Description of Postgraduate Courses -- Research Postgraduate Course Sharing Scheme (Spring Term 2023-2024)

Last Update: 11 January 2024

Important Information about HKUST Courses:

Level of Courses

All courses offered in this scheme are at postgraduate level.

Course Vector and Credits

Each course is assigned a course vector which indicates the number of instructional hours required and credits to be earned. The course vector is presented in the form of [L-T-Lab:C] where

L = lecture hours per week
T = tutorial, seminar or recitation hours per week
Lab = laboratory or field study hours per week
C = number of course credits

For example, a course vector of [3-1-2:3] denotes a course that requires 3 lecture hours, 1 tutorial/seminar/recitation hour, and 2 laboratory/field study hours each week, and carries 3 credits.

Medium of Instruction

The medium of instruction is English. Some courses will have the following notations in the course description to specify the language of reading materials or permitted spoken language (dialect) used in teaching.

[C] Courses may required students to read materials in Chinese. Students who have difficulty reading materials in Chinese should consult the instructor concerned prior to enrolling in these courses.

[Pu] / [Ca] Courses approved to be taught in Chinese carry a *[Pu]* or *[Ca]* notation in the course description, which indicates the spoken language used in teaching: *[Pu]* stands for Putonghua; and *[Ca]* for Cantonese.

Postgraduate Grades

Students receive a grade in each course in which they are enrolled. Grades range in equal increments from A+ to F (i.e. A+, A, A-, B+, B, B-, C+, C or F). The Pass, Ungraded (P) grade is given only for courses that are indicated in the course description that they will be graded as such.

CHEM

CHEM 5130	Asymmetric Catalysis	3-0-0:3

This course teaches the basic concepts and general modes of action of asymmetric catalysis and synthesis. Asymmetric catalysis is an essential tool in organic synthesis, which is used daily in various industries, such as pharmaceutical, chemical, agriculture, materials, etc. The course will provide in-depth explanation of how catalysts work in organic reactions and how asymmetric control is accomplished in different scenarios. Lectures will focus on mechanistic details of chirality control using case studies. Students are expected to be able to use this important tool to solve various synthetic problems. Background: Students

are expected to have solid knowledge of organic chemistry, especially common reaction mechanisms, for example, CHEM 3120 Organic Chemistry II with a grade of B+ or higher, or equivalent.		
CHEM 5160	Advanced Medicinal Chemistry	3-0-0:3
Drug design, structure-activity relations, chemistry and biological effects of major classes of physiologically active and psycho-active drugs.		

CIVL

CIVL 5210	Principles of Project Finance	3-0-0:3
In-depth discussion of principles, techniques, and models of project finance in capital-intensive infrastructure projects, including international infrastructure markets; project bankability; project agreement and ancillary contracts; risk analysis and management; financial structuring, modeling and evaluation; outsourcing; case studies of various public-private partnerships in infrastructure development.		
CIVL 5430	Aquatic Chemistry	3-0-0:3
Chemistry applied to reactions occurring in water and wastewater, includes inorganic solution chemistry, chemical equilibrium, acids/bases, coordination chemistry, chemical kinetics, colloid chemistry, solubility and precipitation, oxidation-reduction potential. Prerequisite(s): CIVL 2410		
CIVL 5460	Landfill Engineering and Design	3-0-0:3
Practical aspects of solid waste collection methods and equipment, current available disposal techniques with emphasis on complete engineering design of landfill systems, and landfill leachate treatment will be included. Prerequisite(s): CIVL 2410		
CIVL 5530	Turbulence Processes in Hydrosystems	3-0-0:3
[Previous Course Code: CIVL 6100A] An introduction to turbulence, including the nature of turbulence, governing equations of turbulent flow, structure of turbulence, turbulence modeling, experimental measurements of turbulence and an introduction to computational fluid dynamics.		
CIVL 5640	Discrete Choice Experiments and Data Analysis	3-0-0:3
[Previous Course Code: CIVL 6100M] Discrete choice modeling and stated choice methods are used in many fields to study individual, household, and organizational behavior. This course covers advanced discrete choice model construction, estimation, and stated choice experimental design theory and practice.		
CIVL 5720	Advanced Foundation Design	3-0-0:3
Current practice of foundation design and analysis; includes design and analysis of bulkheads, deep excavation, tieback systems, tunneling in soft ground, buried conduits, lateral pile loading, pier foundations. Background: CIVL 3740 Exclusion(s): CIEM 5720		
CIVL 5830	Advanced Mechanics of Materials	3-0-0:3
Analysis of stress and strain; elastic and inelastic behavior of materials; formulation of BVP; beam on elastic foundations; torsion of noncircular thinwalled members; deformation of cylinders and spheres;		

inelastic analysis. Exclusion(s): CIEM 5330		
CIVL 6050D	Civil Engineering Seminar I	1-0-0:0
Discussion of current research by faculty members, and guest lectures on recent advances in civil engineering. Graded P or F.		
CIVL 6100R	Climate Change and Climate Modeling	3-0-0:3
This course describes the physics of the climate system and how it is represented in numerical models. It covers global environmental issues related to climate change resulting from both human activities and natural climate variations, and introduces the basic structures of climate models. This course aims to equip students with a solid understanding of the physical climate system and the underlying principles of current climate assessments. It teaches students which aspects of climate science are well understood and where quantitative uncertainties arise. As climate models are one of our primary tools for predicting and adapting to climate change, it is vital that we appreciate their strengths and limitations. The course includes a combination of lectures, homework assignments, a mid-term exam, and a term project of climate model analysis. The lectures provide students with fundamental knowledge of the physical processes in the climate system and basics of climate modeling. Homework assignments reinforce the knowledge base and enhance problem-solving skills for students. The mid-term exam will assess the learning outcome. The term project provides hands-on training on utilizing climate models to understand climate change and make informed decisions.		

COMP

COMP 5111	Fundamentals of Software Testing and Analysis	3-0-0:3
The goal of this course is to introduce how various analysis techniques can be used to manage the quality of a software application. Students will acquire fundamental knowledge of program abstraction, features, verification, testing, refactoring, concurrency, reliability, aspect orientation, and fault analysis. The course will also discuss how to carry out the empirical experimentation for program analysis. Wherever applicable, concepts will be complemented by tools developed in academia and industry. This enables students to understand the maturity and limitations of various analysis techniques.		
COMP 5212	Machine Learning	3-0-0:3
Introduction to major learning paradigms and techniques, basic applied statistics and information theory, decision trees, neural networks, Bayesian classification, kernel methods, clustering, density estimation, feature selection and extraction, hidden Markov models, reinforcement learning, case-based learning, model selection and various applications. Background: COMP 2012, probability theory and linear algebra Exclusion(s): CSIT 5910, MSBD 5012		
COMP 5214	Advanced Deep Learning Architectures	3-0-0:3
[Co-list with ELEC 5680] [Previous Course Code: COMP 6211D] This course focuses on advanced deep learning architectures and their applications in various areas. Specifically, the topics include various deep neural network architectures with applications in computer vision, signal processing, graph analysis, and natural language processing. Different state-of-the-art neural network models will be introduced, including graph neural networks, normalizing flows, point cloud models, sparse convolutions, and neural architecture search. The students have the opportunities to implement deep learning models for some AI-related tasks such as visual perception, image processing and generation, graph processing, speech		

enhancement, sentiment classification, and novel view synthesis. Exclusion(s): ELEC 5680		
COMP 5221	Natural Language Processing	3-0-0:3
Techniques for parsing, interpretation, context modeling, plan recognition, generation. Emphasis on statistical approaches, neuropsychological and linguistic constraints, large text corpora. Applications include machine translation, dialogue systems, cognitive modeling, and knowledge acquisition. Background: COMP 3211 Exclusion(s): MSBD 5018		
COMP 5311	Database Architecture and Implementation	3-0-0:3
Introduction to the relational model and SQL. System architectures and implementation techniques of database management systems: disk and memory management, access methods, implementation of relational operators, query processing and optimization, transaction management and recovery. Hands on experience with building the components of a small DBMS. Background: COMP 3511		
COMP 5411	Advanced Computer Graphics	3-0-0:3
The first part of this course covers an introduction to mathematical tools and computational techniques for image synthesis and manipulation of 3D models. The second part covers more advanced topics which may include digital geometry processing, image processing, visualization, GPU computing, numerical optimization methods. Background: COMP 3711, Linear Algebra, Calculus Exclusion(s): CSIT 5400		
COMP 5421	Computer Vision	3-0-0:3
Introduction to techniques for automatically describing visual data and tools for image analysis; perception of spatial organization; models of general purpose vision systems; computational and psychological models of perception. Background: COMP 3211; knowledge in linear algebra		
COMP 5422	Deep 2D and 3D Visual Scene Understanding	3-0-0:3
[Previous Course Code: COMP 6411B] Visual scene understanding is an important and fundamental field for advanced application scenarios such as self-driving, robotics, and AR/VR. This course majorly focuses on delivering deep learning-based visual scene understanding techniques in both 2D and 3D perspectives. In the 2D part, it introduces topics including image and scene classification, semantic segmentation, and object detection/tracking. In the 3D part, it delivers how 3D scene understanding can be performed through learning from 2D images, point clouds or multi-modal data, involving topics such as scene depth estimation, camera pose prediction, 3D scene reconstruction, and visual SLAM. Representative deep scene understanding architectures and frameworks in supervised, self-supervised, and open-world learning settings will also be introduced. Background: Basic knowledge about computer vision and deep learning fundamentals		
COMP 5423	Deep Learning for Medical Image Analysis	3-0-0:3
[Previous Course Code: COMP 6211H] Nowadays medical image analysis is rapidly growing and plays an indispensable role in healthcare. Recent advances of deep learning techniques have made significant breakthroughs in medical image analysis applications. This course will cover fundamental knowledge of medical imaging and various medical image analysis tasks, including computer-aided detection, segmentation, diagnosis and prognosis. Deep learning methods for solving these tasks will be introduced and state-of-the-art methods will be discussed. The remaining significant challenges and limitations will also be presented, including limited amount of labeled data, deep learning with interpretation and generalization issues, etc. This course will equip students with practical knowledge of medical imaging and		

analysis with deep learning techniques. Background: Basic knowledge about image processing and machine learning are beneficial		
COMP 5631	Cryptography and Security	3-0-0:3
Classical encryption techniques, block and stream ciphers, public-key cryptography, authentication, nonrepudiation, key management, digital signatures, public key infrastructure, cryptographic protocol, secret sharing, electronic mail security, IP security, Web security, Firewalls, Intrusion detection. Background: Computer networks Exclusion(s): CSIT 5710		
COMP 5713	Computational Geometry	3-0-0:3
An introductory course in Computational Geometry. Algorithms for manipulating geometric objects. Topics include Convex Hulls, Voronoi Diagrams, Point Location, Triangulations, Randomized Algorithms, Point-Line Duality. Background: COMP 3711		
COMP 5911	Entrepreneurial Me	3-0-0:3
[Previous Course Code: COMP 6613D] While entrepreneurship is a career choice, its mindset is for everyone. This is a course covering the mindset and elements of founding new and innovative business ventures in information technology sector. Topics include the entrepreneurial risk-taking value-creation mindset, market identification and go-to-market strategies, business models and development, business plan, fundraising and investment, role and protection of intellectual properties, technology-market gap and product-market fit, and growth and exit strategies. Case studies of successful and unsuccessful ventures will be discussed. In-class student participation and presentation are expected. Business and non-engineering students interested in starting IT-related companies are also welcome. Research postgraduate students are encouraged to develop proof-of-concept prototypes and business plans based on their research findings.		
COMP 6411C	Advanced Topics in Multimodal Machine Learning	3-0-0:3
This course provides a comprehensive introduction to recent advances in multimodal machine learning, with a focus on vision-language research. Major topics include multimodal translation, multimodal reasoning, multimodal alignment, multimodal information extraction, and recent deep learning techniques in multimodal research (such as graph convolution network, Transformer architecture, deep reinforcement learning, and causal inference). The course structure will primarily consist of instructor presentation, student presentation, in-class discussion, and a course project.		
COMP 6511B	Advanced Software Testing	3-0-0:3
This course introduces the most recent works in software testing (including symbolic execution, fuzzing and formal methods). Topics cover classic symbolic execution, classic formal method and traditional fuzzing, ML-assisted fuzzing and neural-symbolic fuzzing.		

ECON

ECON 6120Q	Topics in Theory	4-0-0:4
In this course we deep-dive into market design, that is, the application of economic theory to designing or improving various kinds of market mechanisms. In particular, we will focus on two kinds of market mechanisms: matching and auction. If time permits, we may also discuss the design of financial markets. We will learn some theory, and then we will also learn how to use the theory to analyze and design markets for practical use. This course will be taught in a seminar format. Prepare to actively participate in		

discussions. Prerequisite(s): ECON 5220		
ECON 6120T	Applied micro-econometrics	4-0-0:4
This course teaches classical and recent applied econometric methods in empirical microeconomics for Ph.D. students. The learning goal of this course is to be able to understand, design, and implement effective empirical strategies to support empirical claims, particularly causal claims, at the level required for professional researchers of empirical microeconomics. These empirical strategies include randomized experiments with and without compliance, regression discontinuity, the difference-in-difference, and recent techniques such as causal machine learning. In addition, I expect students to understand how to write code in R to perform simulation, estimation, and inference. Finally, I also expect students to learn how to read empirical microeconomics papers critically. Prerequisite(s): ECON 5300		
ECON 6120Y	Advanced Topics in Behavioral Decision Theory	4-0-0:4
Behavioral decision theory is a field of study that recognizes the crucial role that psychological and behavioral factors play in decision-making, and aims to capture and understand these factors through the use of formal theories. This graduate course provides students in business school with a comprehensive overview of the various topics in behavioral decision theory. These topics include decision-making under risk and uncertainty, decision-making over time, and decision-making in social contexts. This course emphasizes the interplay between theories, experiments, and applications in fields such as finance, labor economics, and development economics. By taking this course, students will gain a deeper understanding of psychological and behavioral factors that influence decision-making, and develop skills on how to model these factors and apply them to real-world scenarios. Prerequisite(s): ECON 5300		

ELEC

ELEC 5050	Advanced CMOS Devices	3-0-0:3
Principles and characteristics of semiconductor devices found in State-of-the-Art ICs. Emphasis is on deep-submicron MOS device design, characterization and modeling. Important issues such as short channel effects, high-field behavior, hot carrier effects, reliability and device scaling for present and future technology will be covered. Prerequisite(s): ELEC 3500		
ELEC 5080	Integrated-Circuit Fabrication Laboratory	2-0-6:4
Laboratory course requiring hands-on work in fabricating MOS transistors. Process modules including photolithography, dry etching, wet etching, metal sputtering, oxidation, diffusion and low-pressure chemical-vapor deposition will be covered. Student will also learn to characterize the fabricated devices. Prerequisite(s): ELEC 5070		
ELEC 5140	Advanced Computer Architecture	3-0-0:3
[Previous Course Code: ELEC 6910K] The course introduces the important building blocks in modern computing systems including superscalar processor pipeline, memory hierarchies, network design in the multicore-processors. The design techniques, evaluation metrics and optimization techniques will be discussed in detail with the example of real computer systems. The students will gain not only theoretical knowledge through lectures, but also hands-on experiences through projects. Background: Background knowledge in ELEC 2300 (Computer Organization) or COMP 2611 (Computer Organization)		

ELEC 5160	Digital VLSI System Design and Design Automation	3-0-0:3
Structured design styles; specification, synthesis and simulation using Hardware Descriptive Language (HDL); Structural chip design and system design; Circuit design of system building blocks: arithmetic unit, memory systems; clocking and performance issues in system design; Design-Automation tools and their applications. Background: ELEC 2200 Exclusion(s): EESM 5020 Prerequisite(s): ELEC 4410		
ELEC 5240	Advanced Display Technologies	3-0-0:3
[Previous Course Code: ELEC 6910V] Introduction of the human visual system, Colorimetry and photometry, Introduction of the modern TFTs, Modern AMLCD, AMOLED, Fluorescence and phosphorescence, Introduction of Electrophoretic displays, Color electrophoretic displays, Nano-material for displays, Electroluminescence and Photoluminescence, Quantum dot, Quantum rods, State-of-the-art development in the area of display technology: High-resolution displays (4k, 8k, and 10k), Local backlight dimming, Introduction to AR/VR display solutions, Holographic displays, Flexible displays etc. Background: Basic understanding of calculus and algebra.		
ELEC 5280	High Frequency Circuit Design	3-0-0:3
High frequency circuit design for wireless applications. S-parameters, front-end amp, VCO, PLL, power amplifier, and integration issues will be covered. Background: ELEC 3100, ELEC 3400, ELEC 4180 and ELEC 4630		
ELEC 5460	Stochastic Optimization for Wireless Systems and Federated-Learning	3-0-0:3
Stochastic Optimization plays a critical role in radio resource optimization of wireless networks, optimal control theory as well as financial engineering (portfolio optimization). This course will focus on the stochastic optimization theory and the application to the design and optimization of next generation wireless systems and federated learning applications. Topics covered include (A) Physical Layer Modeling: review of information theory for wireless fading channels, MIMO spatial diversity and spatial multiplexing, (B) Theory of Stochastic Optimization: classifications and motivating examples of stochastic optimizations [Type I stochastic Optimization and Type II stochastic optimization problems], theory of Stochastic Approximation, Stochastic Gradient, (C) Applications of Type I SO: Robust optimizations and Federated Learning: (D) Applications of Type II SO: Markov Decision Process, Stochastic Stability and Delay-optimal wireless resource control. Background: ELEC 4110 or equivalent		
ELEC 5470	Convex Optimization	3-0-0:3
[Co-list with IEDA 5470] Convex optimization theory with applications to communication systems and signal processing: convex sets/functions/problems; Lagrange duality and KKT conditions; saddle points and minimax problems; numerical algorithms; primal/dual decomposition methods. Applications: filter design; robust beamforming; power control in wireless systems; design of MIMO systems; GP duality in information theory; network utility maximization. For PG students in second year or above. Background: Linear algebra (also basic digital communications and basic signal processing) Exclusion(s): IEDA 5470		
ELEC 5510	Switch Mode Power Converters	3-0-0:3
DC-DC conversion: topologies, continuous and discontinuous conduction modes, steady state analysis, loop gain analysis and relevant mathematical tools, stability and compensation; AC-DC conversion: power factor correctors. Background: ELEC 2100 AND ELEC 3400		
ELEC 5530	Mixed-Signal Integrated Bio-Sensory Circuit Design	3-0-0:3

[Previous Course Code: ELEC 6910C] The course aims to systematically introduce major issues of mixed-signal circuit designs and their applications in bio-medical and sensory systems. The first half course is dedicated to mixed-signal IC design. The course starts with 2 review classes on OPAMP design, filter design and circuit noise. Then, the course covers topics on pipelined ADC, Sigma-delta ADC, and SAR ADC. The second half course is dedicated to sensory and bio-medical IC design. The topics include bio-potential detection, implants, DNA detection, CCD, CMOS imaging, and CT/SPECT. Background: ELEC 4420		
ELEC 5600	Linear-System Theory	3-0-0:3
Introduces modern system theory, with applications to control, signal processing and related topics. Basic system concepts, state-space and I/O representation, properties of linear systems, controllability, observability, minimality, transfer-function matrices, state and output feedback, stability, observers, optimal regulators. Background: ELEC 2100, MATH 2350 and MATH 2352		
ELEC 5640	Robot Manipulation	3-0-0:3
[Co-list with MECH 5561] Extensive introduction to robot manipulation theory from a geometric viewpoint. Rigid-body kinematics; spatial and body representation of rigid-body velocities; coordinate transformations; forward kinematics of open-chain manipulators; solution of inverse kinematics; robot workspaces; nonlinear decoupling control and force control. Exclusion(s): MECH 5561		
ELEC 5650	Introduction to Networked Sensing, Estimation and Control	3-0-0:3
[Previous Course Code: ELEC 6910E] The course gives an introduction to the analysis and design of sensing, estimation and control systems in a networked setting. It consists of three parts: the first part introduces necessary background knowledge in communication networks, sensor networks, linear state estimation, MAP and ML estimators, Kalman filtering, and modern control theory; the second part focuses on analysis of network effect to remote state estimation and control; the third part presents some advanced topics including distributed state estimation and resource allocation through scheduling. Background: ELEC 2600 AND ELEC 3200		
ELEC 5660	Introduction to Aerial Robotics	3-0-3:3
[Previous Course Code: ELEC 6910P] This course gives a comprehensive introduction to aerial robots. The goal of this course is to expose students to relevant mathematical foundations and algorithms, and train them to develop real-time software modules for aerial robotic systems. Topics to be covered include rigid-body dynamics, system modeling, control, trajectory planning, sensor fusion, and vision-based state estimation. Students will complete a series of projects which combine into an aerial robot that is capable of vision-based autonomous indoor navigation. Background: Linear algebra; Probability; MATLAB programming skills; C++ programming skills		
ELEC 5680	Advanced Deep Learning Architectures	3-0-0:3
[Co-list with COMP 5214] [Previous Course Code: ELEC 6910T] This course focuses on advanced deep learning architectures and their applications in various areas. Specifically, the topics include various deep neural network architectures with applications in computer vision, signal processing, graph analysis, and natural language processing. Different state-of-the-art neural network models will be introduced, including graph neural networks, normalizing flows, point cloud models, sparse convolutions, and neural architecture search. The students have the opportunities to implement deep learning models for some AI-related tasks such as visual perception, image processing and generation, graph processing, speech enhancement, sentiment classification, and novel view synthesis. Exclusion(s): COMP 5214		
ELEC 5810	Introduction to Bioinformatics Algorithms	3-0-0:3

This is an introductory course on computational biology at the molecular level. It will cover basic biological knowledge, important biological questions, common data acquisition techniques, popular data analysis algorithms and their applications. The major content of this course is computation-oriented.		
ELEC 5900	Modern Engineering Research Methodologies	3-0-0:3
The course provides a high-level description of modern engineering research practices. It covers topics including research mentality, the scientific method, evaluating research topics, literature search, report writing, presenting data, publication, research management, research ethics and technology transfer. Exclusion(s): EESM 5770		
ELEC 6910D	Electronic Design Automation for VLSI Design	3-0-0:3
The course introduces Electronic Design Automation (EDA) techniques for VLSI digital IC design. The modern RTL to GDS-II design flow and related tools will be explained in detail. Classical automated algorithms adopted in logic synthesis, floorplanning, placement, CTS, routing, etc. will be covered. Simulation and optimization techniques of key design objectives and constraints will be presented.		
ELEC 6910E	Compound Semiconductor Device Physics and Technologies	3-0-0:3
This course covers the physics and technologies of compound semiconductor devices, stressing how differences from silicon enable unique applications in wireless communications, power switching, photovoltaics, and solid-state lighting. Electronic bandstructures will be used to develop band diagrams of complex heterostructures and nanostructures. Examples in electronic and photonic applications will be used to motivate the materials science of crystal growth, doping, and fabrication. Prerequisite(s): ELEC 4510		
ELEC 6910Y	Topics in Deep NLP	3-0-0:3
This is a course primarily for ECE and CSE PG students with an overview of the state-of-the-art research in Natural Language Processing. The course will include overview of fundamentals of deep learning for NLP such as DNN, RNN, Transformer architecture; representation learning; (pre-trained and large) language modeling; natural language understanding; natural language generation; multi-modal and multi-lingual learning; neural machine translation; neural conversational AI; responsible AI topics such as hallucination and bias detection and mitigation in LLM.		

HUMA

HUMA 5230	Languages of China: Anthropological and Cognitive Dimensions	3-0-0:3
A cross-disciplinary discussion of issues pertaining to social, historical, cultural, and cognitive aspects of languages and dialects of China, approached from perspectives of areal linguistics, linguistic anthropology, and cognitive linguistics. **[Pu][C]** Exclusion(s): HMMA 5008		
HUMA 5301	The Zhuangzi and its Multimedia Reception in China and Beyond	2-1-0:3
The Daoist classic Zhuangzi, a collection of cryptic sayings and short anecdotes attributed to the mysterious Master Zhuang Zhou, has deeply influenced cultural life in East Asia. In this course, we explore both the Daoist classic's multifaceted content and its diverse reception history to understand why the text might have exuded such an incessant relevance for a wide range of audiences in East Asia and beyond.		
HUMA 5330	Traditional Chinese Literary Theory and Criticism	3-0-0:3

Aims to familiarize students with the traditional Chinese theories and criticism of literature; advantages and limitations of the various modes of discourses such as prefaces to books, poetry-talks, poems on poetry, literary anthologies, stray remarks and commentaries. **[Pu][C]**		
HUMA 5340	Modern Chinese Literary Criticism	3-0-0:3
Examines the transformation of Western literary theories in the Chinese context. Focuses on practices of individual Chinese literary theorists and the relationship between literary criticism and socio-cultural criticism from historical and comparative perspectives. **[Pu][C]**		
HUMA 5350	Socialist Film Culture	3-0-0:3
[Previous Course Code: HUMA 6001X] This graduate course concentrates on the film culture in socialist China (1949-1976). The major theoretical problematic of the course resides in the convoluted relationship between totalitarian politics and film as propaganda and art. Focusing on live-action feature films, model operas, animated films, and documentaries, this course will explore aspects of film industry, aesthetics, authorship, projection and viewing, soundscape, and internationalism. It will also discuss conceptual issues regarding national identity, ethnicity, gender, children, machines, and animals against the backdrop of an authoritarian regime. Following a chronological order, the course will begin with the socialist transition in 1949, and then move to the Seventeen Years (1949-1966) and the Cultural Revolution (1966-1976).		
HUMA 5516	Research Methods and Sources in Qing History	3-0-0:3
This course is designed to help students familiarize themselves with various types of Qing documents. The course will cover a variety of different types of documents, from formal publications originating from the central government, to personal and family records of various types. This will help students intending to conduct research in late imperial Chinese history and related subjects.		
HUMA 5530	Chinese Diasporas: A Global History	3-0-0:3
Before 1700, the Chinese population was concentrated in core areas of China Proper. Nonetheless, significant numbers of Chinese people moved to the frontiers of an expanding empire and across it borders, while Chinese families adapted to migration as a way of life. Critically employing the notion of "diasporas," this course traces this worldwide circulation of Chinese people over the ensuing three centuries.		
HUMA 5630	Digital Humanities	3-0-0:3
The course introduces tools and methods of the Digital Humanities as they can be used in literary, historical, art historical, linguistic, and cultural studies. Students will learn how to apply data analysis, text mining, visualization tools and StoryMaps to explore a variety of research questions pertinent to the use, sharing and presentation of cultural and historical data. Special attention will be given to the application of such tools and methods to China-related subject areas. Background: Experience in Python is desirable but not required.		
HUMA 6002U	Marco Polo and Eurasian Globalization	3-0-0:3
Marco Polo's travel to China 700 years ago led to the first reliable account of Central and East Asian economies and cultures to circulate in Europe. This course will focus on a complete reading Marco Polo's short book in English translation accompanied by selected readings situating Marco Polo in his historical context, discussing his connections with the Silk Road and the first Eurasian Globalization as well as the debates surrounding the reliability of his account.		

MATH

MATH 5112	Advanced Algebra II	3-0-0:3
Advanced topics in algebra: group representations, associative algebras, commutative algebra, homological algebra, algebraic number theory. Background: MATH 5111		
MATH 5261	Algebraic Geometry II	3-0-0:3
Derived functors, cohomology of coherent sheaves on schemes, extension groups of sheaves, higher direct image of sheaves, Serre duality, flat morphisms, smooth morphisms, and semi-continuity, basics of curves and surfaces. Background: MATH 5111 or equivalent postgraduate algebra Prerequisite(s): MATH 5251		
MATH 5281	Partial Differential Equations	3-0-0:3
[Previous Course Code: MATH 6050E] This is an introductory postgraduate course on Partial Differential Equations (PDEs). We will start with the classical prototype linear PDEs, and introduce a variety of tools and methods. Then we will extend our beginning theories to general situation using the notion of Sobolev spaces, Holder space and weak solutions. We will prove the existence, uniqueness, regularity and other properties of weak solutions. Background: Multi-variables calculus, linear algebra, Lebesgue integral		
MATH 5312	Advanced Numerical Methods II	3-0-0:3
Direct and iterative methods. Programming techniques and softwares libraries. Sparse solvers, Fast algorithms, multi-grid and domain decomposition techniques. Prerequisite(s): MATH 5311		
MATH 5353	Multiscale Modeling and Computation for Non-equilibrium Flows	3-0-0:3
[Previous Course Code: MATH 6385D] Introduction of the Navier-Strokes equations and the flow modeling in the hydrodynamic scale. The derivation of the Boltzmann equation in the kinetic scale. The basic mathematical analysis of the Chapman-Enskog expansion and the numerical methods for the Boltzmann equation. The multiscale modeling from the kinetic to the hydrodynamic scales and the discretized governing equations. The study of non-equilibrium transport phenomena in gas dynamics, radiative and heat transfer, and plasma physics. Background: Background knowledge in MATH 5350 is preferred		
MATH 5380	Combinatorics	3-0-0:3
Enumerative Combinatorics: bijective counting, permutation statistics, generating functions, partially ordered sets, Mobius inversions, Polya theory. Graph Theory: cycle space, bond space, spanning-tree formulas, matching theory, chromatic polynomials, network flows. Matroid Theory: matroid axioms, representations, duality, lattice of flats, transversals. Background: Linear algebra; Calculus Prerequisite(s): MATH 2343 or MATH 3343		
MATH 5432	Advanced Mathematical Statistics II	3-0-0:3
Theory of statistical inference in hypothesis testing. Topics include: uniformly most powerful tests, unbiasedness, invariance, minimax principle, large-sample parametric significance tests. Concept of decision theory also covered.		
MATH 5450	Stochastic Processes	3-0-0:3
Theory of Markov processes, second order stationary theory, Poisson and point processes, Brownian motion, Martingales and queueing theory.		
MATH 5470	Statistical Machine Learning	3-0-0:3

[Previous Course Code: MATH 6450A] This course covers methodology, major software tools and applications in statistical learning. By introducing principal ideas in statistical learning, the course will help students understand conceptual underpinnings of methods in data mining. The topics include regression, logistic regression, feature selection, model selection, basis expansions and regularization, model assessment and selection; additive models; graphical models, decision trees, boosting; support vector machines; clustering. Exclusion(s): MFIT 5010, MSDM 5054		
MATH 5473	Topological and Geometric Data Reduction and Visualization	3-0-0:3
[Co-list with CSIC 5011][Previous Course Code: MATH 6380Q] This course is a mathematical introduction to data analysis and visualization with a perspective of topology and geometry. Topics covered include: classical linear dimensionality reduction, the principal component analysis (PCA) and its dual multidimensional scaling (MDS), as well as extensions to manifold learning, topological data analysis, and sparse models in applied math/high dimensional statistics. Extensive application examples in biology, finance, and information technology are presented along with course projects. Exclusion(s): CSIC 5011		
MATH 6250L	Higher Loops in Topological Strings	3-0-0:3
Polyakov's bosonic strings. Witten's topological field theory. Vafa's Landau Ginzburg string theory. Supersymmetry and couple with 2D gravity. Mathematic approaches to surpass renormalizations in Type IIA strings path integrals. Loop reductions including BCOV and Virasoro conjecture statement. Witten's conjecture and Mizarkhani's proof. The theory of Mixed-Spin-P fields. Students with very basic Riemannian geometry, basic Riemann surfaces, schemes and Chern classes will be helpful but not necessary. Students without course prerequisite should seek the course instructor's approval to take this course. Prerequisite(s): MATH 3121 AND MATH 4023 AND MATH 4033		

MECH

MECH 5230	Computational Fluid Dynamics and Heat Transfer	3-0-0:3
Numerical simulation of viscous incompressible flows and heat transfer; finite-difference and finite element methods; accuracy and stability; grid generation; stream function and primitive-variable formulations; application to internal, external flows, diffusion, convection, and dispersion problems. Background: Basic programming background (e.g. C/C++/Matlab) Prerequisite(s): MECH 2210 or equivalent AND MECH 3310 or equivalent		
MECH 5320	Convective Heat and Mass Transfer	3-0-0:3
Laminar and turbulent boundary layer heat transfer by similarity, integral and superposition methods; effects of roughness, curvature, transpiration and high turbulence; forced and free convections, free-shear flows and buoyant flows; numerical methods. Background: MECH 3310 Prerequisite(s): MECH 5210		
MECH 5561	Robot Manipulation	3-0-0:3
[Co-list with ELEC 5640][Previous Course Code: MECH 6910M] Extensive introduction to robot manipulation theory from a geometric viewpoint. Rigid-body kinematics; spatial and body representation of rigid-body velocities; coordinate transformations; forward kinematics of open-chain manipulators; solution of inverse kinematics; robot workspaces; nonlinear decoupling control and force control. Exclusion(s): ELEC 5640		
MECH 6910U	Sustainable Engineering and Energy	3-0-0:3

What business can generate long-term profit? What is the most important topic in this era? What are the most critical challenges to our human society? All these go to sustainability. The rise of solar power, the surge in popularity of electric cars, and the debates surrounding genetically modified food are all indicative of the complex and interrelated issues we face today. Extreme weather events and the ever-pressing threat of climate change further compound the urgency of our situation. This course aims to equip you with the necessary tools to address these challenges. We will introduce and elucidate the fundamental design concepts, methods, tools, and technologies associated with lean and green manufacturing systems, supply chains, and green energy. It will also encompass the evaluation, design, and maintenance of environmentally friendly products, processes, services, and policies.

MGMT

MGMT 7100	Behavioral Science	3-0-0:3
In-depth study of the foundations of behavioral science research using examples from organizational behavior and other related business disciplines.		

PHYS

PHYS 5170	Solid State Physics I	3-0-0:3
[Previous Course Code: PHYS 6810A] This is an introductory course on postgraduate level solid state physics. The topics covered include: electronic band structures of solids, phonons, electron dynamics in crystals, electron interactions in solids, linear response theory, electronic transitions and optical properties of solids, electron phonon interactions, integer quantum Hall effects, superconductivity and magnetism. Background: Students should have good understanding in undergraduate level quantum mechanics before taking this course.		
PHYS 5310	Statistical Mechanics I	3-0-0:3
[Co-list with NANO 5320] Laws and applications of thermodynamics, kinetic theory, transport phenomena, classical statistical mechanics, canonical and grand canonical ensemble, quantum statistical mechanics, Fermi and Bose systems, non-equilibrium statistical mechanics. Exclusion(s): NANO 5320		
PHYS 5340	Introduction to Quantum Many-body Theory	4-0-0:4
Introduction to theoretical methods for quantum many-body systems. Perturbative methods, like Green's functions and diagrammatics, will be introduced. Topics in response theory and quantum magnetism will be covered. More modern, entanglement-based approaches, like tensor networks, will also be discussed.		
PHYS 5810	Modern Semiconductor Physics	3-0-0:3
[Co-list with NANO 5200] Detailed explanations of the electronic, vibrational, transport, and optical properties of semiconductors based on quantum mechanics. Emphasis on nanostructured heterostructures, quantum size and low-dimensional effects, and application to modern electronics and opto-electronics. Background: PHYS 4052 or equivalent Exclusion(s): NANO 5200		

SOSC

SOSC 5170	Qualitative Research Methods	3-0-0:3
This course explores links between theory and practice in qualitative research. It combines learning about selected methods of qualitative inquiry (participant-observation, in-depth interview, oral history) and analysis (grounded theory, ethnography, and discourse analysis). Enrollment by students from outside the Division of Social Science by instructor permission. Background: Knowledge in Social Science Prerequisite(s): SOSC 5110		
SOSC 5340	Econometric Approaches to Social Science Research	3-0-0:3
Management and analysis of multivariate data sets, including simple and multiple regression analysis, and econometric approaches to causal inference. Enrollment by students from outside the Division of Social Science by instructor permission. Background: Knowledge in Social Science Exclusion(s): MGCS 5011 (Prior to 2019-20) Prerequisite(s): SOSC 5090		
SOSC 5500	Computational Social Science	3-1-0:3
The increasing use of the Internet and online communities in the last decade has led to an explosion of social data capturing every aspect of our daily activities. The new digital data have in turn led to the rise of Computational Social Science, an emerging field that aims to empirically study social behavior by applying computational methods, algorithms, and models on "big data". This course introduces the methods and ideas of computational social sciences. The course consists of lectures, projects and tutorials. Students will learn and evaluate the new possibilities and challenges that digital data have created for studying social phenomena. Students will also learn and practice essential methods that are needed to analyze digital data, from data collection to techniques and methods to analyze big data. Background: Knowledge of at least one programming language, such as Python or R. Prerequisite(s): SOSC 5090		
SOSC 6030R	Experiments and Quasi-experiments in the Social Sciences	3-0-0:3
This course explores the statistical methods used for causal inference in the social sciences within the potential outcomes framework. Using this perspective puts the logic of statistical inference for both experimental and non-experimental studies within the same framework. Though randomized experiments serve as the gold standard for causal inference, the course also outlines how it may sometimes be reasonable to treat non-experimental data as if it had been drawn from an experiment. Usually, this involves a set of assumptions or substantive factual information about how the natural world produced the data. Research designs and methods covered include randomized experiments, matching, instrumental variables, difference-in-differences, synthetic control, and regression discontinuity designs.		
SOSC 6880	Seminar on Emotion	3-0-0:3
This course covers major perspectives on emotion, with an emphasis on a psychological rather than a biological or a sociological level of analysis. It provides an in-depth examination of emotion theories and research to students with different research foci. Background: This is a graduate level course designed for advanced and motivated students with background in (a) upper-level (non-1000 level) psychology courses and (b) research methods in psychological science.		

[C] = Courses may required students to read materials in Chinese. Students who have difficulty reading materials in Chinese should consult the instructor concerned prior to enrolling in these courses.

[Pu] / [Ca] = Courses approved to be taught in Chinese carry a *[Pu]* or *[Ca]* notation in the course description, which indicates the spoken language used in teaching: *[Pu]* stands for Putonghua; and *[Ca]* for Cantonese.