and Distributed Systems 4 credits 64 hours

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 and distributed systems, including multiple-programing systems (processes, inter-process communication, and synchronization), memory management (segmentation, paging), resource allocation and scheduling, file systems, networking (packet switching, file control, reliability), transaction and recovery, distributed systems protocols (timing, mutual exclusion, consensus), remote procedure calls, distributed storage, distributed computing systems, distributed system security and blockchain. Students are expected to complete set of major design and implementation projects.

40470454 Quantum Computation +X 4 credits 64 hours

This course discusses the real-life applications of quantum computers after the students systematically learn the basics of quantum computing. It starts from reviewing the quantum algorithms on a large-scale universal quantum computer and the current research status, and then move on to introduce the potential applications of a noisy intermediate-scale quantum (NISQ) device that can be achieved in the near term. Students will learn methods like quantum annealing, variational quantum optimization, variational quantum eigensolver and quantum machine learning, and learn how to execute these methods on a classical simulator or a cloud-based quantum computer.

Students will further survey the interdisciplinary applications of a quantum computer in fields like chemistry, material science, medicine, energy industry, engineering, nuclear physics, finance, artificial intelligence, etc., and apply the methods they learn to design quantum algorithms to solve crucial problems in these fields.

40470463 Cryptographic Protocols: Zero-Knowledge Proofs and MPC 3 credits 48 hours

Zero-knowledge and Secure Multiparty Computation are the most popular and interesting topics in Cryptography. In this course, we will start from the background and definition of these two notions and learn how the basic constructions work and why they are secure.

40470473 Embodied Artificial Intelligence 3 credits 48 hours

This course will discuss a working definition of intelligence and use it to delve into the questions of sensorimotor learning goals and building embodied intelligent agents.

The course will first observe behavioral experiments of human ' s sensorimotor stage and extrapolate the knowledge into the design of intelligent sensorimotor algorithms for robots. Specifically, we will cover the computational basis of sensorimotor as well as fundamental algorithmic approaches. This course provides hands on experience for constructing agents that learn to act from raw sensory observations.

40470482 Introduction to Large Language Model Applications 2 credits 32 hours

This course is a freshmen seminar, aiming to equip students with basic knowledge of the unique research and development methodologies, application scenarios, and hands-on practices of large language models (LLMs). The topics covered in the course include the using LLM for in-context learning, end-to-end application development using LLMs, fine-tuning, data management for AI, and development tools and services for large language models. The course consists of lectures and a significant amount of programming labs. Under the guidance of teaching assistants, students will complete several independent mini-experiments and team up to design a real-world LLM-based application. In this course, students will:

1)Learn how to use LLM for in-context learning with modern open-source frameworks;

2)Understand the fine-tuning methods of large language models, the usage of distributed training systems, and metrics to evaluate the quality of LLMs;

3)Learn the end-to-end practical development methods of LLM applications by designing and developing a non-trivial LLM application project;

4)Know the latest application scenarios of large language models and cutting-edge research problems in LLM.

5)Improve their team collaboration skills and project presentation skills.

40470492 Multi-modal Machine Learning 2 credits 32 hours

With the development of Internet, multimedia data have become increasingly accessible, such as images, audios, videos, texts, etc; the advances of artificial neural networks (e.g. large multi-modal model GPT4) have also made multimodal fusion a general trend in AI. This course covers applications including image/video processing and generation, audio/ speech processing and generation, natural language processing and generation. It introduces popular signal processing and machine learning techniques in the artifitial intelligence field, such as data representation, data compression, 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 be a follow-up for computer vision and natural language processing classes.

00510232 Management of Technological Innovation 2 credits 32 hours

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.

30510073 Public Finance 3 credits 48 hours

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.

40510193 Management Systems Simulation 3 credits 48 hours

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.

30510202 Management Information Systems 2 credits 32 hours

The objectives of the Management Information Systems (MIS) course are to provide the students with (1) a understanding of MIS essentials and prospects from a combined perspective of technology and management, in the context of big data; (2) a mastery of some classical MIS theories and methods; (3) a mastery of some new MIS concepts and techniques; and (4) a understanding of certain key issues of and thoughts on information technology (IT) management.

In light of rapid advances in IT and Internet applications, the course covers a series of related materials as follows:

(1) Gaining competitive advantages with IT (e.g., supply chain management (SCM) and ERP, customer relationship management (CRM), business intelligence (BI)); (2) Business analytics (BA) for decision support (e.g., knowledge discovery from data, associative/grouping patterns); (3) Modeling and decisions in having information systems (e.g., in-sourcing cycle, business modeling, outsourcing); (4) Emerging trends (e.g., big data/cloud computing and artificial intelligence (AI)).

30510273 Data Structures and Algorithms 3 credits 48 hours

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.

40510323 Intermediate Financial Accounting(1) 3 credits 48 hours

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) 3 credits 48 hours

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) 3 credits 48 hours

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.

30510523 Money and Banking 3 credits 48 hours

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 3 credits 48 hours

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.

40510673 Empirical Finance 3 credits 48 hours

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:

40510682 Social Insurance 2 credits 32 hours

This course includes the concept of social security, basic principles of social insurance, premature death and old age, old-age, survivors, and disability insurance, financial management of social security program, problem of poor health and health insurance, problem of unemployment and unemployment insurance, supplemental old-age insurance, public assistant, economics of social insurance programs, and Chinese reform and development of social insurance.

30510743 Intermediate Microeconomics 3 credits 48 hours

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 3 credits 48 hours

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.

40510763 International Economics-Theory and Policy 3 credits 48 hours

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.

30510863 Developmental Economics 3 credits 48 hours

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.

30510893 Financial Statement Analysis 3 credits 48 hours

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 2 credits 32 hours

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) 3 credits 48 hours

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.

40510973 Labor Economics 3 credits 48 hours

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.

30510992 Corporate Strategy Management 2 credits 32 hours

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.

40510992 Enterprise Resource Planning 2 credits 32 hours

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.

40511012 Business Case Analysis 2 credits 32 hours

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.

30511053 Corporate Finance 3 credits 48 hours

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.

30511073 Computer Language and Programming 3 credits 48 hours

This course is a prerequisite for students who plan to have a career in areas like information systems, financial engineering, numerical methods, and other areas that require skills harnessing modern computation power. The

skills learnt could be easily transferred to learning other computer languages.

The goal of the course is to teach students how to program in C language to solve problems with computational methods. Therefore the goal is two-fold. First, students will learn the basic programming language concepts, such as data types, control structures, memory addressing and modular programming, with C as an example. Second, students will be expected to develop a computational thinking to solve problems. General methods, such as bisection method, Monte Carlo simulation, and divide and conquer, will be introduced. Basic analysis of program complexity will also be discussed.

Specific topic coverage includes:

(1) Concepts of Computation and Computers

(2) Data Types

(3) Interactive Input and Output

(4) Program Flow Control

(5) Functions

(6) Arrays

(7) Pointers and Memory Management

(8) Character Strings

(9) Data Files

(10) Structures

(11) Bisection Method

(12) Newton’s Method

(13) Monte Carlo Method

(14) Search and sort

(15) Computational Complexity

30511093 Computer Systems and Networks 3 credits 48 hours

This course provides a comprehensive introduction to the concepts and principles governing computer 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 infrastructure in a business environment. Topics covered in the computer systems part include CPU architecture, memory structure, storage, peripheral devices, and the structure of operating systems. Topics covered in the computer networks part include the Internet architecture, protocols, technological principles, and typical applications. A systems perspective will be adopted to help students master the fundamentals of modern computer systems and networks.

40511103 Game Theory 3 credits 48 hours

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) 3 credits 48 hours

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.

40511202 International Business 2 credits 32 hours

International Business differs in important ways from business conducted within national borders. It poses additional challenges but also offers new opportunities. This course provides a framework for analyzing decisions made by firms in an international context. The analytical framework provides a basis for formulating strategies that will enable businesses to succeed in the international business environment. The course combines material from strategy, international finance, trade theory, trade policy, marketing, human resource management and other related areas. We emphasize the use of analytical tools and concepts but provide many real-world examples. Course projects help students develop their research and writing skills. The course is integrative by design, which leads to some overlap with material taught in other courses.

40511273 Information Resource Management 3 credits 48 hours

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 3 credits 48 hours

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.

40511373 Mathematics of Risk(1) 3 credits 48 hours

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 3 credits 48 hours

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.

40511891 Global Perspectives—Management and Innovation of German Firms 1 credits 40 hours

The RWTH-Tsinghua Exchange Program provides an opportunity for cross-cultural learning about business and management in China and Germany through the provision of an environment that will nurture relationships between students at Tsinghua University and students at RWTH Aachen University

The program consists of four core elements: 1) Business related Lectures delivered by guest speakers from both universities. 2) Field study in German firms. 3)Joint collaboration on academic projects between groups of four/five students (at least two students from each university). Deliverables will be in the form of presentations.

40512091 Innovation and Entrepreneurship in The Whole World 1 credits 56 hours

It's an innovation and entrepreneurship practice journey for students. Students visit innovation and

entrepreneurship centres in Muti-National Companies and Start-ups. The regions are selected among Germany, Israel, Silicon Valley, India and Russia, etc.

40512103 Health Economics 3 credits 48 hours

The functioning of the health care markets has rising importance in the current public policy debates. The recent public health events (including the 2019 COVID-19 crisis) and the developing medical reforms in various countries (e.g. the China health care reform since 1990s, as well as the US Affordable Care Act reform) require systematic analysis in the field. Health economics, a sub-discipline of applied microeconomics, provides a unique perspective and useful tools in the discussion of these issues. Motivated by needs from the public policy domain and its interesting application for a range of economic theory, health economics has become one of the most rapidly growing sub-fields of economics.

In this course, we will establish a framework of understanding the health care market using economic tools. The course has three modules. In the first module, we will cover a range of theoretical models in health economics, including, but not limited to: the supply and demand of health, health insurance market (risk aversion, adverse selection, moral hazard), market failure, imperfect competition etc. In the second module, we will learn how to apply the theory into understanding the health care market and the medical reform policies. We will introduce institutional details of the health care markets in China and other countries, link the theoretical foundation to current policy issues. In the last module, we will learn “health analytics”: analyzing health-related data to inform policy decision making. We will work on a large dataset from scratch and learn all stages of empirical analysis, with an emphasize on econometrics techniques and computation methods.

40512182 FinTech 2 credits 32 hours

Financial technology (FinTech) is revolutionary and rapidly changing the financial services industries. This undergraduate course provides an introduction to FinTech such as blockchain, cryptocurrencies (e.g., Bitcoin and Ethereum), and so on. Students are expected to develop a broad understanding of the recent FinTech development and its impact in the financial industries especially through mutual fund and hedge fund investment. Topics may include but are not limited to: blockchain and cryptocurrencies, Bitcoin, Ethereum, Altcoins, and mutual funds investment.

40512273 Game Theory and Mechanism Design 3 credits 48 hours

Game theory and mechanism design are the foundation of modern economic theory, and are increasingly playing an important role in other social sciences such as philosophy, law, and politics, as well as in natural sciences such as computer science, applied mathematics, and evolutionary biology. The first half of this course introduces game theory, focusing on basic game theory, including the concepts, methods, and applications of various types of games. We will discuss static games with perfect information, static games with incomplete information, and dynamic games with or without perfect information. The second half of the course introduces mechanism design, focusing on adverse selection, moral hazard, signalling, and contract design, etc..

Most courses will be taught in English, and the course content includes both theoretical foundations and applications.

40512402 Information and Valuation in Capital Market 2 credits 32 hours

Along with the evolution of technology, capital market participants are facing enormous amounts of information every day. How does the information affect valuation and how exactly market participants use it? This course aims

to discuss the role of information, especially the financial information, in capital market, its intended and unintended consequences, and the regulation of information disclosures.

Referring to the class content, we start from the basic information economics, and then discuss the applications of these theories in capital market. We are going to focus on the relation between information and valuation. In the meantime, students will be exposed to real world data and learn how to use data to answer meaningful economic questions.

40512413 Macroeconomic Analysis 3 credits 48 hours

This course aims to provide our students majoring in economics and finance a thorough and rigid training in macroeconomic analysis. It will cover the following five topics: 1) macroeconomic data and measurement; 2) economic growth; 3) labor market; 4) consumption demand; 5) financial market. Each of the five topics will be explored combining data and theory. Additionally, the course will emphasize the “China” story with case studies of China’s macroeconomic analysis.

40512423 Chinese Political Economy 3 credits 48 hours

Chinese political economy covers both major theoretical and practical perspectives of exploring Chinese political institutions. The main features of the course include: (1) the course is offered by both international and local scholars. The anchor professor has extensive experience in studying China from a comparative perspective, and complemented by the co-instructor’s in-depth knowledge and experience within China; (2) the course is committed to bridge the linkage between political theory and read-world practice in understanding Chinese political institutions by including the distinguished political leaders’ talks; (3) the course attempts to analyze Chinese political institutions in a comparative perspective, and learn the experiences and lessons for the other part of world from the case of China. The design, content and format of this course are aimed optimally to benefit students in both knowledge accumulation and practical orientation.

00642233 Reading and Writing on Environmental Literature 3 credits 48 hours

Environmental Literature focuses on the relationship between man and nature.Environmental writers with a worrying mind and environmental consciousness wrote for the sustainable develpment of humanity. This course selected some classic works such as "Walden", "Silent Spring", "Sand County Almanac“” and “”Making Peace with the Planet” as the core texts for reading. Through reading, the students are led to think about the relationship between man and nature in a new way and gain the environmental and sustainable consciousness and ultimately practice it in their future work in order to prevent the further deteriaration of the environment.

40641963 Novel, History, Modernity 3 credits 48 hours

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.

40641993 Comparative Poetics: from Meaning to Form 3 credits 48 hours

This course introduces students to some important issues in the study of comparative poetics through the perspectives of culture and language. While emphases and specific texts chosen vary from instructor to instructor, this course addresses such topics as the role of language and poetics in different cultures and historical periods, the function of regulated verse in different cultural contexts, and the primary research methods as well as the basic concepts of the discipline.

To explore the nature of poetics through the comparative approach, this course introduces the primary methods and concepts of the discipline. Students will discover new ways of thinking about poetics/literature/culture from a linguistic perspective as they investigate the many ways in which it represents the world and its ideas. With focus on the meaning and forms of poetics as well as the nature of its performance, we will analyze the basic units of both poetics and linguistics, discuss the relationship between them so as to see when they are overlapping or mismatching, universal or specific, etc. through the study of rhythm, prosody, meter, rhyme, beat, foot, dipod, hemistich, distich, quatrain, reading, reciting, and chanting. Additionally, we will discuss, through observation and analysis, the relationship between language, literature, and music. Students are expected to be engaged in analyzing the texts from a variety of different languages, cultures, and time periods. Last but not the least, our discussion will cover various approaches to the question about the nature of poetics, what it does, how it works, and why we find it so endlessly fascinating.

40661493 Legal Reasoning 3 credits 48 hours

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) 2 credits 32 hours

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.

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

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) 3 credits 48 hours

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.

30690524 Logic, Language, and Philosophy 4 credits 64 hours

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 2 credits 32 hours

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 2 credits 32 hours

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.

30690583 Ancient and Medieval Western Philosophy 3 credits 48 hours

the course will focus on the development of Western Philosophy from Aristotle to Augustine, the main topics will include form and matter, soul and body, free will, goodand pleasure and happiness, virtue and happiness, political philosophy, philosophy and theology.

30690633 Modern Western Philosophy 3 credits 48 hours

In this course we will read and discuss works by several important philosophers in the Early Modern period of Western philosophy, namely Descartes, Malebranche, Leibniz, Locke, Berkeley and Hume. The central topics will be in metaphysics and epistemology.

All reading materials and all lectures will be in English. Students can use either English or Chinese.

40690952 Logic, Computation and Games 2 credits 32 hours

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.

40691163 Daoist Philosophy in English Speaking World 3 credits 48 hours

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 鹖冠子 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.

40691263 Classical Chinese Keywords: A Cross-Cultural Perspective 3 credits 48 hours

This course situates classical Chinese key terms within cross-cultural communication and engages students with direct comparative perspectives. It aims at guiding students into unique discourses in classical Chinese philosophy, while building up the language and perspectives for cross-cultural communication. The key terms discuss in our course include “To name or not to name-名”; “Truth and philosophy of language-实”; “Contextualizing harmony in Europe and Chinese-和”; “The conception of self in Chinese philosophy”; “Filial Duties and 孝”; “The philosophy of love 爱”; “The value of silence-默”; “the expression of humour-笑”; “the purpose of questioning- 问”; “instruction dialogues 教”“From scribe to history-史”; “Changing attitudes of reading -读”; “Divergent attitude towards death-死”; and “comparative perspectives on luck- 命”. This course hopes to show students the value of Chinese philosophy while taking into account the audiences with different cultural and educational backgrounds.

40691282 Topics in Contemporary Western Philosophy 2 credits 32 hours

This course will focus on the following two or three topics in contemporary Western philosophy: (1) Idealism and realism, and their relation to skepticism and to the notion of "true". (2) The contrast between two forms of awareness: perceptual awareness and propositional awareness, with the emphasis on propositional awareness and the role of the notion of "capacity". (3) Self-consciousness and privacy (if there is time)

00691652 History of Biology 2 credits 32 hours

This course examines the emergence and development of life sciences since 1700 by introducing major ideas, approaches, and debates about life as well as their material, cultural underpinnings and social impacts. The topics covered include natural history, classification, morphology, cell theory, physiology, evolution, genetics and eugenics, molecular biology and biomedicine, and biotechnology. It offers a series of lectures that survey biology's development in Western Europe and the United States, supplemented with materials on other developments and other views of life from non-Western contexts. One question we ask throughout the course is what are the relations between the views about life held by biologists and the social and cultural contexts at the time.

00691991 Advanced Philosophy of Specific Sciences 1 credits 16 hours

Philosophy of Medicine

1.Scientific Medicine;

2.Disease 1;

3.Disease 2;

4.Evidence-Based Medicine 1;

5.Evidence-Based Medicine 2

00692001 History and Philosophy of Life Sciences 1 credits 16 hours

Culture and Evolution

1.Introduction: What is Culture? And who has it?

2.Evolutionary analyses of culture: memes

3.Evolutionary Analyses of culture: beyond memes

4.Cultural inheritance and evolvability I

5.Cultural inheritance and evolvability II

00692101 Economics,Public Policy and Society 1 credits 16 hours

Philosophy of Society

1.Personal identity, social identity.

2.Action, intention, and description.;

3.Social norms and individual choice.;

4.Social Constructivism and the Looping Effect

5.Cultural Evolution and Social Explanation

00692212 Darwin Revolutions 2 credits 32 hours

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 1 credits 16 hours

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.

00692363 History of Science in the Jewish World from Antiquity till Today 3 credits 48 hours

Albert Einstein, Richard Feynman, John von Neumann, and many others first-rate scientists of the 20th century were all Jewish. However, it is hard to name a famous Jewish scientist in previous centuries. How can this outburst be explained? How come there are few famous Jewish scientist in Antiquity and there are plenty of Jewish famous scientists in the 20th century? Which role has science played in Jewish cultures from Antiquity till nowadays? This course explores the history of science in the history of the Jewish communities from Antiquity till the 20th century.

00692373 History of Science in the Islamic World 3 credits 48 hours

Is it true that the Arabs invented algebra and we still use Arabic numbers? Is it true that science and philosophy were lost in the Western world and passed onto the Latin world through the Arabs? What is the importance of Arabo-Persian science for the History of Chinese science? These are some of the questions which will lead this course, which is an exploration of the sciences in the Islamic world, from the 8th to the 20th centuries.

00692441 Logical Foundations of AI 1 credits 16 hours

Modal μ-calculus is a powerful logical framework that combines the expressive power of modal logic with the least fixed point operator (μ). This combination provides a way to express recursive and invariant properties, making modal μ-calculus particularly useful in dealing with properties of infinite structures and systems. It has a wide range of applications in computer science and artificial intelligence, especially in areas such as formal verification, program analysis, and automated reasoning.

00692461 Research Writing Seminars 1 credits 16 hours

The course will mainly focus on the knowledge content and ability development of research writing, and ultimately enhance the scientific and humanistic spirit of value. Specifically, the course will take the form of a theme-based writing class, selecting a theme that is "with broad possibilities in various disciplines and in-depth thinking in each field" to provide abundant materials, and leading students to experience the selection of topics, documentation, argumentation, and revision of articles, so as to experience the whole process of research writing and realize transferable growth.

10700073 Mind, Individual and Culture 3 credits 48 hours

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 3 credits 48 hours

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.

00701601 Exploring Psychology 1 credits 16 hours

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.

30920013 Observational Astronomy 3 credits 48 hours

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 3 credits 48 hours

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 ill 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 1 credits 20 hours

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.

14700053 A Humanistic Approach to English Literature 3 credits 48 hours

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.

14700301 Tutorials for Academic Writing 1 credits 16 hours

This course is the tutorials for international academic writing for senior undergraduates in PPE (Political Science, Philosophy and Economics) and Humanities (Chinese Literature, History, Philosophy, Foreign Languages and Literatures, Journalism and Communication, etc.) of Xinya College. A teaching team from world-class academic institutions (e.g., Oxford University) will provide this kind of tutorials, where a tutor and two/three students will

participate in a seminar focusing on an issue or topic in humanities. This seminar requires students to read a large number of classic texts critically, to finish two essays, to prepare a reading report each week, and to participate in discussion actively. Tutors will diagnose these essays and reports carefully, and give timely feedback to them. Each student will be given a written-report reviewing their performance and progress by the end of the course. The tutorials in seminar aim at improving students ' capabilities of reading, academic writing, critical thinking, academic discussions, and communication skills.

34720023 Plato's Republic 3 credits 48 hours

Without question, Plato's Republic State is one of the most important works of Western Philosophy. Moreover, the book, written as a dialogue between Socrates and others, is one of the greatest literary achievements of philosophy. Although the exact subject of the book is disputed, the ancient subtitle, On Justice, indicates at least one of the main concerns of the text, which also contains Plato's views on the soul, the good life, education, the theory of forms, and other topics.

Accordingly, in studying this book, we will encounter a philosophical work of unusual literary value in which philosophy is presented through debate, analogy, and imagery, including the famous Allegory of the Cave, as well as rigorous argument. We will become acquainted with some of Plato's important contributions to political theory, ethics, philosophy of mind, metaphysics, and aesthetics.

14720031 Oxford Humanities Tutorial Course 1 credits 16 hours

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 2 credits 32 hours

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.

44720143 Topics in Western Classics 3 credits 48 hours

This course covers major topics in the Western study of Classics. Classics, broadly defined, studies the cultures of the ancient world. In addition to the civilizations of ancient Greece and Rome, this course will cover developments in the study of Ancient Egypt, Mesopotamia, India, and China.

The literary and archaeological heritage of these cultures remains of influence to this very day. Archaeological discoveries and methodological advances in recent years have reinvigorated the study of the classical tradition, and increasingly calls have gone out for the interdisciplinary and comparative study of the ancient world.

This course presents an introduction to the major themes and methods involved in the study of the ancient world. Drawing on scholarship in the fields of literature, archaeology, history, and manuscript studies, the course engages with the main theoretical and methodological advances in classics. Using case studies from the ancient world, the course opens perspectives for the comparative study of ancient cultures, and provides a helpful starting point in

developing a well-rounded understanding of the classical traditions of the ancient world.

44720213 Topics in International Sinology 3 credits 48 hours

The course provides a comprehensive introduction to core issues and cutting edge research problems in International Sinology. Through case studies and deep-engagement with theory, it covers methodology and theoretical 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 but is not limited to ancient historical, literary, anthropological, and comparative approaches to early China in International Sinology.

44720323 Writing and Communcaition, A Cross-Cultural Perspective 3 credits 48 hours

This course situates an early Chinese understanding of the body within a cross-cultural and inter-disciplinary perspective. It trains analytical thinking and academic writing through bodily discussions. It introduces classical texts with contemporary theories from the fields of social epistemology, communication studies, social anthropology, disabled studies, and phenomenology. It shows students different ways of asking questions, finding evidence, forms of reasoning, and perspectives of discussions. Active and ethical engagement with AI reading and writing is also essential to this course.

34730033 Fluid Mechanics（Environmental Engineering） 3 credits 54 hours

1.Introductions. Outline; Development History; Continuum (hypothetical continuous medium); Fluid properties; Viscosity; Coefficient of viscosity; forces.

2.Fluid Statics. Pressure at a point; Basic equation of fluid statics (Euler’s equation); Relative equilibrium; Forces on plane areas; Force components on curved surfaces; Stability of floating and submerged bodies.

3.Fluid Kinematics. Fluid concepts and analysis approaches; Classification; The continuity equation; The basic forms of fluid micro mass motion; Irrotational flow; Rotational flow.

4.Viscous-Fluid Dynamics. The Navier-Stokes equation; The conservation of mechanical energy and the Bernoulli equation; The momentum equation.

5.Jet Flow and Turbulent Diffusion. Jet flow; Characteristics of turbulent jets; Round jets; Plane jets; Turbulent diffusion; Fundamental equation of turbulent diffusion.

6.Flow Resistance and Energy Losses. Classification; Flow pattern; Basic equation of steady uniform flow; Laminar flow through circular tubes; Theory of turbulent flow; Frictional energy loss; Local energy loss.

7.Boundary-Layer Flow. Outline of boundary layer theory; Boundary-layer concepts; Equation of boundary layer; Momentum integral equation of boundary layer; Separation of boundary layer; Passing flow resistance.

8.Seepage Flow. Darcy Filtration Law; Normal and gradually varied seepage flow; Equation of motion of seepage flow; Equation of continuity of seepage flow; Basic differential equation of seepage; Single well; Multiple-well.

04760012 Piano Course 2 credits 32 hours

This course is created for those who have an interest in music, those who want to read music, and those who want to know about the most fundamental concepts and styles in music, as well as for those who want to have a fresh look at already-known music basics and want to take it to a more advanced level of being able to compose a song.

14760013 Physics-1 3 credits 48 hours

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

P4760014 Algebra-Zero 4 credits 64 hours

Introduction to the concept of symmetry groups, with examples and topics in matrices/geometric models, representation theory, etc.

P4760024 Analysis-0 4 credits 64 hours

This course covers some basic theories and tools in traditional analysis in mathematics. The content includes: review of calculus, Tayor expansion and Taylor approximation, basic ordinary differential equations, basic Fourier analysis.

P4760033 Physics-0 3 credits 48 hours

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

P4760063 Introduction to Differential Geometry 3 credits 48 hours

This course covers basic theory on curves and surfaces in the Euclidean three space starting from basic knowledge of calculus and linear algebra. Topics include: regular curves, Frenet formulas, local theory of curves, global properties of curves such as Whitney-Graustein, four vertex theorem and isoperimetric inequality, regular surfaces, 1st and 2nd fundamental form, Gaussian curvature and mean curvature, Gauss map, special surfaces such as surfaces of revolution, minimal surfaces.

34760064 Algebra-2 4 credits 64 hours

Bilinear forms, symmetric forms, Hermitian forms, Euclidean spaces, Hermitian spaces, orthogonal transformations, unitary transformations, quadratic forms, skew-symmetric forms, field, extension of fields, ruler and compass construction, separable extensions, normal extensions, splitting fields, Galois theorem, commutative algebra, localization, integral extension, tensor products, exterior products, Noetherian ring, discrete valuation ring, Dedekind domain.

P4760072 Piano course（pre-college training） 2 credits 32 hours

This course is created for those who have an interest in music, those who want to read music, and those who want to know about the most fundamental concepts and styles in music, as well as for those who want to have a fresh look at already-known music basics and want to take it to a more advanced level of being able to compose a song.

34760075 Analysis-2 5 credits 80 hours

The main content of this course is the differential and integral theory of multivariable functions. The course starts from the definition of differential of map and its basic properties to the application of Fourier series. Including partial derivative and differential, Inverse function and implicit function theorem, Tangent space and normal vector of hypersurface, Differential and integral calculus of submanifolds, Stokes formula, Calculation of integral on submanifold, divergence theorem and Green formula, Fourier series and its application, which are the basic theory and properties of multivariable calculus.

34760083 Physics-2 3 credits 48 hours

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

34760104 Classical Mechanics 4 credits 64 hours

We will learn both the Lagrangian and the Hamiltonian formalution of classical mechanics.

34760114 Quantum Mechanics 4 credits 64 hours

Quantum mechanics is one the two pillars of modern physics, and is also the foundation of many cutting-edge sciences and technologies including quantum information and quantum computation. We will learn the basics of quantum mechanics and impartant applications.

34760194 Electrodynamics 4 credits 64 hours

This course introduces basic theory and method of electramagnetism.

34760204 Statistical Mechanics 4 credits 64 hours

This course introduces basic principle, method and application of thermodynamics and statistical physics.

44760292 Introduction to Modern Cryptography 2 credits 32 hours

In this class, we will cover the basics of modern cryptography including post-quantum cryptography. We will first give a basic introduction to symmetric cryptography and the mathematical idea behind. Then we will cover the first-generation public key cryptography including RSA, Elliptic Curve Cryptography, Diffie-Hellman key exchange and their basic security analysis. Then we will give a basic introduction about Shor’s quantum algorithm to solve the factoring and discrete logarithm problems and then move to post-quantum cryptography, which is the new exciting area where we develop new public key cryptosystems that can resist quantum computer attacks. The main topics about post-quantum cryptography will be about lattice-based cryptography and multivariate public key cryptography and it will be main party of the class. Near the end, we would like to cover some more advanced topics possibly multiparty computation, fully homomorphic encryption. We may bring one or two outside speakers to give lectures on their current research topics and results. An important part of the class is to make students do small research projects, where the students will be asked to implement cryptosystem and attacks and (or) do some independent research on certain topics. This part will account for a substantial part of the credit for this class.