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

Last Update: 30 August 2023

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.

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 5140	Chemical Biology	3-0-0:3
This course is designed to expose students to current methodologies in the field of Chemical Biology. A key focus will be the chemical reactions and probes that have been used to build current techniques in the field. Areas that will be covered include bio-orthogonal chemistry, protein engineering, methods of protein- and cell-specific labelling, biological assay development, cell imaging techniques, and topics in current Chemical Biology research.		
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 Exclusion(s): ENVR 5410		

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 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. Exclusion(s): CIEM 5460, JEVE 5460 Prerequisite(s): CIVL 3420		
CIVL 5450	Hazardous Waste Treatment and Site Remediation	3-0-0:3
Regulatory aspects of the handling and disposal of hazardous wastes, and innovative technologies for hazardous wastes treatment and contaminated soils such as bioremediation, and soil washing will be included. Exclusion(s): CIEM 5410, JEVE 5410 Prerequisite(s): CIVL 2410		

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 Exclusion(s): CSIT 5910, MSBD 5012		
COMP 5222	Advanced Machine Learning with Graphs	3-0-0:3
[Co-list with MATH 5471] [Previous Course Code: COMP 6211B] This course will introduce a number of advanced learning methods and modeling principles for analyzing large-scale complex data structures and graph data. Topics covered include semi-supervised learning, spectral graph theory, deep graph modeling, knowledge graph modeling, etc., as well as open research problems in this area. Exclusion(s): MATH 5471		
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 Exclusion(s): CSIT 5210, MSBD 5002		
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. Exclusion(s): COMP 4622 (prior to 2018-19)		
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		

ECON

ECON 5620	Theory of Industrial Organization	4-0-0:4
[Previous Course Code: ECON 6120L] This course surveys recent advances in the theory of industrial organization, with the objective of preparing students to develop their own research ideas in related areas. Relevant tools of dynamic game theory, mechanism and information design are introduced. Topics such as competition and pricing, contract design and information disclosure will be covered. Prerequisite(s): ECON 5210		

ECON 6120W	Quantitative Macroeconomics	4-0-0:4
The course covers empirical and theoretical tools of applied macroeconomics. With an emphasis on implementation, computation, and applications, we will discuss the following topics: time-series methods, vector autoregressions with different identification schemes, state-space models and filtering, the solution to and estimation of dynamic stochastic general equilibrium models, numerical dynamic programming, and heterogeneous agent models, if time allows. By learning the advanced methods for quantitative macroeconomic research and their applications, students can understand macroeconomic research at the frontier better. It will also help students develop their research ideas and find proper methodological approaches to the questions.		

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. 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 Exclusion(s): EESM 5120		
ELEC 5070	Microelectronics Fabrication Technology	3-0-0:3
Process technologies in IC fabrication: epitaxial growth; chemical-vapor and physical-vapor deposition of films; thermal oxidation; diffusion; ion implantation; microlithography; wet/dry etching processes; process integration of MOS and bipolar technologies.		
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 Exclusion(s): ENEG 5200		
ELEC 5180	RF/Microwave Circuit Design and Measurement	3-0-3:4
Introduction to techniques for analyzing, engineering and testing of circuits for RF/microwave frequencies using CAD tools. The lab provides hands-on CAD/simulation, building and testing of low-noise amplifier, mixer, VCO, filter, IF AGC, detectors and other circuits discussed in lecture. Background: ELEC 3100, ELEC 3400, ELEC 3600 and ELEC 4420		
ELEC 5210	Advanced Topics in Nanoelectronics	3-0-0:3
Introduction to state-of-the-art development in the broad area of nanoelectronics, including concepts and devices for spin electronics and quantum information science. Students are expected to demonstrate the capability of applying fundamental principles to understand advanced electronic devices through hands-on homework projects. Background: ELEC 4510		
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 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) Exclusion(s): IEDA 5470		
ELEC 6910A	First Principles of Computer Vision	3-0-0:3
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 semantic vision, examining classification, recognition, segmentation, CNN, LSTM, and Transformers.		
ELEC 6910B	RF Microsystems: Devices and Applications	3-0-0:3
The goal of this course is to develop students' design, analysis, and evaluation skills at microwave/radio frequencies where lumped elements (e.g., resistors, capacitors, inductors) are no longer appropriate. 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 6910Z	Modern Solid State Devices	3-0-0:3
This course aims to provide students with the up-to-date research and development progress of solid state devices and technologies in the 21st century, with a focus on emerging materials and physical phenomena of modern electronics and optoelectronics. Emphasis will be placed on the interdisciplinary nature of present solid-state research, bridging the gap between fundamental physics, materials science, and practical device engineering.		

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 Exclusion(s): ELEC 5110

HUMA

HUMA 5270	Cantonese Linguistics	3-0-0:3
This course deals with various issues of Cantonese, including sounds and tones, word formation, syntax and pragmatics. It will review the history of the language by studying texts from the early 19th century to the present; and examine the current linguistic changes that have redefined Hong Kong speech as a special variety of Cantonese. **[Pu][C]**		
HUMA 5451	Images of Japan	3-0-0:3
This course examines non-Japanese texts that deploy the imagination of "Japan" in their narratives. Discussions will take up such focal points as: ethnographic cinema, the politics of travel and translation, the intersections of race and gender, the cultural politics of alternate histories, and the ramifications of techno-orientalist discourse.		
HUMA 5541	History and the Future	3-0-0:3
Can our knowledge of the past help us to predict the future? What kinds of lessons can we learn from history? What is the value of history for life, anyway? This course investigates both the philosophical and practical issues associated with studying the past in order to make judgments about the future. The course adopts an interdisciplinary perspective that draws from history, philosophy, political science, sociology, grand strategy, psychology, and physics. Readings include Thucydides, Han Fei, Hegel, Clausewitz, Weber, Arendt, and Nietzsche, as well as contemporary literature on chaos theory, comparative politics, historical sociology, and cliodynamics.		
HUMA 5685	Peasants and the Chinese Communist Party	3-0-0:3
[Previous Course Code: HUMA 6002P] This course examines the historical origins and evolution of the complex relations between Chinese peasants and the Chinese Communist Party in the 20th century. It explores some of the most important events, persistent issues, and recurring themes through the Communist revolution and post-revolution. It also introduces students to major competing interpretations by Chinese and western scholars. **[C]**		
HUMA 5695	Fascism	3-0-0:3
This course aims to provide students with an introduction to the comparative study of twentieth-century dictatorships. Course readings will focus on Italian Fascism and National Socialism, but the overarching theoretical perspectives will be relevant to students of non-European dictatorships as well. Exclusion(s): HUMA 602N		
HUMA 5697	Animals and Society: Biodiversity, Conservation, and Ethics	3-0-0:3
This course introduces students to human-animal issues such as preserving biodiversity, the wildlife trade, zoonotic diseases, animals as food and medicine, and living with animals in an urban setting. It will also provide a broad historical overview of the animal rights and conservation movements, drawing upon case studies from the US, China, and elsewhere. As this is a postgraduate-level course, students will critically engage with key concepts (biodiversity, animal ethics, etc.), and will also be encouraged to explore new ideas and methodologies for conducting research in human-animal relationships.		
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. Exclusion(s): MGCS 5031 (prior to 2018-19)		
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 6001Z	Selected Topics in Russian Literature and Literary Theory	3-0-0:3
This graduate course explores classics of Russian literature and Russian literary theory in their own right and as material meant to prompt comparative analysis with each student's area of academic interest. The course considers major Russian literary texts which exemplify key trends in Russian literary culture - the fantastic and the absurd in literary mythmaking (the "St. Petersburg myth"); Realism, revolutionary utopianism, and its discontents; the Soviet experience from revolutionary avant-garde modernism to Stalinist Socialist Realism; Russian Eurasianism and post-Soviet postmodernism. The course will also explore relevant works of Russian literary criticism by noted critics of the 19th century, Russian Formalists, Soviet Semioticians, Russian Eurasianists, and others.		

LIFS

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

MATH

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 5143	Introduction to Lie Algebras	3-0-0:3
Lie algebras. Nilpotent, solvable and semisimple Lie algebras. Universal enveloping algebras and PBW-theorem. Cartan subalgebras. Roots system, Weyl group, and Dynkin diagram. Classification of semisimple Lie algebras. Representations of semisimple algebras. Weyl character formula. Harish-Chandra isomorphism theorem. Prerequisite(s): MATH 2131 and MATH 3131		
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 commutative 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 5471	Advanced Machine Learning with Graphs	3-0-0:3
[Co-list with COMP 5222] [Previous Course Code: MATH 6450D] This course will introduce a number of advanced learning methods and modeling principles for analyzing large-scale complex data structures and graph data. Topics covered include semi-supervised learning, spectral graph theory, deep graph modeling, knowledge graph modeling, etc., as well as open research problems in this area. Exclusion(s): COMP 5222		
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.		
MATH 5520	Interest Rate Models	3-0-0:3
Theory of interest rates, yield curves, short rates, forward rates. Short rate models: Vasicek model and Cox-Ingersoll-Ross models. Term structure models: Hull-White fitting procedure. Heath-Jarrow-Morton		

pricing framework. LIBOR and swap market models, Brace-Gatarek-Musiela approach. Affine models. Exclusion(s): MAFS 5040		
MATH 6450K	Random Walks on Graphs and Applications	3-0-0:3
Random walks are among the most fundamental models for stochastic evolutions, with applications ranging from the description of physical motions in homogeneous or disordered media to the modeling of macromolecules or explorations of networks in data science. The principal objectives of this course are to introduce techniques to study random walks on general weighted (potentially random) graphs, and to investigate the profound connections between the behavior of random walks and the underlying graph topology using tools from potential theory, geometric group theory, and electrical networks. Later parts of this course cover selected advanced topics such as local limits of random walks, mixing/cutoff phenomena, or directed polymers. Some familiarity with measure-theoretic probability theory (as in MATH 5411) is helpful, but not strictly necessary to follow this course.		

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 Exclusion(s): MESF 5010		
MECH 5930	Finite Element Methods	3-0-0:3
[Co-list with CIVL 5390] Finite element formulation; variational principles for structural and continuum mechanics; numerical interpolation and integration; plane stress and plane strain analysis; plate bending and three dimensional solids; solution of large systems of algebraic equations. Background: MECH 3020 Exclusion(s): AESF 5930, CIVL 5390, MESF 5930		
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		
MECH 5961	Acoustics and Aeroacoustics	3-0-0:3
[Previous Course Code: MECH 6910L] The aims of this module are to acquaint students with the knowledge of acoustics and aerodynamically generated sound, its generation either through turbulent flow or unsteady aerodynamic force-surface interaction, and numerical methods for accurate numerical prediction of aerodynamically generated noise as well as its propagation and far-field characteristics. The wide applications of the subject are noise, environmental impact of noise and transport related noise. Exclusion(s): AESF 5390 (prior to 2021-22) Prerequisite(s): MECH 3640		
MECH 6910T	Data-Driven Modeling and Control of Dynamic Systems	3-0-0:3
Data-driven discovery is currently revolutionizing how we model, predict, and control complex nonlinear dynamic systems. This course aims to discuss many existing data-driven tools and their application in the modeling and control in mechanical engineering applications. Representative data-driven methods, including supervised/unsupervised learning, reinforcement learning, balanced truncation, proper		

orthogonal decomposition, principal component analysis, etc., will be introduced with particular case studies. The course aims to help the students to develop a data-driven perspective to analyze and control nonlinear and complex dynamic systems, in addition to conventional physics-based models and linear control theories. The students will have the opportunity to have individual course projects to practice the data-driven modeling and control methods introduced in the class. Background: MECH 3610

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. Exclusion(s): NANO 5250		

SOSC

SOSC 5090	Quantitative Methods for Social Science Research	3-0-0:3
An introduction to econometric and statistical approaches to social science research. Necessary to understand much of social science literature and topics in research methods. Focuses on applications to students' own research and includes computer exercises. Enrollment by students from outside the Division of Social Science by instructor permission. Background: Knowledge in Social Science Exclusion(s): MGCS 5010, MASS 5020		

SOSC 6030P	Political Culture	3-0-0:3
This is a graduate-level seminar that offers an overview of theoretical and empirical approaches to the study of political culture. The study of culture is highly interdisciplinary, and this course surveys insights from fields such as political science, economics, public policy, psychology, evolutionary biology and anthropology. We will define the term culture using the tools of social science and discuss questions including where culture comes from, how culture is transmitted, and how culture changes. We then examine the possible implications of culture in areas such as economic growth, public goods provision, ethnicity, and social movement. Throughout the course, will read analyses drawn from many parts of the world, particularly Asia, Africa, North America, and Europe.		

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