# Description of Postgraduate Courses -- Research Postgraduate Course Sharing Scheme (Fall Term 2025-2026)

**Last Update: 01 August 2025**

## 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.

## AMCC

| | | |
|---|---|---|
| **AMCC 5010** | Research Methodology in Arts and Machine Creativity | 3-0-0:3 |
| This course provides postgraduate students with an in-depth understanding of the research methodologies and techniques utilized in the fields of arts and machine creativity. Students will explore various approaches to generating creative outputs through machines, including artificial intelligence, computational creativity, and algorithmic art, while developing critical thinking and problem-solving skills in the creative domain. | | |

## BIEN

| | | |
|---|---|---|
| **BIEN 5050** | Global Health Ethics | 2-1-0:3 |
| [Previous Course Code: BIEN 6930A] Through real-time videoconferencing with participants from different countries such as the United States, United Kingdom, Australia, Mexico, and Philippines, this ONLINE course aims at helping students learn the definitions of global health ethics and bioethics, the different protocol and systems in place to ensure adherence to ethical principles, and how different stakeholders and cultures may interpret ethics differently. Through case studies on ethical challenges from real-world situations, students will analyze and discuss the complexities of global health practice and research ethics in a global context. This course is co-offered with the University of Southern California. Besides the joint LIVE sessions, face-to-face sessions and group projects are also arranged for the introduction of background knowledge, case studies, group project discussion, and technical support. | | |

## CHEM

| | | |
|---|---|---|
| **CHEM 5110** | Advanced Organic Chemistry I | 3-0-0:3 |
| Mechanism and theory in organic chemistry, molecular orbital theory, structure-activity relationships, isotope effects, solvent effects, neighboring group participation, and reactive intermediates. Background: CHEM 2118 (prior to 2017-18), CHEM 3120 and CHEM 4140 | | |
| **CHEM 5230** | Quantum Chemistry | 3-0-0:3 |
| Introduction to basic theories of Quantum Chemistry. Popular theories used in modern Quantum Chemistry such as Hantree-Fock theory, Density Functional theory. Perturbation Theories, and other quantum chemistry theories will be introduced in this course. Background: CHEM 3420 OR Equivalent | | |
| **CHEM 5310** | Advanced Inorganic Chemistry I | 3-0-0:3 |
| Symmetry, group theory; molecular orbitals, electronic states; ligand field theory; electronic structure of metal complexes; theory of bonding and structure of inorganic compounds; chemistry of the elements; major physical methods used in the determination of molecular structure and bonding. | | |
| **CHEM 5410** | Atmospheric Chemistry | 3-0-0:3 |
| [Co-list with ENVR 5410] A fundamental introduction to the physical and chemical processes determining the composition of the atmosphere and its implications for climate, ecosystems, and human welfare. Atmospheric transport and transformation. Stratospheric ozone. Oxidizing power of the atmosphere. Regional air pollution: aerosols, smog, and acid rain. Nitrogen, oxygen, carbon, sulfur geochemical cycles. Climate and the greenhouse effect. Background: Basic knowledge of physical chemistry<br>Exclusion(s): ENVR 5410 | | |
| **CHEM 5880** | Polymer Chemistry | 3-0-0:3 |
| Modern Polymer synthesis, step and chain polymerizations, macromolecular structures, and polymer properties.<br>Prerequisite(s): CHEM 2112 (prior to 2017-18) or CHEM 3120 | | |

## CIVL

| | | |
|---|---|---|
| **CIVL 5220** | BIM and Digital Construction | 3-0-0:3 |
| [Previous Course Code: CIVL 6100B] This course covers the principles and applications of information technology for construction management. Topics include building information modeling, database management and implementation, web-based communication and project management technologies, | | |

| | | |
|---|---|---|
| decision support systems, knowledge management, and data processing and analysis. Background: CIVL 3210 | | |
| **CIVL 5350** | Bridge Engineering | 3-0-0:3 |
| This course introduces the limit states design method for bridges, discusses the design philosophy and code requirements and presents examples of analysis and design of bridge super-structure components (using the limit states design method). | | |
| **CIVL 5410** | Physical-Chemical Water/Wastewater Treatment | 3-0-0:3 |
| Principles of treatment for removing contaminants from drinking water and municipal wastewaters; includes equalization, neutralization, precipitation, coagulation and flocculation, sedimentation, filtration, air stripping, carbon adsorption, disinfection.<br>Exclusion(s): CIEM 5460, JEVE 5460<br>Prerequisite(s): CIVL 3420 | | |
| **CIVL 5610** | Urban Transportation Networks Analysis | 3-0-0:3 |
| Reviews transportation planning models and traffic analysis; examines the assignment of traffic flow on a network according to user-equilibrium and system optimal objectives; addresses formulation methods and solution techniques. Background: CIVL 3610 AND IEDA 3010 | | |
| **CIVL 5760** | Geotechnical Site Characterization | 3-0-0:3 |
| Presents state-of-the-art geotechnical site characterization methodologies; includes basic principles of site characterization planning, drilling and sampling, soil and rock description, cone penetration test, standard penetration test, pressuremeter test, dilatometer test, geophysical methods, permeability and ground water monitoring, and fundamentals of geostatistics. Background: CIVL 3720 (prior to 2018-19) | | |

## COMP

| | | |
|---|---|---|
| **COMP 5211** | Advanced Artificial Intelligence | 3-0-0:3 |
| This advanced AI course will cover advanced concepts and techniques in AI. The major topics will be: problem solving, knowledge and reasoning, planning, uncertain knowledge and reasoning, learning, and robotics. | | |
| **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<br>Exclusion(s): ARIN 5103, CSIT 5910, MAIE 5212, MSBD 5012 | | |
| **COMP 5331** | Knowledge Discovery in Databases | 3-0-0:3 |
| An introduction to knowledge discovery in databases. Different discovery and learning techniques are presented and compared. Automatic generation of query language expressions is discussed in depth. Potential applications are shown. Background: COMP 3311<br>Exclusion(s): CSIT 5210, MSBD 5002 | | |
| **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<br>Exclusion(s): CSIT 5400 (prior to 2024-25) | | |
| **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<br>Exclusion(s): ARIN 5302, BEHI 5011 | | |
| **COMP 5621** | Computer Networks | 3-0-0:3 |
| Principles, design and implementation of computer communication networks; network architecture and protocols, OSI reference model and TCP/IP networking architecture; Internet applications and requirements; transport protocols, TCP and UDP; network layer protocols, IP, routing, multicasting and broadcasting; local area networks; data link and physical layer issues; TCP congestion control, quality of service, emerging trends in networking. | | |
| **COMP 5711** | Introduction to Advanced Algorithmic Techniques | 3-0-0:3 |
| This is an introductory graduate course in algorithmic techniques. Topics include: advanced data structures; graph algorithms; amortization; approximation algorithms; on-line algorithms; randomized and probabilistic analysis. Background: COMP 3711, COMP 3721 | | |
| **COMP 6211J** | Advanced Large-Scale Machine Learning Systems for Foundation Models | 3-0-0:3 |
| In recent years, foundation models have fundamentally revolutionized the state-of-the-art of artificial intelligence. Thus, the computation in the training or inference of the foundation model could be one of the most important workflows running on top of modern computer systems. This course unravels the secrets of the efficient deployment of such workflows from the system perspective. Specifically, we will i) explain how a modern machine learning system (i.e., PyTorch) works; ii) understand the performance bottleneck of machine learning computation over modern hardware (e.g., Nvidia GPUs); iii) discuss four main parallel strategies in foundation model training (data-, pipeline-, tensor model-, optimizer-parallelism); and iv) real-world deployment of foundation model including efficient inference and fine-tuning. Instructor's approval is required. | | |
| **COMP 6311G** | Advanced Spatiotemporal Indexing and Query Processing | 3-0-0:3 |
| This course introduces advanced techniques for indexing and querying large-scale spatiotemporal and graph-structured data. It covers spatial and temporal data models, and explores how various query types such as range, k-nearest neighbor, join, and shortest path are supported by suitable indexing methods. Topics include spatial indexes such as R-tree, KD-tree, and Octree, graph indexes such as Contraction Hierarchies and Pruned Landmark Labeling, as well as learning-based indexing for adaptive and efficient query processing. The course also addresses out-of-core and distributed indexing, with emphasis on algorithm design, performance optimization, and practical applications on real-world datasets. In addition to lectures, students will present and discuss recent research papers, fostering a deep understanding of current trends and open challenges in the field. | | |

| | | |
|---|---|---|
| **COMP 6411D** | Data Visualization | 3-0-0:3 |
| Data visualization (or information visualization) is a rich research area that focuses on the design, development, and utilization of visual representations and interaction techniques to help people understand, analyze, and make decisions using data. This introductory special topic course teaches the design principles, considerations, and applications of data visualization, providing best practices and hands-on experience for visualizing datasets across diverse domains for a variety of use-cases. | | |

## ELEC

| | | |
|---|---|---|
| **ELEC 5010** | Introduction to the Design & Implementation of Micro-Systems | 3-0-1:3 |
| Introduction to the concept of micro-systems. Dimensional scaling and its implications. Multi-physics modeling. Micro-fabrication techniques. Introduction to Coventor, a numerical simulation package for micro-systems. The design, implementation and testing of a micro-device.<br>Exclusion(s): MECH 5950 | | |
| **ELEC 5040** | Advanced Analog IC Analysis and Design | 3-0-0:3 |
| Noise analysis; Advanced op-amp design techniques; Analog VLSI building blocks: multipliers, oscillators, mixers, phase-locked loops, A/D and D/A converters; Passive filter design; Frequency scaling; Active filter design. Background: ELEC 4420 and ELEC 4510<br>Exclusion(s): EESM 5120 | | |
| **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.<br>Prerequisite(s): ELEC 5070 | | |
| **ELEC 5110** | Nanoelectronic Materials for Energy Technologies | 3-0-0:3 |
| [Co-list with ENEG 5200] Conventional and unconventional fabrication of nanostructures including electron beam lithography, nanoimprint, chemical synthesis, self-assembly, etc.; size dependent electronic and optoelectronic properties of nanomaterials; large-scale assembly and integration of nanomaterials for electronics; energy harvesting and storage devices using nanoelectronic materials. Background: ELEC 3500<br>Exclusion(s): ENEG 5200 | | |
| **ELEC 5120** | Semiconductor Power and Energy Conversion Technologies | 3-0-0:3 |
| [Co-list with ENEG 5250] Analysis of power semiconductor device technologies in the context of electric power conversion and transmission; emphasis on the understanding of the critical roles of semiconductor device technologies in power and energy conversion. The mainstream silicon and emerging semiconductor power devices technologies; material properties, device structure design, advanced fabrication techniques, and device characteristics. Critical device-circuit interaction issues and basic power electronics circuits will be covered focusing on the role of these circuits in electric power conversion and transmission.<br>Exclusion(s): ENEG 5250 | | |
| **ELEC 5130** | RF Microsystems: Devices and Applications | 3-0-0:3 |
| [Previous Course Code: ELEC 6910B] Students will receive the following knowledge: Electromagnetic fields & waves, transmission line theory, Smith Chart, S-parameters, and Network Analysis; RF wireless communication systems; Properties of passive components; Impedance Matching network, RLC networks, and 2-port parameters; Microwave measurement and calibration; Simulation methods for EM passive devices: HFSS & PathWave Advanced Design System (ADS); Micron passive acoustic wave devices: resonators, filters, delay lines; Simulation methods for multi-physic devices: COMSOL; MEMS technologies | | |

| | | |
|---|---|---|
| for RF microsystems. This course discusses methodologies to synthesize and model the operation of several key passive components currently employed in commercial Radio Frequency (RF) microsystems. The operation, design methodologies, and equivalent circuit representations relative to RF devices will be presented. | | |
| **ELEC 5360** | Principles of Digital Communications | 3-0-0:3 |
| The aim of this course is to provide an in-depth treatment of the theoretical basis, analysis, and design of digital communication systems. The first half of the course will focus on the theoretical foundations of a basic digital communication system, including source coding, modulating and channel coding, and introductory information theory. The second half will deal with advanced techniques including orthogonal frequency division multiplexing (OFDM), multi-antenna communications, spread-spectrum communications, and cooperative communications. Background: Probability theory<br>Exclusion(s): EESM 5536 | | |
| **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)<br>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 5630** | First Principles of Computer Vision | 3-0-0:3 |
| [Previous Course Code: ELEC 6910A] This course focuses on the fundamental mathematical and physical principles of computer vision. It begins by introducing the physical imaging process, encompassing crucial subjects such as color, polarization, radiometry, reflectance models, and photometric methods. Subsequently, it explores the realm of geometric multi-view vision, encompassing topics like features, multi-view stereo, optical flow, structure-from-motion, visual SLAM, and NeRF. Finally, the course delves into the domain of learning-based methods including classification, segmentation, detection, and diffusion models. | | |
| **ELEC 6910F** | Optical Materials and Applications | 3-0-0:3 |
| The course explains the optical properties of isotropic (dielectric, metallic, semiconducting) and anisotropic (crystalline, liquid crystalline) materials, and the influence of external fields (electric, magnetic, strain). The optical properties are discussed in various applications (lenses, mirrors, gratings, wave plates, wave plates, modulators, liquid crystal devices. | | |
| **ELEC 6910H** | Advanced AI Chip and System | 3-0-0:3 |
| Artificial Intelligence (AI) techniques have achieved great success in a wide range of applications like computer vision, natural language processing, and scientific computing. Traditional processors are not optimized for AI tasks, which can result in slow performance and high energy consumption. To unlock the full potential of AI, both academia and industry have developed many AI processors for efficient AI computing from edge to cloud, with specialized architecture for the complex computations of AI applications. This is an introductory course to advanced processor architecture for AI computing. The topics covered include AI algorithm basics, processing element, dataflow, memory system, software- | | |

| |
|---|
| hardware co-design for AI processors. This course will also introduce benchmarking and recent advances of AI processors. |

## ENEG

| | | |
|---|---|---|
| **ENEG 5200** | Nanoelectronic Materials for Energy Technologies | 3-0-0:3 |
| [Co-list with ELEC 5110] Conventional and unconventional fabrication of nanostructures including electron beam lithography, nanoimprint, chemical synthesis, self-assembly, etc.; size dependent electronic and optoelectronic properties of nanomaterials; large-scale assembly and integration of nanomaterials for electronics; energy harvesting and storage devices using nanoelectronic materials. Background: ELEC 3500<br>Exclusion(s): ELEC 5110 | | |
| **ENEG 5250** | Semiconductor Power and Energy Conversion Technologies | 3-0-0:3 |
| [Co-list with ELEC 5120] Analysis of power semiconductor device technologies in the context of electric power conversion and transmission; emphasis on the understanding of the critical roles of semiconductor device technologies in power and energy conversion. The mainstream silicon and emerging semiconductor power devices technologies; material properties, device structure design, advanced fabrication techniques, and device characteristics. Critical device-circuit interaction issues and basic power electronics circuits will be covered focusing on the role of these circuits in electric power conversion and transmission.<br>Exclusion(s): ELEC 5120 | | |

## HUMA

| | | |
|---|---|---|
| **HUMA 5170** | Chinese Historical Lexicology | 3-0-0:3 |
| This course provides a theoretical and practical introduction to Chinese historical lexicology, dealing with various issues of Chinese words including word formation, semantic structures and sense relations of words, x-bar analysis of Chinese words, lexicalization, cultural component of words, and lexical variation among dialects of Chinese. **[Pu][C]** | | |
| **HUMA 5360** | History and Theory of Comparative Literature | 3-0-0:3 |
| This course introduces students to the field of Comparative Literature through a variety of readings. It examines the development of the discipline by looking into the major theories and methodologies. Through readings and in-class discussions, we explore the significance of reading literature from comparative perspectives, crossing geographical, temporal, and linguistic boundaries. We also encourage students to examine the key concepts, themes, and debates that have shaped the evolving field of comparative literature. **[C]**<br>Exclusion(s): HMMA 5009 | | |
| **HUMA 5371** | Videogames in East and Southeast Asia | 0-3-0:3 |
| While Japan used to dominate the Asian gaming landscape, its East Asian and Southeast Asian neighbors have since developed into major gaming hubs with distinctive characteristics. This course examines the formative influence of Japanese games throughout East and Southeast Asia, studies the rise of South Korea and China as centers for online gaming and esports, and surveys the emergence of robust national videogame industries in numerous Southeast Asian nations. | | |
| **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 5632** | Digital Humanities Seminar | 0-3-0:3 |
| The seminar introduces the latest scholarship, methods, and tools in Digital Humanities (DH), engaging students in interdisciplinary DH discourses. Students will also acquire foundational digital skills, including Python, text mining, data analysis, visualization, large language models (LLMs), artificial intelligence (AI), and geographic information systems (GIS). These skills will be applied to their research projects, enhancing their analytical and digital approaches. | | |
| **HUMA 5692** | The Scientific Revolution (1450 to 1750) | 3-0-0:3 |
| This postgraduate course explores the scientific revolution in early modern Europe, examining the cultural and intellectual framework in which new discoveries were made, the shift towards a mathematic vision of the world, and the development of new experimental techniques. Through the comparison with other intellectual traditions, especially the Chinese scientific tradition, students will gain a deeper understanding of the scientific revolution and its impact on modern science and the modern world. The course aims to develop students' analytical and communication skills, as well as their understanding of early modern intellectual history. | | |
| **HUMA 5702** | A New History of Humanity | 2-1-0:3 |
| This course takes on the broad sweep of human history from an anthropological perspective, highlighting the extraordinary social and cultural diversity of human experience. It delves into phenomena that showcase this diversity, such as hunter-gatherers' seasonality, 'play agriculture' in Amazonia and Aboriginal Australia, egalitarian cities, urban revolutions in Mesoamerica, or stranger-kings across the Pacific. These case studies, analyzed through modern anthropological theory, unsettle popular unilinear narratives about human history while revealing the role of collective agency in shaping its course. In illuminating the past, the course will offer new ways of thinking about humanity's future. | | |
| **HUMA 5770** | Field Research: Theory and Practice | 3-0-0:3 |
| [Previous Course Code: HUMA 5550] Theories, methods, and techniques in ethnographic field research are explored. Students conduct individual and group research projects. | | |
| **HUMA 5901** | Philosophy of the Social Sciences | 3-0-0:3 |
| This is an advanced module in the philosophy of the social sciences. The students will be provided an overview of the history of the social sciences (especially sociology and economics). In addition, the module will cover some of the central debates in the philosophy of the social sciences, such as the paradigm wars, and examine some important concepts in the social sciences including 'social mechanism', 'explanation', and 'causation'. Background: Students are expect to have some background in the humanities (e.g. history and philosophy) and social sciences. | | |
| **HUMA 6001B** | Sentimental Republic: Emotion Literature and Modern China | 3-0-0:3 |
| This course takes an interdisciplinary approach to the study of Chinese literature and culture from the late Qing to the Republican era, focusing on the expression and representation of emotion and affect. Linking literature to other cultural and political discourses of the late nineteenth and early twentieth centuries, we will examine the social and cultural significance of modern Chinese sentimentalism. The course will broadly address issues such as public/private sentiment, sympathy and empathy, translations of emotions, reformulations of the senses (sight, hearing, smell, taste and touch), suffering and trauma, negative emotions (e.g. shame, anger and grief), and the gendering of the public sphere. **[C]**<br>Exclusion(s): HUMA 6001V | | |

## LIFS

| | | |
|---|---|---|
| **LIFS 5710** | Cellular Regulation | 3-0-0:3 |
| Molecular basis of cellular regulation. Cellular signal transduction cascades. | | |

## MATH

| | | |
|---|---|---|
| **MATH 5011** | Advanced Real Analysis I | 3-0-0:3 |
| Basic topology, continuous function spaces, abstract measure and integration theory, Lp spaces, convexity and inequalities, Hilbert spaces, Banach spaces, Complex measure. Background: MATH 3033 | | |
| **MATH 5111** | Advanced Algebra I | 3-0-0:3 |
| Advanced theory of groups, linear algebra, rings, modules, and fields, including Galois theory. Background: MATH 3121 and MATH 4121 (prior to 2014-15) | | |
| **MATH 5240** | Algebraic Topology | 3-0-0:3 |
| Fundamental group, covering space, Van Kampen theorem, (relative) homology, exact sequences of homology, Mayer-Vietoris sequence, excision theorem, Betti numbers and Euler characteristic. | | |
| **MATH 5251** | Algebraic Geometry I | 3-0-0:3 |
| Projective spaces, algebraic curves, divisors, line bundles, algebraic varieties, coherent sheaves, schemes. Some commumative algebra and homological algebra such as notherian ring, regular ring, valuation ring, kahler differentials. Background: MATH 5111 or equivalent postgraduate algebra | | |
| **MATH 5285** | Applied Analysis | 3-0-0:3 |
| [Previous Course Code: MATH 6050B] Contraction mapping theorem, Fourier series, Fourier transforms, Basics of Hilbert Space theory, Operator theory in Hilbert Spaces, Basics of Banach space theory, Convex analysis. Background: Undergraduate course of multivariable calculus, linear algebra, and real analysis | | |
| **MATH 5311** | Advanced Numerical Methods I | 3-0-0:3 |
| Numerical solution of differential equations, finite difference method, finite element methods, spectral methods and boundary integral methods.  Basic theory of convergence, stability and error estimates. | | |
| **MATH 5350** | Computational Fluid Dynamics for Inviscid Flows | 3-0-0:3 |
| Derivation of the Navier-Strokes equations; the Euler equations; Lagriangian vs. Eulerian methods of description; nonlinear hyperbolic conservation laws; characteristics and Riemann invariants; classification of discontinuity; weak solutions and entropy condition; Riemann problem; CFL condition; Godunov method; artificial dissipation; TVD methods; and random choice method. | | |
| **MATH 5351** | Mathematical Methods in Science and Engineering I | 3-0-0:3 |
| Modeling and analytical solution methods of nonlinear partial differential equations (PDEs). Topics include: derivation of conservation laws and constitutive equations, well-posedness, traveling wave solutions, method of characteristics, shocks and rarefaction solutions, weak solutions to hyperbolic equations, hyperbolic Systems, linear stability analysis, weakly nonlinear approximation, similarity methods, calculus of variations. | | |
| **MATH 5411** | Advanced Probability Theory I | 3-0-0:3 |

| | | |
|---|---|---|
| Probability spaces and random variables, distribution functions, expectations and moments, independence, convergence concepts, law of large numbers and random series. | | |
| **MATH 5431** | Advanced Mathematical Statistics I | 3-0-0:3 |
| Theory of statistical inference in estimation. Topics include: sufficiency, ancillary statistics, completeness, UMVU estimators, information inequality, efficiency, asymptotic maximum likelihood theory. Other topics may include Bayes estimation and conditional inference. | | |
| **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.<br>Exclusion(s): MFIT 5010, MSDM 5054 | | |
| **MATH 5472** | Computer Age Statistical Inference with Applications | 3-0-0:3 |
| [Previous Course Code: MATH 6450E] This course is designed for RPg students in applied mathematics, statistics, and engineering who are interested in learning from data. It covers advanced topics in statistical learning and inference, with emphasis on the integration of statistical models and algorithms for statistical inference. This course aims to first make connections among classical topics, and then move forward to modern topics, including statistical view of deep learning. Various applications will be discussed, such as computer vision, human genetics, and text mining. | | |

## MECH

| | | |
|---|---|---|
| **MECH 5010** | Foundation of Solid Mechanics | 3-0-0:3 |
| Continuum concept for deformation of solids; analysis of stress and strain; constitutive equations; solution of problems relevant to materials processing, fracture mechanics and structural analysis; energy methods and numerical solutions. Background: MECH 3020<br>Exclusion(s): MESF 5010 | | |
| **MECH 5940** | Continuum Mechanics for Crystalline Solids | 3-0-0:3 |
| [Previous Course Code: MECH 6910Q] This is an interdisciplinary course covering the fundamental laws of the mechanics and physics of crystalline solids, the general description of a periodic structure and their specific characterization methods. The course will start with tensor analysis, and basic calculations of tensor fields. After that, basic kinematics such as deformation gradient, Cauchy-Green tensor will be introduced and defined, followed by the mathematical description of symmetry of crystals. Finally, the course will discuss reciprocal lattices and the X-ray diffraction for structural solving. Background: Solid mechanics related courses. Basic symmetry knowledge. Linear algebra and multivariable calculus | | |

## MGMT

| | | |
|---|---|---|
| **MGMT 7130** | Doctoral Seminar in Organization Theory and Strategy | 3-0-0:3 |
| Presentations and discussions of current research topics in organization theory and strategic management for doctoral students. | | |

## PHYS

| | | |
|---|---|---|
| **PHYS 5110** | Mathematical Methods in Physics | 4-0-0:4 |
| Review of vector analysis; complex variable theory, Cauchy-Rieman conditions, complex Taylor and Laurent series, Cauchy integral formula and residue techniques, conformal mapping; Fourier series; Fourier and Laplace transforms; ordinary differential equations, Bessel functions; partial differential equations, wave and diffusion equations, Laplace, Helmholtz and Poisson's equations, transform techniques, Green's functions; integral equations, Fredholm equations, kernals; Rieman sheets, method of steepest descent; tensors, contravariant and covariant representations; group theory, matrix representations. | | |
| **PHYS 5210** | Electromagnetic Waves, Maxwell Equations, and Relativity | 4-0-0:4 |
| Wave solutions of the Maxwell equations, electromagnetic wave propagation, scattering, and diffraction; Fourier optics; dielectric constant of metals and dielectrics and its analytic properties; guided waves; radiation by accelerating charges; special relativity and the transformation of Maxwell equations; radiation by moving charges. | | |
| **PHYS 5260** | Advanced Quantum Mechanics | 4-0-0:4 |
| Discussion of various applications of quantum mechanics, such as collision theory, theory of spectra of atoms and molecules, theory of solids, second quantization, emission of radiation, relativistic quantum mechanics. | | |
| **PHYS 5530** | Introduction to General Relativity | 4-0-0:4 |
| [Previous Course Code: PHYS 6810E] This is an introductory course on general relativity (GR). The covered topics mainly include Einstein field equation and its application in black hole physics, gravitational waves astronomy and Friedman cosmology. Background: Undergraduate-level classical mechanics, electrodynamics and mathematics | | |
| **PHYS 5820** | Diffraction and Imaging Techniques in Materials Science | 3-1-0:3 |
| [Co-list with NANO 5250] Fundamental crystallography; crystalline structure and defects; X-ray and electron diffractions; imaging contrast mechanisms; structure determination; analytical electron microscopy. The instructor's approval is required for taking this course.<br>Exclusion(s): NANO 5250 | | |

## SOSC

| | | |
|---|---|---|
| **SOSC 5260** | 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. Background: Familiarity with introductory statistics through multivariate regression. | | |
| **SOSC 6030T** | The Political Economy of Development | 3-0-0:3 |
| This seminar course is devoted to understanding various dimensions of development, including economic growth, state building, and democratic accountability. Why are some countries rich while others remain | | |

| | | |
|---|---|---|
| poor? Why do some countries have well-functioning states while others do not? Why do some countries have strong laws and property rights protection that support economic development, while others do not? Why are some countries stable democracies, and others authoritarian? This course explores the key analytical concepts and theories that explain the development trajectories of countries, with an emphasis on the rigorous application of empirical methods. | | |
| **SOSC 6500** | Seminars in Cognitive Science | 3-0-0:3 |
| [Previous Course Code: SOSC 6030S] This course aims to introduce current issues in Cognitive Science to postgraduate students. Cognitive Science is the interdisciplinary, scientific study of the mind and mental phenomena, encompassing Artificial Intelligence, Psychology, Linguistics, Neuroscience, Philosophy, Anthropology, and Education. At each week's class, we will read and discuss research papers from major Cognitive Science journals including Trends in Cognitive Sciences and Topics in Cognitive Science, or other related interdisciplinary journals. This course is open to all postgraduate students who are interested in learning more about interdisciplinary studies on the mind and behavior, including both human and artificial intelligence. Background: Students are expected to have prior knowledge in at least one of the related fields within the scope of Cognitive Science, including psychology/social science, computer science/engineering, linguistics, philosophy, neuroscience, anthropology, and education. | | |

[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.