Carnegie Mellon University Sustainability Course Inventory 1-12-2019

Department	College	Course #	Course Title	Grad/UG	Description
Sustainability Focused					**83**
					Architecture 15
Architecture	CFA	48116	BUILDING PHYSICS	UG	This course is composed of two parts related to fundamental building physics concepts, namely, the lighting performance of buildings (first part)and the thermal performance of buildings (second part). In the first part, the course will introduce fundamental lighting principles in the context of performance-based architectural design and diagnostics. The course will cover relevant aspects of lighting environment that affect the physiological and psychological experience of buildings, performance metrics, design and benchmarking methods, and contemporary simulation tools. Topics include a review of physiological and psychological response to the visual environment, analytical and numeric methods for the prediction of lighting conditions in interior spaces, lighting engineering and design methods, and application of computer-aided lighting simulation tools in architectural design. In the second part, the course will introduce fundamental thermal principles in the context of performance-based architectural design and diagnostics. The course will cover relevant aspects of thermal environment that affect the physiological and psychological experience of buildings, performance metrics, design and benchmarking methods, and contemporary simulation tools. Topics include a review of basic theory of heat transfer, thermal dynamics, thermal comfort, analytical and numeric methods for the prediction of building thermal load and energy consumption, and application of computer-aided thermal simulation tools for building thermal design. Demonstration of a set of environmental measurement and sensing devices will also be included in the thermal part of this lecture. DIVA-for-Rhino and ArchSim-for-Grasshopper/Rhino software platforms will be used for lighting and thermal performance simulations

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48315	ENVIR I: CLIM & ENG	UG	This course introduces architectural design responses for energy conservation, human comfort, and the site-specific dynamics of climate. Students will be expected to combine an understanding of the basic laws of comfort and heat flow with the variables of local climate to create energy design guidelines for their own work. The state of the art in building energy conservation and passive heating and cooling technologies will be presented, with take-home readings and assignments. To stress the significance of architectural design decision-making on energy consumption and comfort, full design specifications and calculations will be completed for a residential-scale building. Students will compile a professional energy consultant's report, designing the most viable energy conservation retrofit measures for their client from siting, massing, organization, enclosure detailing, opening control, to passive system integration and management. An overview of world energy consumption in buildings and energy design standards will be challenged by lectures on building energy conservation successes, and emerging demands for a broader definition of sustainability. The course will end with a focus on the design integration of natural conditioning systems and the potentially dynamic interface of mechanical systems in small- and large-scale buildings.
Architecture	CFA	48432	ENV II: INTEG ACTV SYST	UG	High performing buildings can only be achieved with designs that effectively integrate passive and active systems. Having been introduced to passive systems in prior semesters, students will now be introduced to the range of active systems typically included in commercial buildings and strategies for their successful integration with passive components. The goal of the Design Integration of Active Building Systems course is to familiarize students with active building systems and integrative design strategies that should result in high levels of occupant comfort in commercial buildings that approach net zero energy and net zero carbon emissions Active systems introduced in this class include: electrical lighting; mechanical ventilation; active heating and cooling; water systems for interior and exterior use and water heating, including solar; onsite electricity generation with renewable energy; building transportation systems; and active fire protection & smoke control. Because of the breadth of this subject area, the course will be future-focused, concentrating on design approaches and technologies that appear to be well-suited to a net zero energy and net zero carbon future. Prerequisites: successful completion of 48-116, 48-215 and 48-315 or their equivalent is expected. No prior knowledge of active commercial systems and systems integration is assumed, but students are expected to understand heating and cooling load calculations, to be able to identify factors in building design that affect those loads, and to quantify their impact. A basic understanding of daylighting and electric lighting principles as covered in 48-116 and 48-315 is also assumed.

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48493	REP ACT UDBS	UG	Efforts to promote social, political, economic and environmental change can range in form from written word to direct action. Sources of injustice are multi-dimensional and complex. Effective forms of activism are fueled by creativity that synthesize and distill complex constellations of information and foster understanding. REPRESENTING ACTIVISM explores the role of multi-media graphic representation as a lens through which to effect change and social justice. Modes of representation explored will span four dimensions, 1) Social Media, 2) Film, 3) Graphic Design, and 4) Technical Delineation.
Architecture	CFA	48635	ENVIRO I M. ARCH	GR	This course introduces architectural design responses for energy conservation, human comfort, and the site-specific dynamics of climate. Students will be expected to combine an understanding of the basic laws of comfort and heat flow with the variables of local climate to create energy design guidelines for their own work. The state of the art in building energy conservation and passive heating and cooling technologies will be presented, with take-home readings and assignments. To stress the significance of architectural design decision-making on energy consumption and comfort, full design specifications and calculations will be completed for a residential-scale building. Students will compile a professional energy consultant's report, designing the most viable energy conservation retrofit measures for their client from siting, massing, organization, enclosure detailing, opening control, to passive system integration and management. An overview of world energy consumption in buildings and energy design standards will be challenged by lectures on building energy conservation successes, and emerging demands for a broader definition of sustainability. The course will end with a focus on the design integration of natural conditioning systems and the potentially dynamic interface of mechanical systems in small- and large-scale buildings.

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48655	ENVIRO II M. ARCH	GR	High performing buildings can only be achieved with designs that effectively integrate passive and active systems. Having been introduced to passive systems in prior semesters, students will now be introduced to the range of active systems typically included in commercial buildings and strategies for their successful integration with passive components. The goal of the Design Integration of Active Building Systems course is to familiarize students with active building systems and integrative design strategies that should result in high levels of occupant comfort in commercial buildings that approach net zero energy and net zero carbon emissions Active systems introduced in this class include: electrical lighting; mechanical ventilation; active heating and cooling; water systems for interior and exterior use and water heating, including solar; onsite electricity generation with renewable energy; building transportation systems; and active fire protection & smoke control. Because of the breadth of this subject area, the course will be future-focused, concentrating on design approaches and technologies that appear to be well-suited to a net zero energy and net zero carbon future. Prerequisites: successful completion of 48-116, 48-215 and 48-315 or their equivalent is expected. No prior knowledge of active commercial systems and systems integration is assumed, but students are expected to understand heating and cooling load calculations, to be able to identify factors in building design that affect those loads, and to quantify their impact.
Architecture	CFA	48712	MUD GRADUATE SEMINAR	GR	The seminar explores key issues of 21st Century global urbanization including regional planning, smart growth, smart transportation, smart cities, new cities, post-industrial cities, resilient cities, urban systems, and big data, and will include: lectures; visiting speakers; class discussion; reading assignments; one paper; one presentation to the class; and weekly blogs. This is a 3-unit course that requires attendance at one 1.5 hour class per week and an average of 1.5 hours of work outside of class per week. The core of the seminar is the time spent together in the seminar classroom. Enrollment is restricted to MUD students.
Architecture	CFA	48722	BLDNG PERFMNC MODLNG	GR	This course introduces fundamentals and computational methods in building performance modeling. Topics include: modeling and design, overview of thermal, visual, and acoustical domain knowledge, integration of performance simulation in computer-aided design, introduction to the application of advanced computational building simulation tools, case studies and design assignments on the application of simulation in the evaluation and improvement of building performance.

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48723	PERF ADV BLDNG SYSTM	GR	Advanced Building Systems Integration This is a graduate level course that focuses on commercial building performance achieved through systems integration. In lectures, class discussion, and student projects, we will explore the topic of building performance, the design and technical strategies that support sustainable high performance; the design, construction and operation processes that are likely to produce sustainable high(er) performance buildings; and the current state of theory versus practice. The course assumes a basic understanding of buildings' impact on the environment, of building design and materials performance, and the calculation of building heating and cooling loads. On that foundation, we will examine the concept of systems integration and how this approach can sustain the occupants and the environment far better than conventional design, construction and operation. Although US climate, building conventions and codes will be our reference point, we will broaden our discussion by using examples and data from many other countries. An essential aspect of our exploration will be identifying successful built projects and examining the factors that may have allowed those projects to succeed. If this course meets its objectives, students who successfully complete the material will understand and be able to discuss sustainable building performance characteristics, will understand the systems integration approach and how it differs from conventional approaches to building design, and will know how to positively affect architectural and engineering decisions to support the design, construction and operation of sustainable high performance buildings.
		48723	PERF ADV BLDNG SYSTM	GR	Advanced Building Systems Integration This is a graduate level course that focuses on commercial building performance achieved through systems integration. In lectures, class discussion, and student projects, we will explore the topic of building performance, the design and technical strategies that support sustainable high performance; the design, construction and operation processes that are likely to produce sustainable high(er) performance buildings; and the current state of theory versus practice. The course assumes a basic understanding of buildings' impact on the environment, of building design and materials performance, and the calculation of building heating and cooling loads. On that foundation, we will examine the concept of systems integration and how this approach can sustain the occupants and the environment far better than conventional design, construction and operation. Although US climate, building conventions and codes will be our reference point, we will broaden our discussion by using examples and data from many other countries. An essential aspect of our exploration will be identifying successful built projects and examining the factors that may have allowed those projects to succeed. If this course meets its objectives, students who successfully complete the material will understand and be able to discuss sustainable building performance characteristics, will understand the systems integration approach and how it differs from conventional approaches to building design, and will know how to positively affect architectural and engineering decisions to support the design, construction and operation of sustainable high performance buildings.

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48729	PROD HLTH QUAL BLDGS	GR	Given the growing demand for green buildings by federal and private sector clients, professional practices are ?tooling up? all over the world to deliver high performance, environmentally responsive, ?green? buildings and communities. However, investments in green, high performance building solutions and technologies are still limited by first cost decision-making, and life cycle tools are still largely inaccessible to professionals. A building investment decision support tool ? BIDS? - continues to be developed by the Center for Building Performance and Diagnostics at Carnegie Mellon University, with the support of the Advanced Building Systems Integration Consortium. This cost-benefit decision support tool presents the substantial cost-benefits of a range of advanced and innovative building systems designed to deliver ? privacy and interaction, air quality, ergonomics, lighting control, thermal control, network flexibility, and access to the natural environment - from field case studies, laboratory studies, simulation studies, and other research efforts. This course will explore the relationship of quality buildings, building systems, and land-use to productivity, health, well-being and the environment. The course will engage students in the literature that relates building design decisions to ten cost/performance impacts: energy, facilities management, organizational change, technological change, attraction/retention (quality of life) of employees, individual productivity, organizational productivity, salvage/ waste, tax/ insurance/ litigation, and health.
Architecture	CFA	48738	SP TPCS: ECOLG FTPRN	GR	The Ecological Footprint is a measure of the demand that human activity puts on the biosphere. More precisely, it measures the amount of biologically productive land and water area required to produce all the resources an individual, population, or activity consumes, and to absorb the waste they generate, given prevailing technology and resource management practices (Global Footprint Network 2010). This course will engage students in the metrics and impacts of our collective consumption and waste of: -Energy -Materials (Cradle to Cradle) -Food -Water -Transportation -The Integration of Systems towards Quality of Life Starting at the global context, this course will address challenges/opportunities to advance regenerative practices, improving our relationship to nature. Learning from international best practices, we will continue to explore ecological footprints at the global, national, regional, city, neighborhood, building and individual scale. The course will be based on lectures and readings, with assignments and student presentations to fully explore each of the footprint characteristics. Experts on water, energy, materials, food and other resources have been invited to lecture. By mid semester, an application project will be selected for ecological footprint analysis and the development of design, engineering, and operational guidelines towards reducing that footprint. The potential application projects include: the CMU campus footprint and Donner House retrofit; the Energy Innovation Center and education of the trades in reducing our regions footprint; or a new Net Zero building for Carnegie Mellon University. This will be a collaborative effort.

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48752	ZERO ENERGY HOUSING	GR	Net zero energy construction has gone from concept to policy in just a few years, but built examples are still rare. What does it take, technically, to achieve net zero and what else, beyond technical requirements, advances or impedes a net zero future? 48-752 is a graduate level class that explores net zero energy design and construction in the residential sector. Through case studies and applied projects, we will explore what it takes to achieve quantitative net zero in residential buildings while maintaining occupant comfort and satisfaction. In locations where net zero is now required, we will examine the results of those requirements. At the outset, we will discuss specific definitions of a net-zero building and the implications of each definition. Through case studies, lectures, field trips, outside reading and assignments, we will examine how a net-zero building is achieved, including the use of renewable energy to achieve the net-zero balance. We will apply lessons learned from metered examples to real sites and to new design or renovation projects in Pittsburgh and will use simulation software to test and quantify the impact of our design/renovation strategies. We will also compare our strategies to requirements in US codes and rating systems such as IECC-2012 and LEED for Homes to evaluate their impact in moving the US residential sector toward much higher performance buildings. Although our focus is residential, many of the concepts and strategies we cover have parallels in the commercial sector. Students who enroll in the class must know how to calculate without software heat loss and heat gain for a small building. You are also expected to have a fundamental understanding of residential design and construction, plan reading and mechanical systems; US residential materials and construction methods for net zero will be covered in class.
Architecture	CFA	48753	INTRO UD MED	GR	This course introduces urban design history, theory and methods of analysis and representation. Urban design is examined at multiple scales: city form and networks, neighborhood and block structures, streets, public spaces, and urban building typologies. A wide variety of cities, projects, proposals and methodologies are examined with a special focus on urban sustainability in the contemporary city. Assignments include readings from seminal texts, presentations and discussions, graphic assignments and a final project. A required course for Master of Urban Design students, it is also open to fourth and fifth-year architecture undergraduates as well as graduate students in related programs.

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48795	LEED BLDGS GREEN DES	GR	LEED, Green Design and Building Rating in Global Context is a graduate level mini-course that examines holistic, integrated strategies for sustainable building design, construction and operation. The course is organized within the framework of the US Green Building Council?s Leadership in Energy and Environmental Design (LEED) Rating System: location, site, water, energy, materials, and the interior environment. Within that framework, we explore strategies promoted within LEED and compare/contrast them with strategies in the rating systems of other countries. We also consider additional ways to encourage development of better buildings, e.g., codes and standards, incentives, and project delivery methods. The course focuses on the concepts underlying rating system credits, the national contexts that can produce different rating systems, and substantive improvement in building performance. This course provides the foundation for taking USGBC's LEED Green Associate exam. More importantly, students who successfully complete the course will understand buildings' powerful impact on the environment and equally powerful strategies to address those impacts. There are no prerequisites for this course. However, because the course moves quickly and we are discussing improvements to building practice, a basic knowledge of the vocabulary, design, construction and operation of buildings is assumed.
					Art 1
Art	CFA	60203	CONCEPT: ECOART	UG	An interdisciplinary studio course that provides an introduction to an art practice focused primarily on ecology and the environment. Combines the exploration of the history of environmentalism and ecological art with the production of creative projects to address related issues such as sustainability. Shorter initial exercises and collaborative projects will precede and evolve into larger and more extended individual and/or collaborative projects. Considers both indoor and outdoor sites with an emphasis on context and the use of natural and recycled materials. Open to freshman and sophomores in the School of Art and to students in other disciplines.
					Chemical Engineering 1

Department	College	Course #	Course Title	Grad/UG	Description
Chemical Engineering	CIT	6365	WATER TECH INNOV PLCY	UG	Innovation in water technologies is necessary to confront profound water resource challenges facing countries around the world. Students successfully completing this course will be able to discuss the factors and conditions that drive innovation in the water sector. Students will begin by describing and classifying the historical drivers for innovation in water treatment, including technical, economic, and regulatory drivers. After an introduction to the fundamental principles of water treatment technologies, students will identify present day technology shortcomings and distill these into discrete design objectives. Students will then formulate and answer quantitative and qualitative questions that respond to these design objectives by leveraging their knowledge of engineering fundamentals, regulatory tools, and pricing policies. Comparing their own solutions with those proposed in the peer-reviewed academic literature in engineering and the social sciences, students will evaluate the technical feasibility, usability, and social desirability of proposed water innovations in developed and developing countries and summarize their findings in policy briefs
					Chemistry 4
Chemistry	MCS	9225	CLIMATE CHANGE	UG	Understanding the essential features of climate and climate change is a critical tool for modern citizens and modern scientists. In addition, the prevalence of climate skepticism in modern political discourse requires of citizens that they be able to think critically about a technical subject and also be able to distinguish reliable scientific experts from advocates. In this course we shall examine the climate of terrestrial planets (specifically Earth and Venus) through geological time and to the present, considering geochemical methods used to determine atmospheric composition over Earths history (specifically the onset of oxygen in the atmosphere as well as the relationship between carbon dioxide and global temperature over geological timescales. The shorter climate history of Venus will be considered as a counter example, where the brightening dim young sun overwhelmed negative feedbacks in the weathering cycle, leading to a runaway greenhouse amplified by complete evaporation of the onetime Venus ocean. Throughout the course, we will consider climate change driven by human activity since the industrial revolution as a unifying theme.

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Chemistry	MCS	9510	CMSTY & SUSTAIN	UG	This course aims to educate students in the foundations of systematic leadership for building a sustainable world. Many sustainability challenges are associated with commercial chemicals and with operational modes of the chemical enterprise. For scientists, effectiveness in solving the technical challenges and redirecting cultural behavior is the defining substance of sustainability leadership. The course aims to challenge students to analyze and understand the root causes of unsustainability, especially in the technological dimension, to imagine a more sustainable world and to begin to define personal leadership missions. Students will be introduced to sustainability ethics as the foundation stone of transformative sustainability leadership, to the Collins ?Sustainability Compass? and ?Code of Sustainability Ethics? and to the Robért/Broman ?Framework for Strategic Sustainable Development (FSSD)?as powerful guiding tools. The Collins ?Bookcase of Green Science Challenges? organizes the technical content. It systematizes the major chemical sustainability challenges of our time: clean synthesis, renewable feed-stocks, safe energy, elemental pollutants, persistent molecular toxicants and endocrine disruptors. Focal areas will be the technical, toxicological and cultural histories of elemental and molecular pollutants and endocrine disruptor (ED) science?EDs represent the single greatest sustainability challenge of everyday chemicals. The graded substance will take the form of take-home work. Students will primarily read key books and articles and will summarize and personally evaluate the material in essay assignments. The course is intended for upper level undergraduates and graduates. There are no other prerequisites. The class is limited to 25 students. The 09-510 assignments are common to both undergraduate and graduate classes offerings. (Graduate course 12 units 09-710) 3 hrs. lec.
Chemistry	MCS	9524	ENVIRON CMSTY	UG	Environmental pollutants are common consequences of human activities. These chemicals have a wide range of deleterious effects on the environment and people. This course will introduce students to a range of major environmental pollutants, with a particular focus on persistent organic pollutants. We will use chemical principles including thermodynamics, kinetics, photochemistry, organic reaction mechanisms, and structure-activity relationships to understand the environmental fate of major classes of pollutants. The transport of chemicals through the environment and their partitioning between air, water, soil, and people will be described. The major environmental reaction pathways (oxidation, photolysis, hydrolysis, reduction, metabolism) of common pollutants will be explored. This will provide students with the necessary knowledge to predict the chemical fate of environmental pollutants, and improve their understanding of the environmental impacts of their everyday chemical use and exposure. Specific topics include water quality, photochemical smog, organic aerosols, atmospheric chemistry and global climate change, toxicity of pesticides, and heterogeneous and multiphase atmospheric chemistry. The 12-unit course is intended for graduate students that want to explore aspects of the course more deeply. This includes additional requirements including a final term paper and in-class presentation, and additional advanced questions on the homework assignments.

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Chemistry	MCS	9529	SUSTAIN ENERGY SCI	UG	This course focuses on the chemistry aspects of sustainable energy science. It introduces the major types of inorganic and molecular materials for various important processes of energy conversion and storage, such as photovoltaics, fuel cells, water splitting, solar fuels, batteries, and CO2 reduction. All the energy processes heavily rely on innovations in materials. This course is intended to offer perspectives on the materials/physical chemistry that are of importance in energy processes, in particular, how the atomic and electronic structures of materials impact the energy harvesting and conversion. In current energy research, intense efforts are focused on developing new strategies for achieving sustainable energy through renewable resources as opposed to the traditional oil/coal/gas compositions. This course offers students an introduction to the current energy research frontiers with a focus on solar energy conversion/storage, electrocatalysis and artificial photosynthesis. The major types of materials to be covered include metals, semiconductors, two-dimensional materials, and hybrid perovskites, etc. The material functions in catalysis, solar cells, fuel cells, batteries, supercapacitors, hydrogen production and storage are also discussed in the course. The lectures are power-point presentation style with sufficient graphical materials to aid students to better understand the course materials. Demo experiments are designed to facilitate student learning.
					CIT Interdisciplinary 1
CIT Interdisciplinary	CIT	39109	GRANDCHALCLIMATECHNG	UG	Climate change is considered by many the most serious social, political, and environmental issue of the 21st century. As human activities increase the level of greenhouse gases in the atmosphere, scientists have established the reality of climate change and have estimated its impacts on human society and the natural world. Despite the scientific consensus on its existence, causes, and consequences, a substantial number of Americans and citizens of other countries still question these conclusions and a small but vocal group of doubters continue to challenge the science and scientific consensus on climate change. In spite of some social division over these issues, governments at local, national, and international levels have made concerted efforts to craft policies to address climate change. These policies have shifted over time as the information, attitudes, and technology associated with climate change have evolved. In this course, we will explore the challenges and complexities of climate change by investigating the subject from a variety of angles: scientific, political, rhetorical, cultural, economic, technological, and ethical. Over the course of the semester, well inquire: What is climate change? How do scientists know it is happening? Why is there public debate over it? What solutions are available? And what are the pros and cons of the different solutions?
					Civil & Environmental Engineering 10

Department	College	Course #	Course Title	Grad/UG	Description
Civil & Environmental Engineering	CIT	12351	ENVRMNTL ENGINEERING	UG	Provides a scientific and engineering basis for understanding environmental issues and problems. Introduces material and energy balances for tracking substances in the atmosphere, source and ground waters, and soil systems. Pertinent environmental laws are described, simple quantitative engineering models are developed, and qualitative descriptions of environmental engineering control technologies are presented.
Civil & Environmental Engineering	CIT	12352	ENVMNTL ENGRNG LAB	UG	(Required for CEE students, not for others) Laboratory and field experiments that illustrate the basic principles of environmental engineering.
Civil & Environmental Engineering	CIT	12645	SMART CITIES	GR	Cities all around the world are being built and re-invented as smart cities utilizing information systems and innovative applications of data analytics. One major smart cities component is transportation. The Intelligent Transportation Systems (ITS) industry is expected to grow at a rate of 19% per year and reach $5.5 Billion in annual investment by 2020. This shifting dynamic provides great opportunity for improved transportation safety and efficiency but also poses challenging information systems and public policy challenges. Furthermore, there are new opportunities for professional-school graduates outside of engineering schools for employment in transportation planning and policy. This course is supported by CMU's Traffic21 Initiative and Technologies for Safe and Efficient Transportation (T-SET) University Transportation Center. Classes will feature guest lectures provided by T-SET faculty and industry and government ITS professionals.
Civil & Environmental Engineering	CIT	12712	INTRO SUSTNBL ENGRG	GR	This course begins with an overview of the concept of sustainability, including changing attitudes and values toward technology and the environment through the twentieth century. Models for population growth, global food production, and global water resources are then presented, and current problems such as land use, urbanization, and energy and material resources are discussed. Models of industry based on life sciences are then explored, and tools for sustainable engineering are presented. These tools include metrics of sustainability, principles of design for the environment, methods for pollution prevention, and use of mass and energy balances in the design of sustainable systems. Prerequisite: senior/graduate standing in engineering or permission of the instructor.

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Civil & Environmental Engineering	CIT	12714	ENV LFE CYC ASSMNT	GR	Cradle-to-grave analysis of new products, processes and policies is important to avoid undue environmental harm and achieve extended product responsibility. This course provides an overview of approaches and methods for life cycle assessment and for green design of typical products and processes using the ISO 14040 family of standards. This includes goal and scoping definition, inventory analysis, life cycle impact assessment (LCIA), interpretation, and guidance for decision support. Process-based analysis models, input-output and hybrid approaches are presented for life cycle assessment. Example software such as MATLAB, Excel, and Simapro are introduced and used in assignments. A group life cycle assessment project consistent with the principles and tools of sustainability to solve real-world engineering problems is required.
Civil & Environmental Engineering	CIT	12726	MATH MDL ENV QUA SY	GR	Development and application of mathematical models for environmental systems. Material balance formulations and their solutions, computer implementation, model validation, uncertainty analysis, and use for projection and policy analysis. Applications to surface water, groundwater, atmospheric transport, indoor air pollution, and human exposure and risk. Prerequisite: 12-704 or equivalent.
Civil & Environmental Engineering	CIT	12747	SUSTNBL BLDG	GR	This course will cover the basics of the design, retrofit and monitoring of buildings to achieve energy efficiency. We will introduce energy simulation tools, the fundamentals of the most important building systems (i.e., heating, cooling, ventilation, insulation, etc.) and the technologies that can be used to monitor their performance. Graduate Standing, or approval of instructor
Civil & Environmental Engineering	CIT	12748	MCH EL SY DES	GR	Class will cover HVAC, Electrical, and Plumbing systems for buildings. We will calculate heat loss and heat gains manually and with computer programs and calculate operating costs with various fuels and system types. We will size building electrical systems and look at alternative generation, smart metering and new lighting systems. Plumbing will include sizing water, drain and vent lines along with system design. Focus of the class will be on energy conservation and use, and how future systems will meet this criteria. The final project will be the audit of a building on campus using what we learned. Graduate Standing, or approval of instructor.

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Civil & Environmental Engineering	CIT	12749	CLIM CHGE ADAPT	GR	While the specific timing and magnitude of climate change impacts are uncertain, long-lived civil engineering infrastructure will need to be resilient to these potential impacts. Engineers designing for climate change adaptation require the tools to maximize resiliency and minimize cost for existing and proposed energy, transportation, water, urban and other types of infrastructure. Students successfully completing this course will understand how climate change affects civil infrastructure and how to quantitatively incorporate resilient designs and co-benefits under uncertainty. Students will use open data to examine current adaptation engineering challenges, quantify solutions, and communicate their technical recommendations through policy briefs. Prerequisites: Graduate standing or consent of instructor.
Civil & Environmental Engineering	CIT	12765	ST: INT CLMT ADAPT INFRA	GR	Although an international problem, climate change will affect each country's critical infrastructure in diverse ways. This course will focus on understanding how international communities are adapting and innovating to reduce critical infrastructure risk. Students will be able to list and describe natural hazards affected by climate change, focusing on their impacts on natural and built critical infrastructure systems in physically, socially, and economically diverse countries. Students will then use cost-benefit analysis, the triple bottom line approach (physical, social, economic), and robust decision making to analyze, compare, and contrast different countries' responses. The class will culminate in a final paper and presentation on one country's approach to decision-making under uncertainty for adaptation. Learning Objectives: By the end of the semester, you should be able to: · Understand risk. o Define risk, hazard, vulnerability, exposure, adaptation, hazard mitigation, greenhouse gas mitigation. Explain the link between some natural hazards and climate change o List 10 natural hazards and their impacts on the international community. · Analyze outcomes/impacts. o Predict how physically, socially, and economically detrimental a given natural hazard will actually be in different critical infrastructure systems. o Compare and contrast different adaptations to reduce risk. · Create recommendations for improving adaptation in an international

Design 6

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Design	CFA	51366	DESIGN W COMMUNITY	UG	This course will utilize social innovation principles and practices while striving to bring sustainable solutions to a grassroots community space through a series of integrated strategies. The initiative strives to build new types of services and social enterprises by addressing the unmet basic needs of residents. We aim to do that by focusing on the intersection of food, community health, and education. Students will examine Social Design case studies, with a focus on Problem Reframing processes (Dorst), and Solution Amplification (Manzini), and various design-enabled Theories of Change. For the project students will move the vision for Latham St. Commons forward through social experimentation and listening to the needs of an array of people within the neighborhoods of Garfield and Friendship. This type of active participation with the community will help students see the challenges of the community from an insiders point of view, in order for them to design appropriate responses to some of those challenges
Design	CFA	51373	DESIGN FOR GOOD	UG	This seminar-in-action will investigate and explore the responsibility of the designer as an agent for social change and development. We will critically examine theoretical readings, case studies, institutions and initiatives from a diversity of interdisciplinary perspectives encompassing economic, socio-cultural, political, ethical, technical and aesthetic factors. These broad survey investigations will then inform the rapid creation of design interventions, artifacts and provocations in response to our collective discoveries. Structured as one seminar and one action lab per week, students will throughout, closely document their thinking and designing in action, as a meta-lens on their own emergent role as a designer, researcher and change-maker.
Design	CFA	51387	INTRO DEXIGN FUTURES	UG	As corporations, governmental organizations, and civil associations face accelerating change in uncertain times, increasingly they are looking to designers for new ways of thinking and acting. Designers today are engaged as thought leaders, strategists, activists, and agents of change in complex socio-technical problems throughout private, public, civil and philanthropic sectors worldwide. For designers trained to shape futures defined by uncertainty and change, these exponential times represent unprecedented creative opportunities for innovation. In this course, students learn the basic design skills necessary explore the forces that drive change in the future and learn to align innovation strategically with the trajectories of those forces.

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Design	CFA	51390	SOCIAL INT DESGN COMM	UG	The course looks at Design for Social Innovation principles and practices, Documentary Photography, and Design Research while walking the streets, talking to residents, and working with organizations in a Pittsburgh neighborhood to understand its challenges. Students will examine Social Design case studies, with a focus on Problem Reframing processes (Dorst), and Solution Amplification (Manzini), and various design-enabled Theories of Change. They will also explore histories and theories of Documentary Photography. For the project/ethnographic portion of the class, students will work in teams of two within a neighborhood, and partner with residents and organizations. These collaborations will help students see the challenges of the community from an insiders point of view, in order for them to design appropriate responses to some of those
Design	CFA	51396	DESGN ETHOS & ACTION	UG	Increasingly, designers have the potential to operate as agents of change in a broad range of areas including corporate, government, non-profit, social innovation start-ups, and sustainability projects. With so much choice on the horizon, some designers may wonder, What value do I bring to the world through design? Values often are implicit and may vary across contexts (e.g., profit, efficiency, effectiveness, fairness, social impact, environmental impact). This course focuses on exploring and identifying the potential for positive and negative impact that design can have in the world around us. For example, how might a designer embed values related to sustainability, gender equality, or race relations into his or her design projects and design practice?
Design	CFA	51455	DEXIGN FUT HUMAN INNOV	UG	DEXIGN THE FUTURE: Human Centered Innovation for Exponential Times As corporations, governmental organizations, and civil associations face accelerating change in uncertain times, increasingly they are looking to designers for new ways of thinking and acting. Designers today are engaged as thought leaders, strategists, activists, and agents of change in complex socio-technical problems throughout private, public, civil and philanthropic sectors worldwide. For designers trained to shape futures defined by uncertainty and change, these exponential times represent unprecedented creative opportunities for innovation. In this course, students explore methods and tools for design in exponential times to shape uncertain futures. Students will explore the forces that drive change in the future (i.e., social, economic, political, environmental, technological), and learn to align innovation strategically with the trajectories of those forces. The design project that drives everything else is the future of mega-metropolitan regions, the hubs of innovation where 70% of people in the world and 75% of Americans will live in 2050. In the semester long project, students create scenarios for Life 2050 in Metro 3.0, using Pittsburgh as a locus and focusing on a project within urban systems such as Sustainable Production & Consumption, Lifelong Learning, Human Development and Resilient Community.

Department	College	Course #	Course Title	Grad/UG	Description
Dietrich College Information Systems	DC	67353	IT ENVRNMNTL SUSTAIN	UG	Sustainable living and sustainable development are serious challenges facing individuals, communities, organizations and countries around the world. Addressing these challenges is a multidisciplinary effort. In particular, while Information and Communications Technologies have been among the most transformative developments in recent decades, they have the potential to address some of society's most urgent needs. For examples, intelligent use of IS/IT can help enable smarter cities, more efficient transportation systems, smarter energy systems, more efficient logistics and 'greener' product life cycle design. In this course, students will reflect on the challenges of sustainability and the potential role IS/IT may play in enabling adaptation and mitigation of these challenges.
					Dietrich College Interdisciplinary 3
Dietrich College Interdisciplinary	DC	66102	DC FRESHMAN SEMINAR	UG	This seminar will focus on major issues in the evolution of the American environment. Much of America's past environmental history has been beset with controversy, as scientists and engineers, health officials, politicians and the public debated about the cause and solution for various environmental problems. This seminar will examine some of the major environmental issues that have evolved over time through a combination of reading, discussion, and short papers. Where ever possible, comparisons will be made with conditions in other parts of the world.
Dietrich College Interdisciplinary	DC	66109	DC FRESHMAN SEMINAR	UG	Many consider climate change to be the most serious social, political, and environmental issue of the 21st century. As human activities increase the level of greenhouse gases in the atmosphere, scientists have established the reality of climate change and have estimated its impacts on human society and the natural world. Despite the scientific consensus on its existence, causes, and consequences, a substantial number of Americans and citizens of other countries still question these conclusions and a small but vocal group of doubters continue to challenge the science and scientific consensus on climate change. In spite of some social division over these issues, governments at local, national, and international levels have made concerted efforts to craft policies to address climate change. These policies have shifted over time as the information, attitudes, and technology associated with climate change have evolved. In this course, we will explore the challenges and complexities of climate change by investigating the subject from a variety of angles: scientific, political, rhetorical, cultural, economic, technological, and ethical. Over the course of the semester, we will inquire: What is climate change? How do scientists know it is happening? Why is there public debate over it? What solutions are available? And what are the pros and cons of the different solutions?

Department	College	Course #	Course Title	Grad/UG	Description
Dietrich College Interdisciplinary	DC	66119	DC FRESHMAN SEMINAR	UG	Food in the twenty-first century is ripe with paradox: fewer people than ever work as farmers or ranchers, but the quantity and global variety of foods available to consumers continues to expand; public health officials around the world are raising alarms about diseases linked to the over-consumption of fats and sugars, even as hundreds of millions of people do not know where their next meal is coming from; organic agriculture is booming, while agribusiness giants like Monsanto continue to expand. Producing food consumes more land and water resources than any other human activity. The individual and collective decisions people make about food shape individual and community health, social justice, and sustainability. If we are to make sound decisions about how to feed the world and feed ourselves, we need to understand the highly creative and contentious ways that people produce and consume food. In this class we will address the following central questions in order to unravel some paradoxes, and help us make informed choices, about foods we consume: (1) What are the origins of agriculture, and why does it matter for the future of food? (2) How do cultural, ecological, economic, and technological contexts shape food acquisition, preparation, and consumption? (3) What are the causes of hunger ¿ can we feed 8 billion people healthy food and not trash the planet? And (4) what roles have science and technology played in shaping ¿industrial food,¿ and in shaping the world around us?
					Economics 3
Economics	DC	73328	HEALTH ECONOMICS	UG	This course will teach the student to use economic analysis to understand critical issues in health care and and health policy. We will address issues such as the following: 1. What factors best explain the level and rate of growth of U.S. health expenditures? 2. Does the recent high rate of growth of U.S. health care expenditures make U.S. firms less competitive in international markets? 3. What are some of the likely consequences (intended and unintended) of the proposed reforms to Medicare? 4. Can physicians induce demand for their services? 5. What are the impacts of managed care on the health care system? 6. Do strong affiliations between physicians and health plans hurt competition? (Lecture, 3 hours). Minimum grade of "C" required in all economics pre-requisite courses. Junior standing required.

Department	College	Course #	Course Title	Grad/UG	Description
Economics	DC	73331	POLIT ECON INEQUAL	UG	Three basic types of institution - markets, communities, and states (i.e. public governments) - determine the distribution of economic resources and opportunities in societies. The balance between these governing institutions has changed dramatically over time, at very different rates across societies. This course will begin with economic and political theory on why these differences over time and across countries may exist. Then it will survey some of these differences across both industrialized and pre-industrial societies and investigate their causes and consequences. Some of the questions the course will ask include the following: In the industrialized world, the public sector (government) plays a much larger role in Europe than in the United States. Why is this so? How does this affect the quality of everyday life for different classes of people? How have globalization and technological change affected the distribution of income and social policy in industrialized countries, and how does this affect the public sector? In some tribal societies, people have no access to markets at all. How does this affect distributive behavior within communities? Finally, what might be the ultimate causes of income inequality on a global scale? Are there prehistoric and environmental roots in the ways peoples of different societies live today? This course will examine these questions by studying theoretical and empirical research conducted by economists, economic anthropologists, political economists, and economic geographers on these questions.
Economics	DC	73358	ECON ENVMT NAT RES	UG	An advanced course on the allocation of environmental and natural resources. Topics include: externalities and the misallocation of resources, examining the efficiency/inefficiency of markets for non-renewable resources, intended and unintended consequences of regulatory and tax policies, and modern alternative to regulation such as the creation of new markets and property rights for environmental resources.
					Engineering & Public Policy 10
Engineering & Public Policy	CIT	19424	ENERGY & THE ENVRNMT	UG	This course will explore the relationships between environmental impacts and the utilization of energy through a series of case studies on topics of current interest. Such topics might include the use of renewable and non-renewable fuels for electric power generation; energy use for automobiles and other transportation systems; energy use for buildings and industrial processes; and environmental issues such as urban air pollution, ozone formation, acid rain, and global warming. The emphasis will be on analysis of energy-environmental interactions and tradeoffs, and their dependency upon engineering design choices, economic variables, and public policy parameters. Junior or Senior standing in CIT or permission of instructor.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19425	SUST ENER DEV WORLD	UG	This course examines the current state of the energy system in developing countries and the challenges these countries will face in sustainably meeting their energy needs in the 21st century. The following are examples of questions and issues we will cover throughout the semester. What is the current status of the energy system in the developing world? What is the role of energy in supporting economic growth and alleviating poverty? What are the future energy needs of developing countries? What are the challenges developing countries will face as they build/improve their energy systems? What technologies are available to meet the energy challenges in the developing world?
Engineering & Public Policy	CIT	19625	SUST ENER DEV WORLD	GR	This course examines the current state of the energy system in developing countries and the challenges these countries will face in sustainably meeting their energy needs in the 21st century. The following are examples of questions and issues we will cover throughout the semester. What is the current status of the energy system in the developing world? What is the role of energy in supporting economic growth and alleviating poverty? What are the future energy needs of developing countries? What are the challenges developing countries will face as they build/improve their energy systems? What technologies are available to meet the energy challenges in the developing world?
Engineering & Public Policy	CIT	19648	ST: INT CLMT ADAPT INFRA	GR	Although an international problem, climate change will affect each country's critical infrastructure in diverse ways. This course will focus on understanding how international communities are adapting and innovating to reduce critical infrastructure risk. Students will be able to list and describe natural hazards affected by climate change, focusing on their impacts on natural and built critical infrastructure systems in physically, socially, and economically diverse countries. Students will then use cost-benefit analysis, the triple bottom line approach (physical, social, economic), and robust decision making to analyze, compare, and contrast different countries' responses. The class will culminate in a final paper and presentation on one country's approach to decision-making under uncertainty for adaptation. Learning Objectives: By the end of the semester, you should be able to: · Understand risk. o Define risk, hazard, vulnerability, exposure, adaptation, hazard mitigation, greenhouse gas mitigation. o Explain the link between some natural hazards and climate change o List 10 natural hazards and their impacts on the international community. · Analyze outcomes/impacts. o Predict how physically, socially, and economically detrimental a given natural hazard will actually be in different critical infrastructure systems. o Compare and contrast different adaptations to reduce risk. · Create recommendations for improving adaptation in an international community

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19653	CLM CHG MTG	GR	Have you ever thought about how we could address the climate change problem? In this course we will study the technological and policy options for responding to the threat of climate change. We will review climate-change science, understand the current systems for energy supply and use, and have a deep dive onto technological solution for low-carbon energy supply and use, as well as the policy frameworks that can help us reduce greenhouse gas emissions. 2hrs 40min of lectures per week.
Engineering & Public Policy	CIT	19665	ENVIR POLITIC POLICY	GR	Engineers, scientists, policymakers, industry, environmental groups, and the public all influence environmental policy making, and should have an understanding of past and current environmental issues, technologies, policies, programs, and politics. Using a case study approach, students will learn how to how to use program evaluation to analyze the effectiveness of past policies (e.g., CFCs, DDT) and apply the lessons learned to conduct policy analysis of current environmental challenges (e.g., nanotechnology, climate change). Students will gain an understanding of the variety of policy mechanisms available to attain environmental goals including the use of voluntary standards. Student interest will guide topic selection for both issues discussed in class and for project work. Class time will include a combination of faculty and guest speaker lectures, discussion of issues, videos, and problem solving time. While the course has no prerequisites, students should feel comfortable with scientific and technical topics.
Engineering & Public Policy	CIT	19666	ENGY POLICY & ECONMC	GR	This course will review how past and future energy technology trajectories are intertwined with pathways of economic development, business investment decisions, social needs, and political priorities. Emphasis will be placed on clean energy and promising technological trajectories for the future. This course will explore how a wide variety of policy mechanisms- technology policy, utility regulation and restructuring, emissions policies, multilateral interventions and agreements, and corporate strategies-can shape energy use and the environmental impacts of energy systems. Study examples will draw from both developed and developing countries.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19696	SUST DEVEL INNOVATION	GR	This course will explore how technology and business contribute to sustainable development. Course segments will include examining global megatrends in ten major sectors (e.g., food, water, energy, health, etc.), opportunities and risks in these key sectors, and developing key metrics for success in sustainable development. Solution pathways that use existing, transferable, and new models in both policy and innovation will be discussed and proposed by the class. Issues for both large multi-nationals and start-ups will be covered. Class time will include a combination of lectures, guest speakers from industry, and problem solving activities. Students will experience how to create a business in this climate of sustainable development. Instructor is former CTO of Alcoa, and Co-Chair of the Vision 2050 project of the World Business Council for Sustainable Development. He is also currently an Advisor & Board Member at a number of Venture Capital firms and a Adjunct Prof. at CMU. The course is intended for MS students. Upper-level undergraduates may enroll with permission.
Engineering & Public Policy	CIT	19714	ENV LFE CYC ASSMNT	GR	Cradle-to-grave analysis of new products, processes and policies is important to avoid undue environmental harm and achieve extended product responsibility. This course provides an overview of approaches and methods for life cycle assessment and for green design of typical products and processes using the ISO 14040 family of standards. This includes goal and scoping definition, inventory analysis, life cycle impact assessment (LCIA), interpretation, and guidance for decision support. Process-based analysis models, input-output and hybrid approaches are presented for life cycle assessment. Example software such as MATLAB, Excel, and Simapro are introduced and used in assignments. A group life cycle assessment project consistent with the principles and tools of sustainability to solve real-world engineering problems is required.
Engineering & Public Policy	CIT	19717	INTRO SUSTNBL ENGING	GR	This course begins with an overview of the concept of sustainability, including changing attitudes and values toward technology and the environment through the twentieth century. Models for population growth, global food production, and global water resources are then presented, and current problems such as land use, urbanization, and energy and material resources are discussed. Models of industry based on life sciences are then explored, and tools for sustainable engineering are presented. These tools include metrics of sustainability, principles of design for the environment, methods for pollution prevention, and use of mass and energy balances in the design of sustainable systems. Prerequisite: senior/graduate standing in engineering or permission of the instructor.

English 1

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76319	ENVIRONMENT RHETORIC	UG	How people think and talk about the environment matters; it reveals what they value and shapes what they do. We will look at how competing discourses define man's relationship to the natural world, frame environmental problems, and argue for public action. As we compare the environmental rhetoric of naturalists, scientists, policy makers, and activists, we will trace an American history that has managed to combine mystical celebration with militant critique, and scientific research with public debate. Equally important, this course will prepare you to act as a rhetorical consultant, by studying how writers communicate the three major "Rs" of environmental rhetoric: man's Relationship with nature, the looming presence of Risk, and the need for a Response.
					History 6
History	DC	79280	COFFEE & CAPITALISM	UG	What role has coffee played in connecting people and places to capitalist markets and consumer cultures? What are the economic, social, and environmental consequences of these connections? How did espresso change from an "ethnic drink" to something served at McDonalds? Why do college students (and professors!) hang out at coffee shops? This course will answer these questions and more by using the history of coffee to think about the changing nature of capitalism, and the history of capitalism to understand changes in the coffee world. We will follow the spread of coffee and capitalism across the globe, with excursions to places where people grow coffee (Ethiopia, Yemen, Indonesia, Brazil, and Costa Rica), and also where they drink coffee (Seattle, Tokyo, Seoul, New York, and Berlin). In the process, we will confront global problems linked to economic inequality, trade, gender relations, and environmental degradation. Course meetings will combine interactive lecture and group discussions. Assignments will include journal responses, short quizzes, and a final project in which students will write a script that tells a story about coffee and capitalism.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79283	HUNGRY WRLD:FOOD/FAM	UG	The science and technology of the Green Revolution in the second half of the 20th century were heralded as a miracle. Agricultural science promised seeds, peasants, companies, governments, scientists, economists, exporters, and planners would work together to support growing populations, especially in the post-colonial world. The human population on Earth reached 6 billion by the year 2000; 7.6 billion were estimated around 2017. The United Nations predicts 8.6 billion by 2030. Awareness of living in this unique period of human history brought new debates among scholars, practitioners, and planners thinking about the critical role of agriculture and development on Earth. How can we conceptualize, hope, and plan for best possible outcomes for a human population that depends on agriculture and development? How has the legacy of the Green Revolution encouraged (or betrayed) public enthusiasm for innovative fixes? This interdisciplinary course will use methods and case studies drawing on History, Historical Demography, Anthropology, Cultural Studies, Regional Studies, Geosciences and Agricultural Sciences, and International Economic Development. If students wish to pursue a particular thematic or regional interest, there will be room in this course to explore particular cases in depth.
History	DC	79315	POLITICS OF WATER	UG	Water is necessary for all forms of life on Earth. The purpose of this course is to introduce students to social and political aspects of water, using in-depth case studies that draw on a variety of perspectives. Examples of regional water projects we'll study include traditional tank irrigation in South India; international negotiations along the Nile River; and the U.S. Government in negotiation with native activists and fisheries on the Columbia River. In addition to regional variety, readings will explore a variety of themes, for example, water and gender; water and armed conflict; and water and private companies versus public management. By the end of this course, students should be able to articulate their own answers to these questions: How have global organizations and participants characterized, enacted, and addressed problems of water supply and delivery for those who need it most? How do particular regions reflect global trends in water resource development, and how might these diverge from global trends? How have social and environmental studies in the literature of development come to understand the problem of water? One set of readings is assigned each week. Students should be prepared to discuss each week's readings in a thoughtful way during class meeting time.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79318	SUST SOCIAL CHANGE	UG	If you wanted to change the world, who would you ask for guidance? Mahatma Gandhi? Rachel Carson? Nelson Mandela? In this interdisciplinary course, we will examine the history of efforts to create sustainable social change. Through a series of targeted case studies, we will examine the successes and failures of notable leaders, past and present, who strove to address social problems nonviolently and to create lasting improvements in fields such as education, healthcare, and human rights. In keeping with the example of the people we will be studying, we will bring our questions and our findings out of the classroom through a variety of creative, student-driven experiments in sustainable social change
History	DC	79320	WOMEN POLITICS PROTECT	UG	This course examines the history of women's rights agitation in the United States from the early nineteenth-century to the present. It investigates both well-known struggles for women's equality—including the battles for women's voting rights, an Equal Rights Amendment, and access to birth control—and also explores the history of lesser-known struggles for economic and racial justice. Because women often differed about what the most important issues facing their sex were, this course explores not only the issues that have united women, but also those that have divided them.
History	DC	79368	UN-NATURAL DISASTERS	UG	Rebellion is a fundamental aspect of human existence. Descartes declared: "I think therefore I am." We might say that over the course of the twentieth century this formula became: "I rebel therefore I am." Relying on historical and philosophical analysis, this course will examine the preconditions and events that led to this transformation. We will consider how violence, revolution, utopian thinking, and the relationship between individuals and institutions inform our understanding of rebellion. The philosophical history of rebellion stretches from the Ancient Greeks (the Cynics) through to the 19th and 20th centuries in the works of Marx, Bakunin, Nietzsche, Sartre, Camus, Adorno, and Marcuse. Over the course of the semester we will explore the philosophical underpinnings of rebellion by reflecting on anarchism, nihilism, and dialectical processes.

Department	College	Course #	Course Title	Grad/UG	Description
Institute for Politics and Strategy	DC	84370	GLOB NUCLEAR POLITIC	UG	The taming of the atom is one of the defining features of the modern era. The awesome creative and destructive potential of nuclear energy has had enormous impact on great power politics, the environment, economic development, and international institutions. Limiting the risk of nuclear Armageddon is one of the dominant challenges in US foreign policy and global governance alike. In this course, we will study 1) why and how countries pursue nuclear weapons and what happens when they acquire them; 2) the national policies and international regimes that have been devised to curb their spread and use, while allowing for the diffusion of energy technology, 3) the national and transnational civil society movements that have fought to roll back the nuclear age or limit its harmful effects, and 4) the role of private actors such as scientists and corporations.
					Materials Science & Engineering 1
Materials Science & Engineering	CIT	27406	SUSTAINABLE MATLS	UG	This course is intended to instill a sense of how materials properties and performance are conceived and brought to market specifically under sustainability constraints arising from the increasing demand of materials, Students will be introduced to the global nature of materials and will explore the global influences on the materials supply and value chains. The student will explore issues through the framework of the materials lifecycle including resource availability, manufacturing choices, and disposable options for materials in light of their use and selection for application. As a result, the student will be able to make more informed material selection or be able to use this information to identify critical research directions for future material development.
					Mechanical Engineering 6
Mechanical Engineering	CIT	24424	ENERGY & THE ENVRNMT	UG	Fuel cycles for conventional and non-conventional energy resources; relationships between environmental impacts and the conversion or utilization of energy; measures of system and process efficiency; detailed study and analysis of coal-based energy systems including conventional and advanced power generation, synthetic fuels production, and industrial processes; technological options for multi-media (air, water, land) pollution control; mathematical modeling of energy-environmental interactions and tradeoffs and their dependency on technical and policy parameters; methodologies for energy and environmental forecasting; applications to issues of current interest. Junior or Senior standing in CIT or permission of instructor. 3 hrs lecture

Department	College	Course #	Course Title	Grad/UG	Description
Mechanical Engineering	CIT	24425	CMBSTN AIR POLL CTRL	UG	Formation and control of gaseous and particulate air pollutants in combustion systems. Basic principles of combustion, including thermochemical equilibrium, flame temperature, chemical kinetics, hydrocarbon chemistry, and flame structure. Formation of gaseous and particulate pollutants in combustion systems. Combustion modifications and post-combustion technologies for pollutant control. Relationship between technology and regional, national, and global air pollution control strategies. The internal combustion engine and coal-fired utility boiler are used as examples. 3 hours lecture Cross listed as 24-740 and 19440/19-740
Mechanical Engineering	CIT	24626	AIR QULTY ENGR	GR	The course provides a quantitative introduction to the processes that control atmospheric pollutants and the use of mass balance models to predict pollutant concentrations. We survey major processes including emission rates, atmospheric dispersion, chemistry, and deposition. The course includes discussion of basic atmospheric science and meteorology to support understanding air pollution behavior. Concepts in this area include vertical structure of the atmosphere, atmospheric general circulation, atmospheric stability, and boundary layer turbulence. The course also discusses briefly the negative impacts of air pollution on society and the regulatory framework for controlling pollution in the United States. The principles taught are applicable to a wide variety of air pollutants but special focus is given to tropospheric ozone and particulate matter. The course is intended for graduate students as well as advanced undergraduates. It assumes a knowledge of mass balances, fluid mechanics, chemistry, and statistics typical of an undergraduate engineer but is open to students from other scientific disciplines. 12 units
Mechanical Engineering	CIT	24640	CLM CHG MITGT	GR	Have you ever thought about how we could address the climate change problem? In this course we will study the technological and policy options for responding to the threat of climate change. We will review climate-change science, understand the current systems for energy supply and use, and have a deep dive onto technological solution for low-carbon energy supply and use, as well as the policy frameworks that can help us reduce greenhouse gas emissions. 2hrs 40min of lectures per week.

Department	College	Course #	Course Title	Grad/UG	Description
Mechanical Engineering	CIT	24683	DESGN MANUFCT & ENVR	GR	Design for Manufacturing and the Environment examines influences of manufacturing and other traditionally downstream issues on the overall design process. Manufacturing is one facet that will be examined. Other downstream influences that will be studied include: assembly, robustness and quality, platform design, maintenance and safety, economics and costing, lean manufacturing and globalization. In addition, a core part of the course will focus on environment-based design issues. The class will study basic fundamentals in each of these areas and how they affect design decisions. Prerequisites: Senior standing in mechanical engineering, or permission of instructor
Mechanical Engineering	CIT	24740	CMB AIR POLLUTN CNTR	GR	24-740 Combustion and Air Pollution Control This course examines the generation and control of air pollution from combustion systems. The course's first part provides a brief treatment of combustion fundamentals, including thermochemical equilibrium, flame temperature, chemical kinetics, hydrocarbon chemistry, mass transfer, and flame structure. This foundation forms the basis for exploring the formation of gaseous (oxides of nitrogen, carbon monoxide, hydrocarbons, and sulfur dioxide) and particulate pollutants in combustion systems. The course then describes combustion modifications for pollutant control and theories for pollutant removal from effluent streams. The internal combustion engine and utility boilers serve as prototypical combustion systems for discussion. The course also addresses the relationship between technology and the formulation of rational regional, national, and global air pollution control strategies. Cross listed 19-740, 19-440, 24-425
					Philosophy 5
Philosophy	DC	80244	ENVIRONMENTAL ETHICS	UG	The aim of the course is to provide students with an introduction to environmental ethics. One aspect of environmental ethics is the study of values underlying human relations to the natural environment. In particular, we are interested in issues that arise when these values conflict. This course begins with a discussion of our current environmental crises, and different approaches to solving these crises. Many of these solutions, however, depend on particular kinds of knowledge, particularly scientific knowledge, about our environment. Thus, another important aspect of environmental ethics is determining what we do, and what we can, know. To address these issues, we will explore some problems in philosophy of science, with special emphasis on the various eco-sciences.

Department	College	Course #	Course Title	Grad/UG	Description
Philosophy	DC	80249	AI SOCIETY HUMANITY	UG	We are surrounded with imagery of artificial intelligence (AI) shaping our future. But for more than one hundred years, our society has already been deeply impacted by automation, computers, and information technology. This course will consider AI and automation from historical, ethical, and public policy perspectives. Our aim is to provide a broad, interdisciplinary introduction to these issues. There is no prerequisite for this course; it open to students from all majors.
Philosophy	DC	80344	MGT ENVIRON ETHICS	UG	This course examines and poses answers to the following question: "What are the legitimate environmental responsibilities of organizational managers from the private, public and nonprofit sectors and how can they be best fulfilled?" This query will provide the course with its major theme and framework. But in order to do justice to it, three interrelated areas that are presupposed by this question will need to be explored first. These areas are: 1) applied ethics, 2) management ethics and 3) environmental ethics. The first half of the course will concentrate upon these three areas. The second half of the course will focus upon management and the environment employing the insights gained during the first half. Here students will review and evaluate past and current management practices with respect to the environment, organizational policies dealing with the environment and the role of government in the process of determining environmental responsibilities in management. Environmental concerns on the international level and their impact upon organizational management, the emergence of the "environmental affairs manager" within organizations, balancing environmental responsibilities with other management responsibilities and examples of management responses to the environmental crises will also be examined during this portion of the course.
Philosophy	DC	80348	HLTH DVLPT HMN RGHTS	UG	Approximately 767 million people, or more than 10% of the world's population, live in a condition the World Bank refers to as "extreme poverty". Those who live in extreme poverty frequently lack effective access to proper nutrition, adequate shelter, safe drinking water, and sanitation. As a result, they also bear the greatest burdens of famine and epidemic disease and frequently face social and political conditions of unrest and systematic oppression. This course aims to introduce students to the problem of global public health and its intersection with claims of human rights. We will focus on theoretical accounts of human rights and questions arising from them: What constitutes a human right, and on what basis or bases might the existence of human rights be defended? If human rights exist, whose responsibility is it to see that they are defended/provided/not violated, and why? What is the relationship between health deficits and human rights deficits, and what would a "human right to health" look like? Are global institutions such as the protection of strong intellectual property rights consistent with respect for a human right to health?

Department	College	Course #	Course Title	Grad/UG	Description
Philosophy	DC	80449	EHPP PROJECT COURSE	UG	The Ethics, History and Public Policy Project Course is required for the Ethics, History and Public Policy major and is taken in the fall semester of the senior year. In this capstone course, Ethics, History and Public Policy majors carry out a collaborative research project that examines a compelling current policy issue that can be illuminated with historical research and philosophical and policy analysis for a chosen client. The students develop an original research report based on both archival and contemporary policy analysis and they present their results to their client and a review panel.
					Public Policy & Mgt:Sch of Pub Pol & Mgt 5
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90758	EHTICS PUB POL GLOBAL	GR	The first section of the mini-course will be devoted to a discussion of the nature of ethics and applied ethics. Here a framework useful in the ethical analysis of issues problems and dilemmas in public life will be constructed. The second section of the course will demonstrate the usefulness of this framework in the analysis and evaluation of policy issues from a normative point of view. In this section various arguments concerning the nature of the social ethics that form the background of policy debates also will be a focus in the mini-course. The course will consider: reproductive rights matters end-of-life decisions questions about free speech social and economic justice and environmental considerations.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90765	CITIES TECH ENVIRNMT	GR	This mini will explore the interaction of cities, technology and the natural environment over time. More specifically, it will consider several major issues confronting cities today: (1) water supply, wastewater and storm water disposal and flooding; (2) Energy and Environment; (3) Transportation, suburbanization and land use; and (4) Brownfield creation and development. In a number of instances, the Pittsburgh region will be used to provide examples of these issues. These themes will be approached through a combination of class discussions, lectures, and visiting speakers. Class participation is expected, and will comprise a portion of the grade. Students will be expected to prepare a problem-oriented paper on one of the areas focused on in the course.

Department	College	Course #	Course Title	Grad/UG	Description
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90789	SUSTAINABLE COMM DEV	GR	This course examines past and current community development topics and trends associated with creating and/or maintaining sustainable communities. Such topics include sustainable development, creative capitalism, regional planning and visioning, governance, regional equitable development, sustainable business practices, green/clean tech, smart growth and smart transportation, carbon management, resource conservation, local living economies, energy systems and strategies, dynamics of neighborhoods, among other topics. Emphasis will fall on how these various dimensions need to strategically align to promote sustainable communities amidst their complexities. The class will also delve into a variety of green and sustainable development practices to provide frameworks for integrating traditional community development practices with sustainable development practices. The class takes lessons from the past (both what has worked and what did not work) as well as appropriate, current practices and explores how to apply them to a variety of community situations and conditions. The focus is on urban communities in the U.S and worldwide, both large and small. The course includes experiential, hands-on learning (projects, case studies, analyses, presentations, field trips, and guest lectures) as well as reflective components (readings, discussion, and papers).
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90813	ENVIR POLITIC POLI	GR	Engineers, scientists, policymakers, industry, environmental groups, and the public all influence environmental policy making, and should have an understanding of past and current environmental issues, technologies, policies, programs, and politics. Using a case study approach, students will learn how to how to use program evaluation to analyze the effectiveness of past policies (e.g., CFCs, DDT) and apply the lessons learned to conduct policy analysis of current environmental challenges (e.g., nanotechnology, climate change). Students will gain an understanding of the variety of policy mechanisms available to attain environmental goals including the use of voluntary standards. Student interest will guide topic selection for both issues discussed in class and for project work. Class time will include a combination of faculty and guest speaker lectures, discussion of issues, videos, and problem solving time. While the course has no prerequisites, students should feel comfortable with scientific and technical topics.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90863	HEALTH POL II	GR	This course teaches how to conduct policy analysis in the area of health care. Students will learn how to identify a problem clearly evaluate alternative proposals and their potential impacts and communicate effectively with policymakers. We will build on the institutional background and conceptual frameworks from the Health Systems and Health Policy I courses. Here students will focus on a particular policy issue and will produce a detailed written analysis and in-class presentation on their topic. To provide examples lectures will cover a range of policy challenges including cost containment retirement-age policy health disparities pharmaceutical safety and innovation and medical malpractice.

Department	College	Course #	Course Title	Grad/UG	Description
Social & Decision Sciences	DC	88352	ENVIRON ECON POLICY	UG	The course will introduce students to the economic analysis of problems associated with private and collective use of environmental resources and to the analysis of public policy options to environmental problems. Policy relevant examples will be used throughout the course. When thinking about protecting nature environmental economics has traditionally focused on the idea that market failure (externalities, non rival goods, asymmetric information) is the critical source of economic inefficiency. Based on this idea economists have designed policies for environmental protection, which include Pigouvian taxes, marketable permits, liability rules and mechanisms design. We will start from the theories of externalities, market failure and mechanism design, and we shall explore the causes of these problems and some of the potential remedies using the competing/complementary lenses of traditional and behavioral economics. To organise and evaluate alternative environmental policy options environmental economics has traditionally used rational choice theory. According to rational choice theory, people respond to policy instruments in their own self-interests and take all possible consequences into account. Behavioral economics has emerged to challenge this traditional view by documenting how people make choices and state values that deviate from the conventional rationality model. We will try to understand the behavioral economics underpinnings of environmental policy and how understanding the success and failure of conventional economic theory can help make good environmental policy better.
Social & Decision Sciences	DC	88366	BEHAV ECON POVTY DEV	UG	This course will introduce students to the study of economic development and poverty alleviation, with a special focus on recent insights from the intersection of psychology and economics. We will primarily focus on the health, microfinance, agriculture, and education sectors in developing countries. The course will have a methodological component largely centered on using experiments to evaluate interventions and policies that apply to households, small firms, and farms. While we will cover standard economic approaches, we will give extra attention to how a behavioral lens can help in both understanding development issues (e.g. barriers to household risk management) and in designing effective interventions (e.g. the timing of fertilizer sales).

Department	College	Course #	Course Title	Grad/UG	Description
Social & Decision Sciences	DC	88412	ENERGY CLIMATE ECON	UG	The scientific community has concluded that human industrial activities are causing global temperatures to increase. Coping with the environmental, economic, and political consequences of this change is considered by many to be the preeminent public policy challenge of the 21st century. In this course, we will investigate the basic science of climate change, the prospective economic impact of global warming, the uncertainty involved in long-run climate forecasting, and the technological alternatives available to us as we seek to mitigate the impact of human industrial activity on global warming. The heart of this course will be an in-depth analysis of the policy options available to the United States and the global community. We will investigate the economic costs of these options and the way political realities are likely to shape and constrain policy at the national and international levels.

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Architecture 25

Architecture	CFA	48215	MATERIALS & ASSEMBLY	UG	The fourth semester of architectural studies at Carnegie Mellon University is concerned with the detailed development and refinement of architectural design as informed by the meaning, aesthetics and techniques related to the usage of materials and the process of construction. As part of the technology sequence, 48-215 introduces and examines the fundamentals between design intent and construction materials, the science of materials (performance) and their assemblies. Learning how materials and techniques inform spatial and form making decisions will be a central theme to the semester. Lectures and discussions will focus on the meaning, aesthetics and techniques related to the use of materials and the process of construction. Field trips will provide further depth into these topics. A basic understanding of essential, well-known systems of building construction will be our base line. Discussions and case studies of contemporary systems that extend, experiment and question these known systems will introduce you to the great depth to which this basic knowledge can lead you. Joint assignments with the second year design studio will provide you with an opportunity for an in-depth exploration of these fundamentals of construction through a direct application and synthesis of this new knowledge to your studio project. This course will introduce a basic understanding, selection, design, preliminary sizing and methodology of construction systems organized by the 16 divisions of construction, as defined by the Construction Specifications Institute (CSI) as well as and introduction to the International Building Code (IBC) with special attention given to fire protection, types of construction, and means of egress.

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48351	HUMAN FACT ARCH	UG	Required course Human Factors is an investigation of what makes buildings tick for people: the internal spaces, transitional spaces, transactional spaces, defensible space, owned space, shared space, public space, and most importantly, occupied space. We move up in scale from the individual and group to the community to consider our designers' biases in how we analyze the human needs, how we judge the quality of space and subsequently, how we apply this knowledge to our own design work. Students develop a research question and test it in field research using observation, interviews and surveys. They draw conclusions about the quality of a space and place and how to improve it. Students should leave this class with the ability to discern a problem, experience in applying their understanding of behavioral settings and the human condition to specific research foci, and the ability to use their knowledge and skills deftly in practice, where time and resources are limited. Assignments will be a mix of individual and group work, with emphasis on the latter. There will be an emphasis on reading relevant literature, field investigations and understanding research methods and collaboration for applications in practice.
Architecture	CFA	48371	AMERN HSE & HOUSING	UG	This architectural history course examines the development of American house and housing choices during the period 1850-1975. A recurring picture of the "American Dream" has typically included the image of a single-family, detached dwelling set within its own green yard in the suburbs. However powerful and durable that image is, the history of house and home in America is actually a far more complex story with many different twists and turns. In the course we will look at both urban and suburban housing choices and cultures, ranging from single family detached dwellings to multi-unit housing, and across a social spectrum income, class, race, and gender. Through the use of occasional field trips, we will use Pittsburgh as a touchstone for understanding broader national trends in the history of American urban and suburban housing. The course is organized as a lecture course supplemented with field trips and discussions based on field trips and primary source readings. The additional time slot on Thursday afternoons will be used only when field trips are scheduled. Student work will include a research paper and several shorter written assignments throughout the semester.
Architecture	CFA	48381	ETHICS & PRACTICE	UG	An examination of moral concepts, reasoning, and methodologies that influence the built and natural environments through action/applied ethics. The course utilizes principles of business practice as a foundational lens through which to understand central and contingent dimensions of contemporary professional practice in, and related to, architecture. Lecture content and assignments emphasize establishing a critical awareness and broad understanding of the mediating factors that inform the intelligent resolution of architecture and construction through multiple forms of advocacy. Theory, case studies, analytical exercises, representational investigation, and production are utilized as a means of developing knowledge in the contractual, legal, fiscal and representational contexts requisite for the fulfillment of the architect's social contract.

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48453	URBAN DESIGN METHODS	UG	This undergraduate lecture course introduces urban design history, theory and methods. It is a required supporting course for the Urban Laboratory design studio, and similarly examines urban design at multiple scales: city form and networks, neighborhoods and block structures, streets, public spaces, and urban building typologies. Key issues introduced include the emergence and evolution of urban design as a discipline, economic, social and political factors affecting the contemporary city, and environmental sustainability at the urban scale. A wide variety of cities, projects, proposals and methodologies are examined. Assignments include readings from seminal texts, quizzes, and a final examination.
Architecture	CFA	48454	FUTURES OF THE CITY	UG	If all design can be read as attempts to predict and to shape the future, then no one looks further into the future than the urban designer and the urban planner. The work in which they are involved often does not materialize in their lifetimes; in fact, the duration of the projects are so long twenty, thirty, fifty and hundred year timeframes, it is more than likely that he or she will pass on before the project reaches fruition. The trouble with predicting the future is that it is so uncertain, so undecided, so unknowable. A brief look backwards reveals that we are not the first generation to consider the future. History is replete with predictions, some of which were actualized, the vast majority of which were not. Today's forecasts for tomorrow vary wildly. A handful of optimists view the future through rose colored glasses, whereby humanity is delivered to salvation via technological wonders and the widespread adoption of common social values. A larger group predicts the end of the world as we now know it, but even they cannot agree on the cause of our demise, with those arguing that climate change will kill us clashing with those convinced that we will be destroyed when robots achieve technological singularity. Shy of total extinction, however, any vision of the future requires designers, and will likely occur in urban (or formerly urban) locations. As of this decade, for the first time in history, more than half of the world's population, almost three and a half billion people, live in towns and cities. Estimates suggest that by 2030 this number will swell to almost five billion.
Architecture	CFA	48551	ETHICS DECSNMKG IN ARCH	UG	Ethical Decision Making in Architecture is a required course in the fifth year of the Bachelor of Architecture Degree. It is part of a sequence dealing with professional aspects of the field of architecture, alongside courses like Human Factors, Real Estate Design and Development, and Issues of Practice. It builds on an understanding of the issues of occupancy, economics and practice in design decision making. The course covers basic frameworks of decision making and ethical adjudication through several case studies including Fallingwater, Sydney Opera House, Citicorp Tower, Pruitt-Igoe housing development, Crystal Palace and Kansas City Hyatt. The text for the course is a manuscript by the instructor entitled "Ethical Decision Making in Architecture"

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48569	GIS CAFM	UG	A Geographic Information System (GIS) integrates displays, edits, analyzes, and shares spatial data for informing decision making. Industries benefiting from GIS include architecture, business, city planning, defense and intelligence, education, government, health and human services, natural resources, public safety, transportation, utilities and communications, and urban planning/design. GIS topics include map design and outputs, geodatabases, downloading and importing spatial and attribute data, digitizing, geocoding, and advanced spatial, 3D, and network analysis. Other topics such as raster-vector integration and web-based GIS will also be covered. Facilities management is the practice of coordinating the physical workplace with the people and work of the organization. Computer Aided Facilities Management (CAFM) integrates software tools to streamline operations, boost productivity and develop strategic planning goals for an organization. CAFM topics include space management, asset management, building operations, emergency preparedness, environmental health and safety, telecommunications, and real property and lease management. This course prepares students to understand, maintain, and manipulate spatial and organizational data using world leading software applications. By the end of the course, students will have sufficient background to identify spatial characteristics of diverse application areas enabling them to integrate spatial thinking and analysis into their academic research and careers.
Architecture	CFA	48576	MAPPING URBANISM	UG	This seminar provides the critical tools necessary to examine the city as both a representation and a reality in flux. Through an interdisciplinary framework, students study urban history, theory, visual thinking and spatial mapping. Contemporary urban issues are introduced through weekly lectures, readings, and class discussions. Parallel to these urban explorations, students learn to employ a diverse set of representational techniques to create inventive mappings. Upper-level (300 and 400 level) undergraduate students and graduate students are encouraged to register.
Architecture	CFA	48705	MUD STUDIO I	GR	Description to be provided by the department
Architecture	CFA	48706	URBAN STUDIO II	GR	Description to be provided by the department

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48708	MUD STUDIO IV	GR	Description to be provided by the department
Architecture	CFA	48711	PARADGMS RESCH ARCH	GR	This course is both an introduction to important models and methods of academic research particularly as they are related to building design issues and a forum for intellectual curiosity. During the initial ten weeks of the semester, the course presents an overview of the field and covers several models of research as they relate to the building design. These will include models of natural sciences, social sciences, sciences of the artificial, engineering and aesthetics in building design. During the final five weeks of the semester faculty both CFA and CIT will be invited to make presentations about their areas of research and the methods they use. These presentations correspond in many respect to those covered in lectures.
Architecture	CFA	48713	MUD URB EC	GR	The course will present the key principles of urban ecology, with a focus on those that are especially relevant to urban design. It will address the causes and consequences of biological patterns and processes in urban environments and illustrate how ecological principles can be used in planning and design projects. The course will introduce ways to examine the implications of urban design decisions on the health and sustainability of urban habitats. Topics in the course include the concept of urban ecosystems, ecosystem functions in cities, climate change, natural processes and regenerative cycles.
Architecture	CFA	48714	DATA ANL URBN DSNG	GR	'Data Analytics for Urban Design' asks how we understand and design cities through large scale data. The pervasiveness of online information provides rich resources for urban design. These include the citizen and open data movements, social media, big data, the Internet of Things and smart cities. We will investigate how these emerging areas contribute opportunities and strategies beyond current practice. We will also explore the potential the web has to offer as a platform not just to gather data but to engage. We will consider its potential to involve and collaborate with residents through urban data. These investigations are organized as a series of 5 modules. Each explores contemporary methods and workflows to leverage online data in the urban design process. The modules will introduce the means to collect and access data; tools, techniques, and context required for analysis and processing; and strategies and visualization techniques for data aggregation and synthesis. Balancing theory and practical application, students will critically examine key topics in city-based data analytics through: relevant readings, independent research, invited lectures, computational tools and techniques, and applied explorations of real world, large-scale datasets.

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48719	AECM UDBS	GR	Description to be provided by the department
Architecture	CFA	48720	PLNNG DES	GR	The focus of this seminar is the connection between design decisions and urban development, and how a better understanding of this relationship will contribute to knowledge, policy and practice of a robust and forward-looking contemporary urbanism. The seminar draws on the instructor's research, teaching, and practice including current projects, focusing on urban design and planning current projects relevant to international, North American, and Pittsburgh perspectives. The course is divided into three units: The Campus in Context; Waterfronts in Transition, and Districts and Design--how urban districts achieve and sustain a meaningful density of interaction and opportunity, and the role of architecture, design, and arts in that achievement. These built environments is that they test the capacity of architecture and development to propose meaningfully complex and resilient program and form, from city centers to polycentric regions. The seminar will address how the design and planning of campuses, waterfronts, and specific "districts" can build up--or tear down--a robust urbanism: to better understand the decisions that can lead to an urbanism that is experientially stimulating, architecturally rich, local and global, and diverse and deep enough for the long term. Each unit will be four weeks, with Campus and Waterfronts completed before Spring Break, the third, Districts, follows, and the semester ends with the final two weeks focused on a synthesizing research project and presentations.
Architecture	CFA	48721	BLDG CONTRL DIAGNSTC	GR	This course introduces the concepts and methods of building diagnostics. It focuses on the empirical evaluation of the built environment (building components and systems, interactions between building, occupants and environmental conditions) in view of multiple performance criteria (thermal, visual and acoustic performance). Field measurement and assessment techniques will be introduced. The empirical methods of building analysis are commonly used to: describe/specify building components; study the real-time behavior of buildings; detect the causes of building failures; and gather data for model validation. The course will address these issues, both theoretically and practically, through the application of: field measurement techniques; physical modeling methods; and computer-aided building modeling. Computer-aided data processing techniques will be applied for the analysis and interpretation of the results of model and field studies. The role of building performance simulation in the area of building diagnostics will be investigated

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48725	REAL EST DSGN DVLPMT	GR	This course will study the real estate development process and explore the interdependence of financial investment drivers and the creation of this built environment. Classroom learning, exercises and guest-lectures will introduce students to the concepts of market, location and valuation, as well as the basic techniques of real estate finance including development budgets, operating profromas, return analysis, and lender requirements. Parallel to this investigation, students will have opportunities to study real world developments and interface with the development professionals that executed them to learn how development drivers shaped the development process and decision-making. The semester's effort culminates in a feasibility study of a development site Pittsburgh. Students will complete a basic market analysis, program evaluation, zoning, deeds, liens and a determination of financial feasibility. Students will study how market demand, tenant requirements, site constraints, and available capital affect feasibility, and through this the ultimate design solution. Development practitioners will interface with student teams during this case study to offer "real world" guidance on student proposals.
Architecture	CFA	48727	INQRY CD ARC	GR	The subject of this course is the emergence of computing as a pivotal concept in contemporary practices in architecture and design. It will explore design theories and practices responding to the so-called "computer revolution," cybernetics, Artificial Intelligence (AI) and the linked transformations on our conceptions of design, creativity, nature, body and place. The aim of the course is to develop a view of computation beyond particular technologies and tools, and an understanding of an expanding landscape of hybrid practices and theories linked to computational, tangible and interactive forms of design practice and expression. The semester will be divided into 2-week modules, which will introduce different approaches to the research and practice of computation in the creative fields at Carnegie Mellon. In each module faculty members will cover topics derived from their own research combining readings and a short team-based project expanding on the topic introduced. Topics include key computational paradigms such as tangible interaction, artificial intelligence, rule-based design systems, responsive environments and robotics.

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Architecture	CFA	48728	SP TPC BPD MOD SUSTN	GR	The best way to learn a subject is to teach. The best way to teach is to create hands-on, interactive learning tools that engage all ages and levels of expertise. This elective will engage CMU students in the creation of a unique set of "EcoPods" that capture the vocabulary, metrics, products and integrated systems that define critical subsets of sustainability: · Visual Delight balancing light and daylight · Thermal Delight with passive and active energies · Breathing Deeply by ensuring indoor and outdoor air quality · Acoustic Delight with managed noise and quiet · Cradle to Cradle materials and assemblies · Living Materials and Biomimicry · Biophilia - our inherent need for connection to nature · Powering Down towards smart grid futures · Water in a Resilient Future Students will work individually or in teams to develop a self-selected modular and mobile learning pod - capturing the guidelines, integrated products and specifications, as well as the environmental and life cycle benefits for diverse audiences. The course will begin with rapid research on the vocabulary, metrics, guidelines and products in the selected area of sustainable design. Collaboration with industry will provide a virtual or physical kit of parts critical to the educational delivery of the critical resource. Finally, modular "eco pods" for hands-on learning will be envisioned with drawings and an educational workbook to inspire students, future clients and practitioners to reach for the highest performing integrated solution.
Architecture	CFA	48733	ENV PERF SIM	GR	"Design of a boat is optimized for sail-driven locomotion. Buildings should be able to sail using free energy if wind, air, sun and internal heat sources to temper indoor environment", Brendon Lewitt. Based on this viewpoint, this course introduces fundamental knowledge in building physics in relation to a range of environmentally responsive building design principles and computational approaches for increased resiliency for human habitability with minimal reliance on mechanical systems. EPS course refreshes some of the fundamental building physics topics such as building thermodynamics (heat & mass transfer mechanisms), photometric quantification of light and luminous environment, human visual and thermal comfort, thermal modeling and the principles of generating electricity from sunlight (photoelectric effect). EPS course outlines a series of environmental design principles with emphasis on evidence-based design approaches and reviews of building case studies are evaluated against actual buildings in operation. Focus is also given to integration of multi-valent environmental design strategies into the early stages of performative architectures. EPS also introduces state-of-the-art architectural design & research oriented environmental performance simulation & visualization tools, methods and techniques (based on the algorithmic/parametric modeling ecosystem of RHINO-Grasshopper-DIVA-ArchSIM -Ladybug-Honeybee programs). Computational introductions will be accompanied with pre-established/seed workflows which are ready for future adaptation and extension by the students.
Architecture	CFA	48740	UD METHODS & THEORY	GR	Description to be provided by the department

Department	College	Course #	Course Title	Grad/UG	Description
Architecture	CFA	48743	INTRO ECO DES	GR	This seminar offers an overview of scholarly and research-based approaches, strategies, and design methodologies that address issues of ecology and sustainability for architecture and urban design. Composed of a series of lectures, readings and bi-weekly assignments, it will lead students through a diverse collection of technical and intellectual inquiries that will help them to enable deep expertise, critical thinking, and investigation of innovative sustainable strategies for the future of our built environment.
Architecture	CFA	48750	HIST URB DES	GR	Description to be provided by the department
					Art 15
Art	CFA	60110	EMS MOVING IMAGE	UG	Electronic Media Studio: Introduction to the Moving Image is an introduction to the computer as a dynamic tool for time-based media production. In this course students develop skills in digital video and audio production through the exploration of narrative, experimental, performance, documentary and animation themes and forms. Historical and contemporary works are presented and discussed to provide a context for studio projects.
Art	CFA	60142	DIGITAL PHOTOGRPHY I	UG	This course explores digital photography and digital printing methods. By semester's end students will have knowledge of contemporary trends in photography, construction (and deconstruction) of photographic meaning, aesthetic choices, and the use of color. Students will learn how digital cameras work, proper digital workflow, RAW file handling, color management and Adobe Photoshop. Through the combination of the practical and theoretical, students will better define their individual voices as photographers. No prerequisites.
Art	CFA	60201	CONCEPT: SPACE&TIME	UG	Concept Studio: Space and Time is a continuation of Concept Studio: The Self and the Human Being with a focus on space and time through projects of increasing complexity. Such topics as biological time, historical time, psychological time, celestial time, clock time, and public space, private space, mathematical space, and virtual space are addressed through projects. Open to sophomores in the School of Art, or by instructor permission.

Department	College	Course #	Course Title	Grad/UG	Description
Art	CFA	60202	CONCEPT: SYSTEM/PROC	UG	Concept Studio: Systems and Processes focuses on the utility, discovery, and the generation of systems and processes through projects. Open to sophomores in the School of Art, or by permission of instructor.
Art	CFA	60223	PHYSICAL COMPUTING	UG	[IDeATe portal course] Physical computing refers to the design and construction of physical systems that use a mix of software and hardware in order to sense and respond to the surrounding world. Such systems include digital+physical toys and gadgets, kinetic sculpture, functional sensing and assessment tools, mobile instruments, interactive wearables, etc. This is a project-based course that deals with all aspects of conceiving, designing and developing projects with physical computing: the application, the artifact, the computer-aided design environment, and the physical prototyping facilities. The class consists of students from different disciplines who collaboratively synthesize and implement several systems in a short period of time. The course is organized around a large set of essential skills that students must gain in order to effectively tackle physical computing problems. It is then deployed through a series of quick group projects that utilize the essential skills and challenge students to not only consider HOW to make things, but also for WHOM we design, WHEN the time is ripe, and WHY the making is worthwhile/necessary. Upon completion of this course the students will be able to: work in a mixed physical-digital environment and laboratory, make effective use of standard hardware and software tools for physical computing, approach complex physical computing problems with a systematic overview that integrates iterative research and design steps, generate systems specifications from a perceived need, partition functionality between hardware and software, produce interface specifications for a system composed of numerous subsystems, use computer-aided development tools for design, fabrication and testing and debugging, evaluate the system in the context of an end user application or experience.
Art	CFA	60242	DIGITAL PHOTO II	UG	Digital Photography II combines digital and analog processes in both color and black & white. Students will gain experience with digital workflow, analog to digital conversion, virtual drum scanning and large format digital printing. Topics include trends in contemporary photography, professional practices, project development, narrative and serial work, and portfolio presentation. Students will be expected to develop their own self-directed projects throughout the semester culminating in a cohesive portfolio of their work. Readings, assignments, artist visits, critiques and discussions will give context to the practical work and help develop a wide ranging familiarity with the subjects. Prereq: 62-141 or 62-142 or equivalent or consent of instructor

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Art	CFA	60245	PORTRAIT PHOTOGRAPHY	UG	Portrait Photography explores the emotional and visual process of collaboration between subject and photographer that creates a photograph. We use cameras of all formats and levels of sophistication to create portraits in the studio and on location. Each photographer is challenged to find and exploit available light, and create artificial light to complete his or her vision. The class will explore a wide range of digital and darkroom strategies to support and add richness to their final prints. Through film and video photographers will meet some of the masters of this form like Arbus, Newman, Avedon, and Penn. Together we will take advantage of any opportunities to visit exhibitions and photographer's studios. Lab fee required. Prerequisites: As listed or consent of instructor.
Art	CFA	60251	2D MEDA STD:PRT MEDA	UG	Printmaking is a process based medium that produces multiples of original artworks. Students will create four works on paper using the following printmaking approaches: Relief (carved), Intaglio (engraved), Lithography (planographic), and Screen Printing (stencil). Each technique's unique set of materials, processes and aesthetics will be explored. This course focuses on traditional tools and processes, but will include utilization of digital images and sources through a critical lens. While primarily focused on the learning of fundamental techniques, the class will also also expose students to ways that Print Media can be a tool (physically and conceptually) in contemporary practice. Open to sophomores in the School of Art, or by instructor permission.
Art	CFA	60280	INTRO CONTEXT PRACT	UG	For some time now art has moved out of gallery and museum spaces and into all facets of public life, where complex social situations and diverse audiences have become important parts of the work. In the past this might have been called Public Art, but today new strategies are being used that challenge public art's tradition of static sculptures and embrace more dynamic forms of public engagement. As its name implies, Contextual Practice embraces the context or social conditions in which an artwork exists as part of the material of that work. Evolving out of the history of site-specific, conceptual, and performance art practices, Contextual Practice covers a range of exciting new methods to making art in the public including street art, interactive social media, environmental art, hacktivism, participatory art, guerilla performance, project-based community art, and urban interventions. Students in this field-based class will create projects that work with the social dynamics of a variety of on and off-campus and online public contexts. We will research new trends in public engagement through art, architecture, and design, as well as politics, ecology, sociology, and economics. Fundamentally, this class asks students to experiment with how their art practice can intersect directly with the real world (outside of the traditional art venues) and how they can proactively create new sites and audiences for their work.

Department	College	Course #	Course Title	Grad/UG	Description
Art	CFA	60397	ART, CONFLICT & TECH	UG	Art, Conflict and Technology in Northern Ireland is a 12-unit course cross-listed in the School of Art, the Robotics Institute, and the Department of English.The class consists of a weekly seminar (Wednesdays) and a required 3-unit recitation in the Robotics Institute (Fridays). Throughout the term students will be introduced to a history of social strife in the North of Ireland from the 1960s to the present, and efforts to reconcile differences in the contemporary period. We will consider the influence of advancing technology on how narratives are shared within a community and worldwide. If you have ever considered how artists explore societal strife through their writing or visual arts practice, if you are interested in the social and political influences of evolving technology, or if you are a practicing artist who uses advancing technology as a tool for individual expression, this integrative course is for you. Throughout the semester we will examine the practice of a range of visual artists that include Rita Duffy, John Kindness and Willie Doherty and writers and dramatists like Dermot Healy, Patrick McCabe and Christina Reid. Students will learn how to use CREATE Lab's technologies as platforms for exploring the content presented in class and for the development of final projects. We will travel to Belfast for spring break 2018, to meet a variety of writers and artists whose work we will study, and stakeholders in reconciliation efforts throughout the region.
Art	CFA	60403	EXTENDED STUDIO	UG	Senior Critique Seminar comprised of group discussions that analyze the conceptual and aesthetic frameworks that surround each student's individual studio practice. The course supports independent inquiry, mature studio practice and both an in-depth critical reading of visual art and an increased comfort in the articulation of ideas and processes. Each student can expect two hour-long critiques throughout the semester, paired with ample time for individual studio work. These course discussions will also be informed by the Visiting Artist Lecture series and concepts and concerns carried from studio and academic seminar classes.
Art	CFA	60413	ADV ETB: SPECIAL TOP	UG	This studio art course will engage with the human alteration of the living through domestication, breeding and engineering as a cultural practice. Students will learn to interpret the human-altered biological world as use it as both an inspirational and material foundation for producing artworks. Field trips, hands-on activity and rigorous scholarship will inform the students process. The BioArtworks produced by the students will encourage ethical discussion and allow for the critical examination of the social and cultural implications of working with living organisms.

Department	College	Course #	Course Title	Grad/UG	Description
Art	CFA	60415	ADV ETB: ANIMATION	UG	This studio will introduce a variety of techniques and concepts for animation production. Using both 2D and 3D tools, animation will be explored through short assignments designed to develop diverse skills and ideas. For a final project each student will construct an animated short that uses animation as a means of self-expression. The class will engage in discussion and critique of each others work along with examples of historic and contemporary animation.
Art	CFA	60419	EXPRMNTL GAME DESIGN	UG	Experimental Game Design: Storyspaces - A hands-on game design course focused on innovative and expressive forms of gameplay. In this installment of Experimental Game Design the emphasis is placed on the complex relationship between stories and games. Topics include: environmental storytelling, world building, branching narratives, Virtual Reality, visual novels, AI-driven narratives and more. The class consists in one long session per week that allows for extended prototyping exercises (mini-jams), technical tutorials, as well as frontal lectures and in-depth playtesting sessions. Projects are team-based. Coding experience is recommended but not required.
Art	CFA	60430	ADV SIS: OPN SCULPT	UG	Sculpture is perhaps the broadest field among the contemporary visual arts. Through its privileged relationship to the physical world and the viewer's body, sculpture is the glue that connects the intermedia practices of object, installation, interactive art and performance. In this class we build on skills and concepts learned in 3D media 1 and 2 to develop students' individual approach. Students define independent responses to topics proposed through discussion of contemporary sculptors. Emphasis is placed on individual development. Students are encouraged to explore interdisciplinary approaches.
					Biological Sciences 18
Biological Sciences	MCS	3121	MODERN BIOLOGY	UG	This is an introductory course that provides the basis for further studies in biochemistry, cell biology, genetics and molecular biology. This course emphasizes the chemical principles underlying biological processes and cell structures as well as the analysis of genetics and heredity from a molecular perspective. This is the introductory biology course for all science and non-science majors.

Department	College	Course #	Course Title	Grad/UG	Description
Biological Sciences	MCS	3125	EVOLTN	UG	Evolutionary theory is the unifying principle of biology. A good comprehension of the concepts that underlie this theory is therefore important to properly appreciate and understand any biological process. This course is designed for students intending to continue studies in biology so that they may gain an understanding of the evolutionary framework in their more advanced courses, and also non-biology majors who want to extend their knowledge of biology at an introductory level. The lectures will include (i) an examination of the history and development of evolutionary theory, (ii) consideration of some of the facts that have established the theory, (iii) an introduction to the concepts of phylogenetics, (iv) discussion of the patterns and mechanism that lead to the diversity and origins of the groups of life, (v) an introduction to genetics and population genetic theory, and (vi) discussion of and how this applies to natural selection and speciation. The course will also include some more specialist topics, including evolution of development, sexual selection, evolutionary applications to medicine and conservation biology, and genome evolution. Assessment will be based on several in-class exams and quizzes, homework assignments, a written term paper, and a final exam.
Biological Sciences	MCS	3132	BAS SCI TO MOD MEDCN	UG	This course will focus on the genetics, cell biology, and developmental biology behind human biology and human disease, as well as the growing opportunities for novel therapeutic options that basic science delivers. This is a topics based course, with topics chosen to cover aspects of human biology and health that students are likely to encounter in their daily lives such as cancer, stem cells, genome sequencing, and the human microbiota. Students will explore these topics from both a basic science and a human health perspective.
Biological Sciences	MCS	3220	GENETICS	UG	The mechanisms of transmission of inherited traits in viruses, bacteria, fungi, plants and animals are discussed. Molecular mechanisms of gene expression and gene regulation are analyzed. Recombinant DNA and its applications in genetic analysis, biotechnology, forensics, agriculture, medicine, and the pharmaceutical industry are presented. Special topics in human genetics are considered, such as the genetics of cancer. Principles and methods for the study of developmental genetics, population genetics and complex traits are also introduced.

Department	College	Course #	Course Title	Grad/UG	Description
Biological Sciences	MCS	3221	QUANT. GENETICS	UG	Scientific and technical advances in genetics have accelerated dramatically since the draft human genome sequence was published in 2001. The development of massively parallel DNA sequencing and associated technologies has transformed the way we approach genetic questions. Contemporary genetics is increasingly concerned with generating, processing and analyzing vast amounts of data to extract information about genetic variation, expression, interactions and associations. At the same time, comparative genomics, bioinformatic and reverse genetic methods are transforming the way in which gene functions are investigated, while the development of powerful methods for precise modification of genomes is opening the way to cell- and gene-based therapies for disease. In parallel, the promise of precision or personalized medicine is predicated on advances in understanding of complex traits, genetic interactions and networks. These and other topics will be covered following a review of basic principles of gene structure and expression, the fundamental principles of Mendelian genetics, and their underpinnings in cellular mechanisms for the replication, recombination and transmission of genetic material. Although the topics overlap extensively with 03220 (Genetics), they will be presented at a more advanced level, with a greater emphasis on current methods of quantitative and statistical analysis. This course is recommended for students with a particular interest in emerging technologies for analysis of human genetics, genomics, gene therapy and precision medicine.
Biological Sciences	MCS	3232	BIOCHEMISTRY I	UG	This course provides an introduction to the application of biochemistry to biotechnology. The functional properties of amino acids, nucleotides, lipids, and sugars are presented. This is followed by a discussion of the structural and thermodynamic aspects of the organization of these molecules into higher-order structures, such as proteins, nucleic acids, and membranes. The kinetics and thermodynamics of protein-ligand interactions are discussed for non-cooperative, cooperative, and allosteric binding events. The use of mechanistic and kinetic information in enzyme characterization and drug discovery are discussed. Topics pertinent to biotechnology include: antibody production and use, energy production in biochemical systems, expression of recombinant proteins, and methods of protein purification and characterization. The course is an alternate to 03-231.
Biological Sciences	MCS	3360	GENOM EPIGEN BRN	UG	The goal of modern neuroscience is to understand the function of the central nervous system using a wide variety of techniques and levels of analysis. This integrative field is actively engaged in addressing questions ranging from the genetics and cell biology of neurons to the perception and behavior of organisms. Topics covered in this course will include the evolution, development and anatomy of the nervous system, the electrophysiology and cell biology of neurons, the function and plasticity of sensory and motor systems and the neurobiology of brain disorders. This course will emphasize unanswered questions in neuroscience and focus on current experimental attempts to answer them.

Department	College	Course #	Course Title	Grad/UG	Description
Biological Sciences	MCS	3391	MICROBIOLOGY	UG	The course provides introductory level microbial science and molecular biology that is aimed for students from all disciplines of natural science. It covers microbiology, genetics, genomics, as well as bacterial, fungal, and protozoan pathogenesis. Topics include: the human microbiome, genome sequencing, gene transfer across species, virulence, and drug resistance.
Biological Sciences	MCS	3411	TOPICS IN RESEARCH	UG	During the year students attend and submit brief summaries of weekly seminars given by outside speakers or members of the Biology Department on current research topics in modern biology; some seminars outside of the department may be substituted.
Biological Sciences	MCS	3435	CANCER BIOLOGY	UG	Cancer affects roughly 1 in 3 people worldwide, and originates from both hereditary as well as environmental causes. Its prevalence makes it practically inescapable. Its of great relevance from both scientific and sociocultural perspectives. This course aims to examine various hallmarks of the biology of cancer while exploring novel concepts that challenge our understanding of cell biology. From the perspective of a cancer cell, we will learn about basic concepts of cell division, DNA replication, cell signaling, cell cycle control, cell metabolism, the regulation of gene expression in human cells, oncogenes, tumor suppressor genes, mutations, the process of metastasis, cancer diagnosis, cancer treatments and ethical questions surrounding treating patients, the epidemiology of cancer including prevalence and historical trends in diagnosis, as well as social impacts of a cancer diagnosis. Students will also explore the primary literature and scientific review articles to better understand research and methods of investigation into the cellular and molecular processes of tumorigenesis. This course will include interactive lectures, guest speakers, and in class discussion exercises aimed at building class participation and association, as well as confidence in public speaking about the sciences. Given the well-documented link between stress and cancer, there will also be a small component aimed at making students aware of health and wellness, such as reducing stress and anxiety.
Biological Sciences	MCS	3451	ADV DEV BIO HUM HLTH	UG	This course will examine current research in developmental biology, focusing on areas that have important biomedical implications. The course will examine stem cell biology, cellular reprogramming, cell signaling pathways, tissue morphogenesis, and genetic/developmental mechanisms of birth defects and human diseases. Emphasis will be placed on the critical reading of recent, original research papers and classroom discussion, with supporting lectures by faculty.

Department	College	Course #	Course Title	Grad/UG	Description
Biological Sciences	MCS	3511	GENOMICS & MOLEC BIO	UG	An advanced introduction to computational molecular biology, using an applied algorithms approach. The first part of the course will cover established algorithmic methods, including pairwise sequence alignment and dynamic programming, multiple sequence alignment, fast database search heuristics, hidden Markov models for molecular motifs and phylogeny reconstruction. The second part of the course will explore emerging computational problems driven by the newest genomic research. Course work includes four to six problem sets, one midterm and final exam.
Biological Sciences	MCS	3512	CPTL MTH BIO MDL SIM	UG	This course covers a variety of computational methods important for modeling and simulation of biological systems. It is intended for graduates and advanced undergraduates with either biological or computational backgrounds who are interested in developing computer models and simulations of biological systems. The course will emphasize practical algorithms and algorithm design methods drawn from various disciplines of computer science and applied mathematics that are useful in biological applications. The general topics covered will be models for optimization problems, simulation and sampling, and parameter tuning. Course work will include problems sets with significant programming components and independent or group final projects.
Biological Sciences	MCS	3709	APP CELL MOLC BIOLGY	GR	The purpose of this course is to review key cellular and molecular phenomenon in biological pathways with strong emphasis on latest experimental techniques used in applications including but not limited to disease diagnosis, therapeutics, large-scale genomic and proteomic analysis. Knowledge gained from this course will be both conceptual and analytical. Students will periodically write extensive research reports on select topics and give oral presentations on a select few, while critically analyzing primary literature.
Biological Sciences	MCS	3711	GENOMICS & MOLEC BIO	GR	An advanced introduction to computational molecular biology, using an applied algorithms approach. The first part of the course will cover established algorithmic methods, including pairwise sequence alignment and dynamic programming, multiple sequence alignment, fast database search heuristics, hidden Markov models for molecular motifs and phylogeny reconstruction. The second part of the course will explore emerging computational problems driven by the newest genomic research. Course work includes four to six problem sets, one midterm and final exam.

Department	College	Course #	Course Title	Grad/UG	Description
Biological Sciences	MCS	3713	BIOINFMTCS DATA PRAC	GR	This course provides a hands-on, self-directed experience dealing with biological data and integrating it to produce software and analyses that are of use to biologists. Data are taken from a variety of sources, including academic research labs, large scale public genomics projects and data from private industry partners. Students will be given a project and asked to design a solution using a combination of existing tools and their own developed software.
Biological Sciences	MCS	3726	EVLN REGULY GENOMICS	GR	This course in will examine the processes by which genomes evolve and how this genetic variation leads to phenotypic diversity. An introduction to gene regulation, how the genome controls development, comparisons of development and the phenotypic diversity in animals will be provided. Then we will consider ways in which genomes evolve, followed by in depth coverage of how gene regulation has evolved (focusing on cis regulatory evolution and non-coding RNA regulatory evolution). Finally the concept of gene regulatory network control of development and understanding evolution as change in these networks will be examined. Concepts and specific examples will come through reading of primary literature and selected readings from advanced texts. Grading will be based on written assignments from readings of literature, participation in class discussion, and two in class exams. The graduate level course (03-726) will in addition require a term paper based on thorough and critical reading of primary literature focused on one of the general topics presented in the course.
Biological Sciences	MCS	3751	ADV DEV BIO HUM HLTH	GR	This course will examine current research in developmental biology, focusing on areas that have important biomedical implications. The course will examine stem cell biology, cellular reprogramming, cell signaling pathways, tissue morphogenesis, and genetic/developmental mechanisms of birth defects and human diseases. Emphasis will be placed on the critical reading of recent, original research papers and classroom discussion, with supporting lectures by faculty.
				Biomedical Engineering	4
Biomedical Engineering	CIT	42101	INTRODUCTION BIOMED	UG	This course will provide exposure to basic biology and engineering problems associated with living systems and health care delivery. Examples will be used to illustrate how basic concepts and tools of science & engineering can be brought to bear in understanding, mimicking and utilizing biological processes. The course will focus on four areas: biotechnology, biomechanics, biomaterials and tissue engineering and biosignal and image processing and will introduce the basic life sciences and engineering concepts associated with these topics. Pre-requisite OR co-requisite: 03-121 Modern Biology.

Department	College	Course #	Course Title	Grad/UG	Description
Biomedical Engineering	CIT	42201	PRO ISSUES IN BIOMED	UG	This course exposes students to many of the issues that biomedical engineers face. It provides an overview of professional topics including bioethics, regulatory issues, communication skills, teamwork, and other contemporary issues. Outside speakers and case studies will describe real world problems and professional issues in biotechnology and bioengineering, and progress toward their solution. Prerequisite or co-requisite: 42-101 Introduction to Biomedical Engineering
Biomedical Engineering	CIT	42202	PHYSIOLOGY	UG	This course is an introduction to human physiology and includes units on all major organ systems. Particular emphasis is given to the musculoskeletal, cardiovascular, respiratory, digestive, excretory, and endocrine systems. Modules on molecular physiology tissue engineering and physiological modeling are also included. Due to the close interrelationship between structure and function in biological systems, each functional topic will be introduced through a brief exploration of anatomical structure. Basic physical laws and principles will be explored as they relate to physiologic function. Prerequisite or co-requisite: 03-121 Modern Biology, or permission of instructor.
Biomedical Engineering	CIT	42444	MEDICAL DEVICES	UG	This course is an introduction to the engineering, clinical, legal and regulatory aspects of medical device performance and failure. Topics covered include a broad survey of the thousands of successful medical devices in clinical use, as well as historical case studies of devices that were withdrawn from the market. In-depth study of specific medical devices will include: cardiovascular medicine, orthopedics, and general medicine. We will study the principles of operation (with hands-on examples), design evolution, and modes of failure. Additional lectures will provide basic information concerning biomaterials used for implantable medical devices (metals, polymers, ceramics) and their biocompatibility, mechanisms of failure (wear, corrosion, fatigue, fretting, etc.). The level of technical content will require junior standing for MCS and CIT students, a degree in science or engineering for non-MCS or non-CIT graduate students, or permission of the instructor for all other students.

Department	College	Course #	Course Title	Grad/UG	Description
Business Administration	TSB	70100	GLOBAL BUSINESS	UG	The course provides a comprehensive overview of business, including how enterprises determine goals, strategies and operational tactics in competitive markets and the increasingly global environment. It covers different types of businesses - entrepreneurial and corporate, industries, markets, and economies. Students learn about the role of business in society, the various functional areas that make business work, and how companies develop plans and processes to achieve their goals for customers, shareholders, and employees. The course has special emphasis on providing a broad overview of business to augment students' major area of study for their professional development. Several sections of the course in the Fall semester are reserved for first-year business students only.
Business Administration	TSB	70122	INTRO TO ACCOUNTING	UG	This course provides the knowledge and skills necessary for the student to understand financial statements and financial records and to make use of the information for management and investment decisions. Topics include: an overview of financial statements and business decisions; the balance sheet, the income statement, and the cash flow statement; sales revenue, receivables, and cash; cost of goods sold and inventory; long-lived assets and depreciation, and amortization; current and long-term liabilities; owners' equity; investments in other corporations; an introduction to financial statement analysis and international issues dealing with financial statements.
Business Administration	TSB	70201	PROFSSNL & SRVC PROJ	UG	Professional service is important in career development because it creates opportunities to use skills and knowledge, develop leadership abilities, develop professional networks, and to learn the importance of community involvement and social values in business practice. Students complete a variety of activities with these objectives over a period of up to four semesters to satisfy this course requirement.
Business Administration	TSB	70311	ORGNZTN BEHAVIOR	UG	This course examines the factors which influence individual, group and firm behavior in the context of the workplace. Topics covered include perception, group behavior, decision making, motivation, leadership and organizational design and change.

Department	College	Course #	Course Title	Grad/UG	Description
Business Administration	TSB	70321	NEGOTIATN CNFLCT RES	UG	This course will complement the technical and diagnostic skills you have learned in other courses. A basic premise of the course is that, while you will need analytical skills to discover optimal solutions to problems, you will also need a broad array of negotiation skills to implement these solutions and make sure that they are truly effective. Your long-term effectiveness - both in your professional and personal life - is likely to depend on your negotiating abilities. This course will give you the opportunity to develop these skills experientially and to understand the analytical frameworks that underlie negotiations.
Business Administration	TSB	70332	BUS SOCIETY & ETHICS	UG	The course draws upon actual cases to explore fundamental questions faced by businesses operating in the United States and elsewhere in the world. What justifies governmental regulation of your business? What are the rights of employers and employees? How does the law protect consumers? What laws protect the environment? How do you choose the best legal form for your business? What are the lines of power within a corporation? What protections are available to shareholders? How do the antitrust laws protect competition? What responsibilities does a business have to the community in which it operates? What is the ethical foundation on which business ought to be conducted? The course puts businesses in their legal and ethical context.
Business Administration	TSB	70340	BUSINESS COMMUNCTNS	UG	Business Communications develops and sharpens your written, oral, and interpersonal communication, introducing you to common forms of professional writing and speaking in specific business situations. The course explores crucial rhetorical issues that impact your ability to communicate and achieve your objectives as a business leader.
Business Administration	TSB	70342	MANAGE ACRSS CLTURES	UG	This course is designed for students who expect to do business in other countries or work with people from other cultures. It provides an intellectual framework for understanding other cultures (and eventually one's own), as well as detailed studies of particular countries. It discusses how culture defines organizations, contracts, personal relationships, attitudes toward authority, time and space, ethics, wealth, and subcultures, and how these affect business. Student teams study a culture of their choice and make presentations, based on interviews and literature research.

Department	College	Course #	Course Title	Grad/UG	Description
Business Administration	TSB	70364	BUSINESS LAW	UG	The external political, social and legal environment of the firm and its managers. Legal and regulatory matters, United States and multinational, will be considered, including restrictive trade practices laws and regulations, acquisitions and mergers, licensing, franchising, officers' and directors' responsibilities and liabilities, manufacturers' responsibilities and liabilities, securities regulation, environmental protection, intellectual property, labor unions, trade associations, employee rights and duties, the attorney-client relationship; values in a business society; social implications of business policies, and corporate social responsibility. The effects of laws upon day-to-day business administration. Contracts, sales, commercial paper, the Uniform Commercial Code, credit transactions, bankruptcy, insurance, agency, partnership, incorporation and corporate governance.
Business Administration	TSB	70376	ENERGY SYSTEMS	UG	This course will provide students with an understanding of the systems and markets that provide energy to businesses and consumers. Students will be introduced to the sources and uses of energy, and how they have evolved and the possible paths over which they may evolve in the next decades. The course places an emphasis on electric energy, the single largest energy source in many industrial economies, but also covers natural gas, oil, and selected other primary energy sources. Students will learn the energy flows in the USA and the world, as well as the business-relevant characteristics of the engineered systems that provide the energy in various forms. Both traditional and emerging energy sources will be discussed, and students will understand the difference between an energy carrier and an energy source. We will also discuss some of the issues that arise without proper management of the physical risks of energy systems. Students will learn some of the history of electric power regulation and the inconsistent subsidy structures that have provided opportunities and challenges for energy companies and investors, including discussion of how emissions restrictions affect fuel, engineering, investment, and project finance choices. The history of electric power markets will be discussed, with an eye to examining the opportunities that market changes create for business.

Department	College	Course #	Course Title	Grad/UG	Description
Business Administration	TSB	70449	SOCL ECON INF NETWKS	UG	Interaction is a fundamental part of social science: firms market products to consumers, people share opinions and information with their friends, workers collaborate on projects, agents form alliances and coalitions. In this course, we will use the emerging field of social networks to put structure on this diverse mass of connections. Using a mixture of theoretical, empirical, and computational methods, we will learn about the structure and function of social networks. We will look at how an individual's position in a social network reflects her role in the community. We will learn to identify tastemakers and trendsetters by looking at how information moves through our increasingly connected society. We will consider how our own position in the social network affects our behavior, opinions, and outcomes. And we will explore where social networks come from, and what affects their structure. The material in this course will be interdisciplinary, drawn from the fields of math, computer science, physics, sociology, political science, and economics. By the end of the course, you will have the tools and knowledge needed to analyze social networks on your own. The course is capped with a project where you will use your skills to answer your own questions.
				Carnegie Mellon University-Wide Studies	9
Carnegie Mellon University-Wide Studies	CMU	99101	CMPTNG CARNEGIE MELL	UG	Computing@Carnegie Mellon (C@CM) is a 3-unit, pass/fail mini course that will help you develop foundational computing and information literacy skills, focusing on the tools and technologies that are specific to Carnegie Mellon so you can be successful in your other academic courses. All undergraduate students are required to take the course. C@CM is offered in a hybrid format through the Open Learning Initiative's (OLI) online course environment; meaning that you'll complete your coursework online and attend a face-to-face recitation session for review and supplemental instruction.
Carnegie Mellon University-Wide Studies	CMU	99153	MINDFUL LIVING	UG	The goal of this course is to increase students¿ internal resources for meeting stress through mindfulness-based meditation training. Each week, students will be trained in ¿formal¿ mindfulness meditation practices and asked to meditate at home with the help of brief guided meditation recordings. Students will also be given weekly ¿informal¿ mindfulness practice suggestions to help them translate the skills of formal meditation practice into daily life. Class meetings will give students the weekly opportunity for reflection, discussion, and questions based on their experience of formal and informal practice assignments.

Department	College	Course #	Course Title	Grad/UG	Description
Carnegie Mellon University-Wide Studies	CMU	99190	MNGNG STRS RSTNG HRM	UG	The course is designed to explore the subject of stress and how it can best be managed to achieve optimal health and wellbeing. Topics addressed will include: the environmental, mental and emotional components of stress, factors that affect the experience of stress, how stress contributes to illness, and an overview of various stress management techniques. Several lectures will be supported by Carnegie Mellon faculty and staff.
Carnegie Mellon University-Wide Studies	CMU	99194	INT RLTSHPS/SXL HLTH	UG	This course will explore the expression of human relationships and sexuality. Emphasis will be placed on college health and the social, cultural and health factors that affect relational interactions. This course is designed to assist students with improved functioning in personal relationships, provide information to take care of their sexual health and help them acquire skills to make decisions now and in the future. Topic areas will include relationships, sexual behavior, sexual health and interpersonal skills. Academic support will be provided by campus and community partners.
Carnegie Mellon University-Wide Studies	CMU	99236	ENVIRONMENTAL IDEAS	UG	By recognizing that environmental problems are themselves complex and require insights from both scientific and social perspectives, the University-wide Minor in Environmental Studies urges students to gain proficiency in different disciplinary habits of thinking about environmental problems. This course fulfills a requirement for the University-wide Minor in Environmental Studies. This course will introduce students from any undergraduate major at CMU to key methods and approaches for inquiry in the framework of Environmental Studies. Students will build up their ability to recognize and apply diagnostic criteria; understand key principles and terms; and take part in an informed discussion about ways of seeing, and creating interventions for environmental problems as social and scientific challenges. There are no pre-requisites for this course. Students will develop skills and apply concepts to different scenarios of environmental crisis.

Department	College	Course #	Course Title	Grad/UG	Description
Carnegie Mellon University-Wide Studies	CMU	99345	GLOBAL HEALTH	UG	With each global health crisis, the interconnectedness of populations around the globe becomes more pronounced. Diseases not only affect the health of communities, but they have a profound impact on political, economic, and social stability within countries and regions. This course engages the interdisciplinary nature of global health by approaching the issue through the lens of the Sustainable Development Goals (SDG) developed by the United Nations. The SDGs range in focus from good health and well-being to gender equality to clean water and sanitation to affordable, clean energy. By engaging the ways that health has a stake in these goals, the course will bring the expertise of faculty from the University of Pittsburgh and CMU to understand and address the issue surrounding global health from a myriad of perspectives and avenues. With a project-based focus, the course will assist students in engaging and impacting their local community though a global issue.
Carnegie Mellon University-Wide Studies	CMU	99346	GLOB HLTH WELLNESS	UG	With each global health crisis, the interconnectedness of populations around the globe becomes more pronounced. Diseases not only affect the health of communities, but they have a profound impact on political, economic, and social stability within countries and regions. This course engages the interdisciplinary nature of global health by approaching the issue through the lens of the Sustainable Development Goals (SDG) developed by the United Nations. The SDGs range in focus from good health and well-being to gender equality to clean water and sanitation to affordable, clean energy. By engaging the ways that health has a stake in these goals, the course will bring the expertise of faculty from the University of Pittsburgh and CMU to understand and address the issue surrounding global health from a myriad of perspectives and avenues. With a project-based focus, the course will assist students engaging and impacting their local community though a global issue. This iteration of the course will examine food insecurity and malnutrition as a part of the larger discussion on how to ensure healthy lives and promote well-being for all at all ages. SDGs 2 and 3 will be the primary focus of this offering.

Department	College	Course #	Course Title	Grad/UG	Description
Carnegie Mellon University-Wide Studies	CMU	99421	FACES OF INEQUALITY	UG	This course introduces students from all academic majors, both undergraduate and graduate, to the socio-political significance and artistic merits of film. Through screenings of acclaimed, international features and documentaries, class discussions, and workshops with award-winning filmmakers, students gain a basic foundation for film analysis. Over the years, the festival has developed strong programming that has attracted internationally-renowned guests including Oscar-winning director Jonathan Demme, Academy-nominated filmmaker Spike Lee, and the former First Lady of Poland Danuta Walesa. The films are presented in conjunction with the 2018 Carnegie Mellon International Film Festival entitled Faces of (In)Equality. Each film in this year's lineup will explore international and contemporary issues surrounding the theme of (In)equality, including but not limited to gender, race, sexuality, and ethnicity, that are often hidden from mainstream media reporting. This course provides the rare opportunity to engage directly with the filmmakers, offering the chance to expand on the film's controversial, global themes and learn more about the filmmaking industry and artistic process. Through viewing the films and learning from the filmmakers' firsthand accounts, the students will hone their critical thinking skills and learn to read the mainstream media with a more discerning eye. Each student will translate the films' themes, directors' perspectives, class discussions and their own cultural backgrounds and personal experiences into written reactions to the screenings and a final written analysis as part of the pass/fail component of the course.
Carnegie Mellon University-Wide Studies	CMU	99452	LANG & CUL TEACHNING	UG	Language and Culture for Teaching, is a 3 unit pass/fail class to help graduate students who are nonnative English speakers begin to develop the skills needed to be successful as teaching assistants (TAs). Students will gain a better understanding of the US/ Carnegie Mellon classroom and culturally appropriate teaching techniques, and be better prepared to take on the role of "instructor". Students will also learn how to better communicate their knowledge and expertise to learners by: 1) working on aspects of pronunciation crucial for the classroom, 2) developing an awareness of key aspects of teaching fluency, 3) having frequent opportunities to practice building aspects of teaching fluency, and 4) learning to compensate effectively for their individual language problems. Each student will have the opportunity to give two videotaped presentations on topics from their fields and then to meet with the instructor for extensive feedback and coaching. Prerequisite: Permission from the Intercultural Communication Center (ICC). Please call the ICC at 412-268-4979.
				Center for the Arts in Society	1
Center for the Arts in Society	DC	64322	GNDR & SEX IN PERFOR	UG	Description to be provided by the department
				CFA Interdisciplinary	6

Department	College	Course #	Course Title	Grad/UG	Description
CFA Interdisciplinary	CFA	62142	DIGITAL PHOTOGRPHY I	UG	This course explores digital photography and digital printing methods. By semester's end students will have knowledge of contemporary trends in photography, construction (and deconstruction) of photographic meaning, aesthetic choices, and the use of color. Students will learn how digital cameras work, proper digital workflow, RAW file handling, color management and Adobe Photoshop. Through the combination of the practical and theoretical, students will better define their individual voices as photographers. No prerequisites.
CFA Interdisciplinary	CFA	62242	DIGITAL PHOTO II	UG	Digital Photography II combines digital and analog processes in both color and black & white. Students will gain experience with digital workflow, analog to digital conversion, virtual drum scanning and large format digital printing. Topics include trends in contemporary photography, professional practices, project development, narrative and serial work, and portfolio presentation. Students will be expected to develop their own self-directed projects throughout the semester culminating in a cohesive portfolio of their work. Readings, assignments, artist visits, critiques and discussions will give context to the practical work and help develop a wide ranging familiarity with the subjects. Prereq: 62-141 or 62-142 or equivalent or consent of instructor
CFA Interdisciplinary	CFA	62245	PORTRAIT PHOTOGRAPHY	UG	Portrait Photography explores the emotional and visual process of collaboration between subject and photographer that creates a photograph. We use cameras of all formats and levels of sophistication to create portraits in the studio and on location. Each photographer is challenged to find and exploit available light, and create artificial light to complete his or her vision. The class will explore a wide range of digital and darkroom strategies to support and add richness to their final prints. Through film and video photographers will meet some of the masters of this form like Arbus, Newman, Avedon, and Penn. Together we will take advantage of any opportunities to visit exhibitions and photographer's studios. Lab fee required. Prerequisites: As listed or consent of instructor.

Department	College	Course #	Course Title	Grad/UG	Description
CFA Interdisciplinary	CFA	62315	BRE ARC: COMP TECH U	UG	Ecology posits that all entities within a given system have thermodynamic relationships to each other and are bound together in complex exchanges of energy and information: an ecosystem. This seminar seeks to translate this dynamic exchange into a computational framework directly influencing design processes. Students will be introduced to computational design thinking, using contemporary parametric modeling as a method for incorporation of environmental data into systemic dynamic behavior and feedback loops. The objective is to speculate about performative architectural, or urban systems, the morphology of which, are informed through design protocols that incorporate environmental data and simulation. We will engage design processes in which the metrics of the systems' performance underpin creative exploration of organization and form. This exploration results in the design and prototype of a specific morphological component system. Students will be introduced to digital parametric tools and immersed in contemporary digital fabrication processes, such as: 3d-printing, cnc-milling, mold casting, etc.
CFA Interdisciplinary	CFA	62715	BRE ARCH COMP TECH G	GR	Ecology posits that all entities within a given system have thermodynamic relationships to each other and are bound together in complex exchanges of energy and information: an ecosystem. This seminar seeks to translate this dynamic exchange into a computational framework directly influencing design processes. Students will be introduced to computational design thinking, using contemporary parametric modeling as a method for incorporation of environmental data into systemic dynamic behavior and feedback loops. The objective is to speculate about performative architectural, or urban systems, the morphology of which, are informed through design protocols that incorporate environmental data and simulation. We will engage design processes in which the metrics of the systems' performance underpin creative exploration of organization and form. This exploration results in the design and prototype of a specific morphological component system. Students will be introduced to digital parametric tools and immersed in contemporary digital fabrication processes, such as: 3d-printing, cnc-milling, mold casting, etc.
CFA Interdisciplinary	CFA	62846	CULTURAL PLCY ADVCY	GR	The work of arts managers is shaped both positively and negatively by cultural policy at the local state and federal levels. In this course we will examine the following core questions: what is cultural policy; who creates cultural policy in the United States; how have past and present policies shaped our nation's current cultural climate; and what can arts managers do to influence and change cultural policy? Pulling from specific examples within the arts community, we will cover a wide variety of policy issues including censorship, economic impact, public funding, and more. During this course students will be asked to select a current cultural policy issue to research and analyze culminating in the creation of a policy brief and advocacy plan.

Department	College	Course #	Course Title	Grad/UG	Description
Chemical Engineering	CIT	6322	JUNIOR CHEM ENG SEMR	UG	This course discusses career choices for chemical engineers, professional practice, including alternate career paths, global industry, and graduate studies. It also emphasizes writing, interview skills, and oral presentations. Safety, environmental and ethical issues are illustrated in projects and via invited lectures.
Chemical Engineering	CIT	6620	GLOBAL ATMOS CHMSTRY	GR	This course will explore global atmospheric chemistry through a series of case studies: Stratospheric Ozone, Global Methane and OH, and Urban and Regional Ozone. Each case will begin with a description of the chemistry and atmospheric physics fundamental to the particular problem. Students will formulate testable mathematical models incorporating that chemistry and physics, turning then to existing atmospheric data sets to test current understanding. The emphasis of this course is to develop an understanding of how to pose a testable hypotheses in a complex chemical environment such as the atmosphere, validate or refute those hypotheses, and then by extension predict how the system will respond to perturbations. A particular objective is to explore how to extend this methodology from the stratosphere and background troposphere (the first two cases), where it has been applied with success, to the much more complicated problem of urban and regional air quality. Students not having the prerequisites listed may seek permission of the instructor.
Chemical Engineering	CIT	6722	BIOPROCESS DESIGN	GR	This course is designed to link concepts of cell culture, bioseparations, formulation, and delivery together for the commercial production and use of biologically-based pharmaceuticals; products considered include proteins, nucleic acids, and fermentation-derived fine chemicals. Associated regulatory issues and biotech industry case studies are also included. A fair knowledge of cell culture and fermentation operations is assumed.
				Chemistry	7

Department	College	Course #	Course Title	Grad/UG	Description
Chemistry	MCS	9108	ILLUSION MAGIC FOOD	UG	Have you ever wondered how your morning orange juice when squeezed fresh from the fruit spoils after few hours while the one from the market lasts much longer without apparent alteration? How is that ground meat looks so red on the outside and unpleasantly brown in the inside? What is the nutritional value of milk and honey? Want to know how fruit flies helped to discover ways to make better-smelling beer? Why is wine normally stored in a dark glass bottle? These and many more questions will be answered in this course, not only by the instructor but also through the students research and curiosity. This course will introduce chemistry concepts on an as-needed basis but it will remain at the level of high school chemistry. We expect to help the student understand what food is made of, its nutritional value, how it is processed to offer longer shelf life, and how this may affect critical components. The topics will vary depending of the students motivation in learning about different concepts related to the food industry, from processing to analysis to packaging and appearance, we plan to discuss interesting things in every class and finish the course with a broad knowledge of what is on our table and better criteria to select our food. 3 hrs. lec.
Chemistry	MCS	9204	PRFL COMM SKLS CHMST	UG	This required course for chemistry majors promotes development of written and oral communication skills in various formats within the discipline. Students are expected to develop these skills by becoming more familiar with the style and format of the chemical literature, current topics in chemistry, and research projects in the Department. Other learning outcomes include developing critical reading skills, providing effective feedback to peers' written and oral communication, demonstrating the ability to revise written work, and using chemical structure drawing software. 1 hr. lec.
Chemistry	MCS	9403	CMY ADDIC	UG	What makes us need something so much that it eclipses other important aspects of our lives, such as family, friends, work, hobbies, health and wellness? There are many different types of addiction; this course will focus on molecular addictions, specifically those involving members of the opiate class of narcotics. The ongoing epidemic of opiate addiction, arising both from over-prescription of pain killers and recreational use of heroin, has been widely reported and continues to rise at alarming rates, ravaging our urban and rural communities. In this course, we will explore the complicated role of chemistry in this epidemic, including the good (elucidating mechanisms of action, development of clinically useful and safe opiates and non-opiate pain killers) and the bad (design and synthesis of increasingly addictive opiates). We will also discuss ethical questions faced by the pharmaceutical industry that develops, markets and sells opiates, the medical community that prescribes opiates, and the government agencies charged with regulating these activities. Students who complete this course will emerge with a broad understanding and perspective on an issue that is of great scientific and societal importance. 3 hrs. lec.

Department	College	Course #	Course Title	Grad/UG	Description
Chemistry	MCS	9710	CMSTY & SUSTAIN	GR	This course aims to educate students in the foundations of systematic leadership for building a sustainable world. Many sustainability challenges are associated with commercial chemicals and with operational modes of the chemical enterprise. For scientists, effectiveness in solving the technical challenges and redirecting cultural behavior is the defining substance of sustainability leadership. The course aims to challenge students to analyze and understand the root causes of unsustainability, especially in the technological dimension, to imagine a more sustainable world and to begin to define personal leadership missions. Students will be introduced to sustainability ethics as the foundation stone of transformative sustainability leadership, to the Collins ?Sustainability Compass? and ?Code of Sustainability Ethics? and to the Robért/Broman ?Framework for Strategic Sustainable Development (FSSD)?as powerful guiding tools. The Collins ?Bookcase of Green Science Challenges? organizes the technical content. It systematizes the major chemical sustainability challenges of our time: clean synthesis, renewable feed-stocks, safe energy, elemental pollutants, persistent molecular toxicants and endocrine disruptors. Focal areas will be the technical, toxicological and cultural histories of elemental and molecular pollutants and endocrine disruptor (ED) science?EDs represent the single greatest sustainability challenge of everyday chemicals. The graded substance will take the form of take-home work. Students will primarily read key books and articles and will summarize and personally evaluate the material in essay assignments. The course is intended for upper level undergraduates and graduates. There are no other prerequisites. The class is limited to 25 students. The 09-510 assignments are common to both undergraduate and graduate classes offerings and 09-710 students will engage in additional projects. 3 hrs. lec.
Chemistry	MCS	9716	BIOACTV NATRL PRODCT	GR	This course is aimed at students with an interest in natural products research. Natural products are used as active components in medicinal products, as model compounds for further development into medicinally active drugs, as ingredients in food and for flavor and fragrances, among other very useful and interesting applications. An overview of the structural variety and activity of natural products will be presented along with their isolation and structural determination. Overall, the course will offer an introduction to the work that is customary in natural product research. This course will cover: Strategies to select the plant or marine material for study; main groups of natural products derived from plants; representative natural products derived from marine organisms; preparation of extracts and selection of active fractions, screening strategies; separation and purification of active components; bench-top bioassays and chemical assays and structure elucidation (especially 2D-NMR spectroscopy) Student's performance will be assessed by weekly assignments on the topics discussed in lecture and exams. 3 hrs. lec.

Department	College	Course #	Course Title	Grad/UG	Description
Chemistry	MCS	9729	INTRO SUS ENERGY SCI	GR	This course focuses on the chemistry aspects of sustainable energy science. It introduces the major types of inorganic and molecular materials for various important processes of energy conversion and storage, such as photovoltaics, fuel cells, water splitting, solar fuels, batteries, and CO2 reduction. All the energy processes heavily rely on innovations in materials. This course is intended to offer perspectives on the materials/physical chemistry that are of importance in energy processes, in particular, how the atomic and electronic structures of materials impact the energy harvesting and conversion. In current energy research, intense efforts are focused on developing new strategies for achieving sustainable energy through renewable resources as opposed to the traditional oil/coal/gas compositions. This course offers students an introduction to the current energy research frontiers with a focus on solar energy conversion/storage, electrocatalysis and artificial photosynthesis. The major types of materials to be covered include metals, semiconductors, two-dimensional materials, and hybrid perovskites, etc. The material functions in catalysis, solar cells, fuel cells, batteries, supercapacitors, hydrogen production and storage are also discussed in the course. The lectures are power-point presentation style with sufficient graphical materials to aid students to better understand the course materials. Demo experiments are designed to facilitate student learning.
Chemistry	MCS	9737	MEDCNL CMY DRG DEVLP	GR	Organic chemistry is an intimate part of the drug discovery and design processes in areas that include structure determination (NMR, mass spectrometry), synthesis, and determination of mechanisms of action. Once a promising compound (i.e. a ?lead?) has been identified in the laboratory, it is rarely ready to be used in the clinic. Complications include poor bioavailability, rapid degradation, and off-target effects. Students will learn about lead compound optimization through structural variations, cell-specific targeting and pro-drug strategies. Several examples will be presented to illustrate the role played by organic chemistry in the development of drugs used to treat a range of diseases, including cancer, HIV-AIDS, bacterial infections and heart disease.
					CIT Interdisciplinary 4
CIT Interdisciplinary	CIT	39610	ENERGY CONVRN & SUPP	GR	This is the first course in the ESTP core mini-course sequence where master?s students learn the basic workings of the systems that supply, distribute, and utilize energy. This class will consider fossil energy, nuclear energy, and renewable energy resources. The course will provide some basic thermodynamics and will cover both conventional and emerging energy conversion technologies. Specific technology examples may vary from semester to semester selected from such important topics as photovoltaics, fuel cells, carbon sequestration and biofuels.

Department	College	Course #	Course Title	Grad/UG	Description
CIT Interdisciplinary	CIT	39611	ENRY DEMD & UTILZTN	GR	This course examines how human demands for energy have evolved over time and how they differ across nations. The course begins from a historical perspective and proceeds to an evaluation of present demand and synthesis of future projections. The course focuses on the technologies used in the different sectors: housing, commerce, food, industry and transportation. Students successfully completing this course will become familiar with a variety of tools for energy analysis and measurement, including some fundamentals of economic analysis, energy efficiency, and demand response. We will also analyze strategies for inducing the adoption of efficient technologies and consumption.
CIT Interdisciplinary	CIT	39612	ENGY POLICY & ECONMC	GR	In this course a survey of the relevant recent Energy Policy literature will be undertaken. An emphasis will be placed on studying the interactions between technology, performance, cost, and government decision-making, with an eye towards placing specific renewable technologies in the context of policy decisions. In this process the course will explore how a wide variety of policy mechanisms - technology policy, utility regulation and restructuring, emissions policies, multilateral interventions and agreements, and corporate strategies - can shape energy use, economics, and the environmental impacts of energy systems. Much of this class will be discussion driven, and significant reading will be required.
CIT Interdisciplinary	CIT	39613	ENGY TRNSPT & STRGE	GR	The logistics and cost of moving and storing energy vary greatly by energy form and geographic region. This mini begins with a global look at resources and the sources, movements, processing and storage of fossil and nuclear fuels. Once fuels have been delivered and converted to heat or electricity, the issues of moving and storage re-emerge. Efficient use of renewable electric power resources is considered, with emphasis on distributed resources and managing variability and intermittency. The technical and economic aspects of electric power transmission, distribution and storage are also evaluated. Management, regulation and operation of the grid are evaluated, including various SmartGrid and MicroGrid initiatives and technologies in the US and worldwide.

Department	College	Course #	Course Title	Grad/UG	Description
Civil & Environmental Engineering	CIT	12100	INTRO CIV & ENV ENG	UG	Introduction to selected subfields in the discipline, such as structural engineering, construction project management, and environmental engineering. Problem-solving exercises apply fundamental concepts from these subfields to integrate the steps of analysis, synthesis, and evaluation through individual homework assignments and group projects that require attention to a broad range of issues. The course also exposes the students to issues related to engineering practice such as working in teams, scheduling, evaluating risk and making ethical decisions. In addition to regular lectures and project exercises, the course includes guest speakers and class demonstrations. 3 hrs., rec., 1 hr. lab.
Civil & Environmental Engineering	CIT	12200	CEE CHALLENGES	UG	Students will be challenged to solve problems related to conventional, cutting-edge, and emerging issues in Civil and Environmental Engineering and one or more of the areas of the built, natural and information environments, such as smart cities. Students will gain an understanding of the effects of uncertainty, such as changing climate conditions. Through several team projects, students will explore the impact and management of tradeoffs, like constructability, sustainability, cost, and maintenance on design. They will learn to apply mathematics and science, advanced technologies, and computing to solve open-ended problems. Students will learn communication and design skills and practice the design process, from problem definition to constructed work.
Civil & Environmental Engineering	CIT	12201	GEOLOGY	UG	Introduction to physical geology; common rocks and rock-forming minerals and their chemical compositions/structure, physical properties, origins, and uses; geologic processes: surface and ground-water flow, volcanism, mountain-building, tectonics, glaciation, sedimentation, seismicity, and atmospheric and oceanic circulation.

Department	College	Course #	Course Title	Grad/UG	Description
Civil & Environmental Engineering	CIT	12215	INTR PRF WRTG IN CEE	UG	The objective of the course is to prepare students for writing technical re-ports and essays assigned in CEE courses and laboratories, writing professional letters and reports for internships and pro-fessional positions, preparing documents in a team setting, delivering individual and team oral presentations, and transforming information for several types of audiences (scientific accommodation). The course focuses on document purpose, organization and style; basic editing techniques; scientific accommodation; plagiarism and proper par-aphrasing and summa-rizing; evaluating, citing and referencing sources; team communication strategies; oral presentations; and proper use of tables, graphics, and other visual aids in documents and presentations. Course ac-tivities include in-class exercises, peer workshops, and homework assignments to illustrate examples of good and poor communication and to practice technical communication skills. Concurrent with lectures and class activities, students draft and revise individual and team technical reports and will give individual and team oral presentations.
Civil & Environmental Engineering	CIT	12301	CEE PROJECTS	UG	Students investigate the elements of civil and environmental engineering projects and advance their design, communication and teamwork skills through hands-on experiences. Students also advance their understanding of the professional and ethical aspects of engineering projects from conception through design, to implementation and operation. Students will design and build structures, use sensing to understand systems, and analyze sustainability as they work on open-ended projects.
Civil & Environmental Engineering	CIT	12335	SOIL MECHANICS	UG	Sampling, testing and identification of soils. Physical, chemical and hydraulic characteristics. Stress-strain-strength relationships for soils. Permeability, seepage, consolidation, and shear strength, with applications to deformation and stability problems, including earth dams, foundations, retaining walls, slopes and landfills.
Civil & Environmental Engineering	CIT	12401	CIV & ENVIR ENG DES	UG	Methodology for formulating and solving design problems, characterized by incomplete specifications, open-ended solution space, and partial evaluations. The methodology is illustrated and applied in the context of realistic design problems drawn from civil and environmental engineering. Design projects performed by teams, emphasizing collaborative problem-solving and preparation of written and oral reports. The importance of ethics, life long learning, and professional licensure are also discussed. Senior Standing in Civil and Environmental Engineering or instructor approval for Design Minors. Corequisite: 12-301, 12-6xx 9 unit course

Department	College	Course #	Course Title	Grad/UG	Description
Civil & Environmental Engineering	CIT	12411	PRJ MANGMT CONSTRCTN	UG	Introduction to construction project management from owner's perspective in organizing planning, design, construction and operation as an integrated process. Examination of labor productivity, material management and equipment utilization. Cost estimation and financing of constructed facilities. Contracting, construction planning and fundamental scheduling procedures. Cost control, monitoring and accounting for construction.
Civil & Environmental Engineering	CIT	12421	ENGINEERNG ECONOMICS	UG	Basic concepts of economic analysis and evaluation of alternative engineering projects for capital investment. Consideration of time value of money and common merit measures such as net present value and internal rate of return. Selection of independent projects and mutually exclusive proposals, using various methods of analysis. Capital budgeting and project financing. Influence of price level changes, depreciation and taxation on choice of alternatives. Uncertainty and risk in operation and financing. Important factors affecting investment decisions for private and public projects.
Civil & Environmental Engineering	CIT	12606	TRAFFIC ENGINEERING	GR	Introduction to traffic engineering providing practical experience that can be used directly in the workforce. Course material will provide a solid foundation in preparing for the Transportation portion of the Professional Engineer exam. The course incorporates the initial planning side of transportation engineering with tasks such as traffic analyses, traffic studies and transportation/traffic engineering report writing.
Civil & Environmental Engineering	CIT	12629	ENV MICROBIOLGY ENGR	GR	This class provides a general introduction to microorganisms in natural and engineered environments. Selected topics include: cellular architecture, energetics and energy conservation, growth and catabolism; evolution and genetics; population and community dynamics; water and soil microbiology; biogeochemical cycling; biofilms; and microorganisms in wastewater, pollution attenuation, and bioremediation.
Civil & Environmental Engineering	CIT	12631	STRUCTURAL DESIGN	GR	Design of structural members for bending moment, shear force, axial force, and combined axial force and bending. Reinforced concrete, structural steel, and composite beam construction are considered. Buckling effects in columns, beams and local plate segments are treated. Serviceability limits such as deflection and cracking are addressed. Design projects include the determination of loads and the selection of system geometry.

Department	College	Course #	Course Title	Grad/UG	Description
Civil & Environmental Engineering	CIT	12636	GEOTECHNICAL ENGINR	GR	Behavior of geotechnical structures; engineering design of geotechnical structures considering failure modes; uncertainties; economic issues, required design formats and relevant code provisions; performance requirements for foundations, subsurface investigations; allowable stress and LRFD design approaches; reliability-based design; shallow foundations; deep foundations; retaining structures; reinforced concrete foundations.
Civil & Environmental Engineering	CIT	12638	BEHAV STRUCT SYS	GR	Students will learn how structural systems work, the rationale behind building design codes, and how to design structures that can resist complicated loads like wind and earthquakes. Topics include fundamental principles of structural design, common structural systems, methods for determining and applying loads to buildings, approximate methods of analysis, distribution of gravity and lateral loads, frames, shear walls, and structural details for steel and reinforced concrete. The conceptual design for a building is developed through a semester-long project.
Civil & Environmental Engineering	CIT	12651	AIR QUALITY ENGIN	GR	The course provides a quantitative introduction to the processes that control atmospheric pollutants and the use of mass balance models to predict pollutant concentrations. We survey major processes including emission rates, atmospheric dispersion, chemistry, and deposition. The course includes discussion of basic atmospheric science and meteorology to support understanding air pollution behavior. Concepts in this area include vertical structure of the atmosphere, atmospheric general circulation, atmospheric stability, and boundary layer turbulence. The course also discusses briefly the negative impacts of air pollution on society and the regulatory framework for controlling pollution in the United States. The principles taught are applicable to a wide variety of air pollutants but special focus is given to tropospheric ozone and particulate matter. The course is intended for graduate students as well as advanced undergraduates. It assumes a knowledge of mass balances, fluid mechanics, chemistry, and statistics typical of an undergraduate engineer but is open to students from other scientific disciplines.
Civil & Environmental Engineering	CIT	12657	WTR RESOURCE SYS ENG	GR	Principles and applications of open channel flow. Hydrology of surface and ground water sources and the estimation of water requirements. Planning and design of water distribution and wastewater and storm water collection systems.

Department	College	Course #	Course Title	Grad/UG	Description
Civil & Environmental Engineering	CIT	12702	FND WATER QUALTY ENG	GR	This course is a systematic overview of water quality engineering designed for students with no prior civil and environmental engineering background. Topics examined include physical, chemical, and biological characteristics of water; common water pollutants; basic water chemistry and micriobiology; mass and energy balances and their use in reactor analysis; physical, chemical and biological processes affecting natural water quality and the use of these processes in water supply and wastewater management systems; and selected problems in surface water and groundwater quality management. A background in college-level general chemistry, physics, calculus, and differential equations is assumed.
Civil & Environmental Engineering	CIT	12718	EESS PROJECT	GR	This course integrates and exercises students in a significant sustainable engineering and/or environmental project that is team-based and built upon the knowledge, skills, and technologies learned in the core and specialist courses in the EESS graduate curriculum.
Civil & Environmental Engineering	CIT	12720	WATER RESOURCE CHEM	GR	This course provides a rigorous yet practical basis for applying the principles of physical chemistry to understanding the composition of natural waters and to the engineering of water and wastewater treatment processes. Topics covered include chemical equilibrium and kinetics; acid-base equilibria and buffering; solid precipitation and dissolution; oxidation and reduction reactions; adsorption on solids; and computer-aided problem solving. The primary objective of the course is to be able to formulate and solve chemical equilibrium models for complex aqueous systems. Knowledge of college-level general chemistry is assumed.
Civil & Environmental Engineering	CIT	12725	FTE TRNS PHSCHM PROC	GR	Examination of the major physical and chemical processes affecting the fate and treatment of organic compounds nanoparticles in aquatic systems. The emphasis is on anthropogenic organic compounds. The course will review some concepts from physical organic chemistry, and examine the relationships between chemical structure, properties, and environmental behavior of organic compounds. Chemical processes important to the fate, treatment, and biotransformation of specific organic compounds are addressed. Two laboratory sessions illustrate measurement techniques for organic compounds in water. 12-702 is a co- req for non environmental engineers or students who have not had and environmental engineering undergraduate course

Department	College	Course #	Course Title	Grad/UG	Description
Civil & Environmental Engineering	CIT	12729	ENV MICROBIOLGY ENGR	GR	This course is intended for first-year graduate students who enroll in 12-629; additional work is required by way of a term project.
Civil & Environmental Engineering	CIT	12735	URBN SYS MODG	GR	This course will introduce graduate students to concepts of probabilistic risk assessment and decision making under uncertainty, with applications to infrastructure systems. Topics covered will include: a review of probability and utility theories, with emphasis on the Bayesian framework; an introduction on graphical models to describe the interdependence of system components; analytical methods to risk assessment (First Order Reliability Method) and numerical simulations (crude and advance Monte Carlo techniques). The student will learn how to quantify the risk, depending on the management policy selected, and how to update the assessment by analyzing observations on the system performance.
Civil & Environmental Engineering	CIT	12741	DATA MANAGEMENT	GR	The intent of this course is to introduce students to database management systems and to knowledge discovery in database principles. Students will learn how to develop powerful tools for efficiently managing large amounts of civil engineering data so that it may persist safely over long periods of time. Students will be introduced to relational database systems and structured query languages. They will also be exposed to other existing data models. Students also will be introduced to data mining and analysis tools to discover patterns and knowledge from data.
Civil & Environmental Engineering	CIT	12746	ST: PYTHON PROTOTYP	GR	This course uses the Python programming language to introduce fundamental programming approaches to students from civil and environmental engineering. No prerequisite required and students with no programming experience are recommended to take this course. This course will cover fundamental programming approaches, object-oriented programming concepts, graphical user interface design in Python, and file and database operation. Real-world examples from infrastructure management will be used in the class for demonstration and term project. Students will work individually and in teams to develop a series of applications that are potentially be used in real-world applications.

Department	College	Course #	Course Title	Grad/UG	Description
Civil & Environmental Engineering	CIT	12750	INFRASTRUCTURE MGMT	GR	This course takes a broad view of infrastructure systems to include physical infrastructure and information networks. The course will consider the need to protect these critical infrastructures from both degradation as well as malicious attacks. Infrastructure management generally depends on public-private partnerships to ensure long-term viability. We will look at relevant academic literature on the topics of infrastructure needs and requirements. We will explore the use of automated sensing and computer network systems to facilitate management.
Civil & Environmental Engineering	CIT	12751	AIR QUALTY ENGINEERG	GR	The course provides a quantitative introduction to the processes that control atmospheric pollutants and the use of mass balance models to predict pollutant concentrations. We survey major processes including emission rates, atmospheric dispersion, chemistry, and deposition. The course includes discussion of basic atmospheric science and meteorology to support understanding air pollution behavior. Concepts in this area include vertical structure of the atmosphere, atmospheric general circulation, atmospheric stability, and boundary layer turbulence. The course also discusses briefly the negative impacts of air pollution on society and the regulatory framework for controlling pollution in the United States. The principles taught are applicable to a wide variety of air pollutants but special focus is given to tropospheric ozone and particulate matter. The course is intended for graduate students as well as advanced undergraduates. It assumes a knowledge of mass balances, fluid mechanics, chemistry, and statistics typical of an undergraduate engineer but is open to students from other scientific disciplines.
Civil & Environmental Engineering	CIT	12766	ST: CLIMATE CHG	GR	This course consists of four parts. The first part will provide a primer for those who are curious about the physical mechanisms by which climate is determined, and by which climate change occurs. The treatment of these mechanisms will not be overly quantitative, and no knowledge of meteorology or atmospheric science is needed. College-level physics, as well as basic calculus and basic chemistry, is, however, needed. The second part will describe the projected consequences of climate change, as well as those that are already occurring. This part will also familiarize students with how societies might adapt to these changes. The third part will explore (and critique) some of the tools that decision-makers use to quantify and compare the damages caused by these consequences. The final part of the course will discuss some of the technologies that could be used to prevent dangerous climate change.

Department	College	Course #	Course Title	Grad/UG	Description
Creative Enterprise:Sch of Pub Pol & Mgt	HC	93703	ARTS ENT: MGT & STR	GR	Arts Enterprises: Structures and Management examines the fundamental structures, governance, and management systems involved in running a successful 21st century arts enterprise. The course goes beyond a 'principles of arts management' position to introduce students to the local, national, and international forces that make running an arts-based business unique. Students discover how arts enterprises are governed internally (formal leadership) and externally (public policy, market forces, and financial realities). Furthermore, students learn how enterprises engage multiple stakeholders, from artists or politicians to staff or audiences. Almost daily, arts managers are faced with choices that affect internal operation dynamics and external stakeholder relations. During the course, students will discern the day-to-day systems and operations of well-run arts organizations and investigate moments of failure in order to find the lessons learned. The course provides a lens into the nexus of institution-artist-audience within a framework of mission-impact and ROI. This course provides students with both the fundamentals and the emerging practices within arts enterprises creating a foundation for subsequent, advanced coursework. Students will encounter the theoretical frameworks necessary to understand the enterprise, and then ground the theory in real-life experience, case studies, and course-exercises. The course is organized in 5 modules: Public Policy & the Profession, Law & Business Structures, Board & Governance, Issues in the Field, and Strategic & Business Planning. For the purpose of this course, arts enterprises will be defined as those that create relationships between artists and audiences. These include, but are not limited to: orchestras, opera companies, music ensembles, museums, arts centers, theatre companies, presenting orgs, multimedia centers, artist agencies, galleries, media and dance companies.
				Design	28
Design	CFA	51171	PLACING	UG	This course will explore the context in which students study design. Using primarily photography, students compare where they are from to the bioregion of the Ohio Valley of Western Pennsylvania and the history of the steel town, Pittsburgh. Students also learn about the modern Western emergence of design as a profession and discipline, and map the edges of current design practice by interacting with local professionals.
Design	CFA	51172	SYSTEMS	UG	Explore how to understand complex phenomena by creating models of the interrelations between components. Students learn soft systems diagramming as well as the systems thinking associated with ecologies, integrative science and sociotechnical regimes. Students also learn how to see design as a way of making interventions into a leverage point in a system in order to transform how it functions elsewhere in the system.

Department	College	Course #	Course Title	Grad/UG	Description
Design	CFA	51173	HUMAN EXPER IN DES	UG	This course introduces the central themes of design and the design professions, and the human centered focus in all aspects of design thinking and practice. We will begin by exploring the nature of having an experience, followed by the broad philosophy of design in relationship to other areas of human activity, the sciences and the arts. We will explore design through its orders of activity: first in communication and second the creation of physical objects. But design has a far greater reach into the intangible and more complex areas of human activity: interaction, systems, environments, and culture. These are the topics of inquiry for design and, unlike what the patchwork of professions would have you believe, are not fixed by boundaries. Design is enormously broad and something everybody participates in as we create the artificial world in which we live. Those who call themselves designers have greater power in shaping this world and for that reason we will end the course with a discussion of ethics. Non-Design majors are welcome.
Design	CFA	51221	COLOR FOR CPE	UG	This course will explore the fundamentals of color through the implementation of various media as they apply to their use in communication and expression in design. While this course does not deal with color theory per se we will spend time on the causes and effects of color interaction, color contrasts, color harmonies and color strategies for the effective use of color in our visual design work. We will use both nature and man made constructs to discuss how color affects what we see and its effect on our visual world. Short exercises and longer- term projects will be the vehicles of our explorations. This course is for Sophomore Design Majors.
Design	CFA	51265	ENVIRON STUDIO I	UG	Learn the basic design processes for experience-driven multi-modal environments, making meaningful physical and virtual experiences through planning, structuring, and explaining/visualizing; utilize a range and combination of analog and digital tools for high fidelity output.
Design	CFA	51267	PROTOLAB I: ENVRNMNT	UG	Learn methods for designing interactions in environments through experiencing the space, low-fi prototyping, rapid making, 3D CAD software and video sketching. Express multi-modal aspects of integrated physical-digital-hybrid environments.

Department	College	Course #	Course Title	Grad/UG	Description
Design	CFA	51268	ENVIRON STUDIO II	UG	Introduce students to the concept of resonant environments that provide meaningful physical and virtual experiences; utilize a range and combination of analog and digital tools for high fidelity output.
Design	CFA	51269	PROTOLAB II:ENVRNMNT	UG	Explore simple reactive and interactive programming as a means to support virtual and hybrid digital/physical environments.
Design	CFA	51272	CULTURES	UG	Explore the many often-unbridgeable differences between people. These differences may be not only ethnic, but also related to gender, age, class. The course will survey critical theories that are useful for warning of these kinds of differences. Studetns will also explore strategies for negotiating these differences, many of which require time and working at multiple levels.
Design	CFA	51341	HOW THINGS ARE MADE	UG	This course will provide a breadth of knowledge for current manufacturing, materials, and processes encountered in the industrial design field. There will be an emphasis on actual production/manufacture methods and not rapid prototyping methods. The class will consist of various lectures, media, electronic tools, and on-site visits to enable an understanding of how mass production affects design and design decisions. Industrial Design Juniors & Seniors or permission of the instructor.

Department	College	Course #	Course Title	Grad/UG	Description
Design	CFA	51347	DRAWING FRM NATURE	UG	Drawing From Nature This course is about observing and making images of things growing, crawling, flying, swimming etc. Observations will be made firsthand in the field, supported with relevant research in topic areas with the aim of deepening personal understanding of all things biological. Issue surrounding natural forms such as behavior, locomotion, adaptation, the environment and systems will also be investigated. We will work in tandem on refining our abilities in communicating what we discover through the process of drawing. A variety of visualization methods will be covered i.e. analytical drawing, visual notes, and diagramming to name a few. We will be using a variety of basic drawing and digital media to develop our work as we uncover aspects of form, structure and surface. Guest speakers will present work they have done in areas such as botany, biology, and environmental studies to name a few. A majority of the work will be done in the field and will then be developed in the studio. A final project will be assigned that will challenge you to develop a concept along with a compelling form(s) that communicates what you have uncovered about nature to a variety of audiences. This course builds on your experiences from First Year drawing and introduces several more advanced visualization methods. This course is intended for Junior and Senior Design Majors.
Design	CFA	51363	ENVRNMNTS STUDIO III	UG	Provide a framework and tools for designing for environments using experience design methods as a means to address the plurality of digital/physical hybrid environments
Design	CFA	51364	DRAWING SPACES	UG	The natural and built environment will comprise the subjects of inquiry in this course. We will investigate systems of spatial and physical organization as found in the landscape in various forms and structures from forest to farm and from tent to tenement as examples. The intersection of these systems found in accessible locals will be investigated in the field through on site drawings using simple media and sketchbooks. These studies will then form the basis for the iteration of more developed images depicting environments both existing and imagined. Some time will be spent on observing people and various life forms as they populate and interact within these spaces to various ends.
Design	CFA	51371	FUTURES	UG	Cover different approaches to interpreting the future: from the extrapolations of trend forecasting, through the risk assessments of scenario planning, to attempts to steering the present through backcasting. Students explore the future through utopian and dystopian fictions that are created by authors, filmmakers and themselves. Students also attempt to evaluate futures in terms of their longer term consequences.

Department	College	Course #	Course Title	Grad/UG	Description
Design	CFA	51377	SENSING ENVIRONMENTS	UG	Whereas UX Design is typically described as shaping the immediate environment between a user and an object/interface, this course will instruct you in techniques, methods, and vocabularies to expand the scale of your design. Course content will give students experience integrating and shaping their current work into 2-3 other levels of scale, such as a single room, building, campus, and neighborhood. Students will walk away with an understanding of environments that will expand their range of capability, fitting for interdisciplinary application within fields such as social innovation, community development, public policy, architecture, and urban design.
Design	CFA	51382	INTRO TO SOC INNOV	UG	This course serves as an introduction to design for social innovation and better prepares students for 51384 Principles & Methods for Design for Social Innovation.
Design	CFA	51384	PRNCPLS SOC INNOV	UG	Service, social innovation, transition: all involve engagement with shifting social patterns. This course addresses theory, approaches, methods and skills needed to address social systems challenges, with an emphasis on equipping students for practice. Through a mix of lecture, readings, classroom activities and short projects, the course covers three scales: system, team, and individual. Topics include theories of change, the nature of social system complexity, current approaches and methods for working toward social system shifts, and the skills needed to apply those methods and approaches. Both classroom activities and homework assignments deal not only with the externals of this work, but also with the "inner game" -- developing the personal stance and capacities necessary to work in uncertainty, in conflict, and in the midst of sometimes difficult social challenges.

Department	College	Course #	Course Title	Grad/UG	Description
Design	CFA	51400	TRANSITION DESIGN	UG	Transition Design: Designing for Systems-Level Change. This course will provide an overview of the emerging field of Transition Design, which proposes societal transitions toward more sustainable futures. The idea of intentional (designed) societal transitions has become a global meme and involves an understanding of the complex dynamics of whole systems which form the context for many of todays wicked problems (climate change, loss of biodiversity, pollution, growing gap between rich/poor, etc.).Through a mix of lecture, readings, classroom activities and projects, students will be introduced to the emerging Transition Design process which focuses on framing problems in large, spatio-temporal contexts, resolving conflict among stakeholder groups and facilitating the co-creation of desirable, long-term futures. This course will prepare students for work in transdisciplinary teams to address large, societal problems that require a deep understanding of the anatomy and dynamics of complex systems.
Design	CFA	51434	EXPERIMENTAL FORM	UG	The Experimental Form Studio looks broadly at the discipline of industrial design with an emphasis on creating new paradigms for interactive objects. This course encourages an exploratory study of physical objects and artifacts and provides a creative and intellectual forum to re-imagine our relationship with objects. Each independently-themed project presents opportunities to consider embedded mechanics & technology, objects as interactive media, and experience-driven design. Experimental Form, at its most basic, is a process that blends play and inquiry in an open-ended way finding the unexpected through tinkering and trying something you don't quite know how to do, guided by imagination and curiosity. In this sense, Experimental Form complements the core ID Studio sequence by providing a playground for intellectual discourse, experimental trial and error, and refining individual processes for designing. This is your sandbox. Prerequisites: Junior standing in industrial design. Junior level communication design with instructor permission.
Design	CFA	51460	RE-THNKG SCH BUS EXP	UG	Re-thinking the yellow school bus experience.
Design	CFA	51480	DES CAPSTONE PROJ	UG	Learn how to work independently, applying skills/knowledge in Products, Communications, Environments to the research/definition/development/testing of a project that focuses on the design of a service or social innovation that warrants investigation; deepen understanding of service & social innovation design principles and how they are put into practice.

Department	College	Course #	Course Title	Grad/UG	Description
Design	CFA	51485	DES:NEW WAYS TO THNK	UG	In this course, we'll carry out 'research through design' projects using experimental investigative methods in the wild, focusing on new ways to think and understand in an increasingly complex world. Learn and develop a variety of tools for conducting innovative forms of research through design, focused on exploring how people think, understand and imagine complex social and technological concepts, and envision futures. By the end of the course students will have worked on an interdisciplinary research project, including with an external partner, drawing on a number of disciplinary domains, and have experience with different kinds of design research and practice, from speculative and critical design to participatory design, as well as developing the skills and experience necessary to innovate with, and deploy, those methods. This course is a complement to 51-487 Design Center: Imaginaries Lab: New Ways To Live, but is independent of it, and eitheror bothcourses can be taken without overlap (we will be doing different projects, with a different focus).
Design	CFA	51487	DES:NEW WAYS TO LIVE	UG	Focusing on new ways to live and experience the world, now and in the future, we'll do practical investigative 'research through design' projects using experimental methods in the wild. Learn and develop a variety of tools for conducting innovative forms of research through design, focused on exploring how people think, understand and imagine complex social and technological concepts, and envision futures. By the end of the course students will have worked on an interdisciplinary research project, including with an external partner, drawing on a number of disciplinary domains, and have experience with different kinds of design research and practice, from speculative and critical design to participatory design, as well as developing the skills and experience necessary to innovate with, and deploy, those methods. This course is a complement to 51-485 Design Center: Imaginaries Lab: New Ways To Think, but is independent of it, and eitheror bothcourses can be taken without overlap (we will be doing different projects, with a different focus).
Design	CFA	51702	TRANSITION DESIGN	GR	Transition Design: Designing for Systems-Level Change. This course will provide an overview of the emerging field of Transition Design, which proposes societal transitions toward more sustainable futures. The idea of intentional (designed) societal transitions has become a global meme and involves an understanding of the complex dynamics of whole systems which form the context for many of todays wicked problems (climate change, loss of biodiversity, pollution, growing gap between rich/poor, etc.).Through a mix of lecture, readings, classroom activities and projects, students will be introduced to the emerging Transition Design process which focuses on framing problems in large, spatio-temporal contexts, resolving conflict among stakeholder groups and facilitating the co-creation of desirable, long-term futures. This course will prepare students for work in transdisciplinary teams to address large, societal problems that require a deep understanding of the anatomy and dynamics of complex systems.

Department	College	Course #	Course Title	Grad/UG	Description
Design	CFA	51782	INTRO TO SOC INNOV	GR	This course serves as an introduction to design for social innovation and better prepares students for 51784 Principles & Methods for Design for Social Innovation.
Design	CFA	51860	RE-THNKG SCH BUS EXP	GR	Re-thinking the yellow school bus experience.
Design	CFA	51877	AI: BUILDGS & CITIES	GR	This seminar considers the critical implications of AI and design at the scale of buildings and cities. We will draw from a mix of sources, including fiction and non-fiction readings, movies, games, and software, and guest speakers, to examine the past, present, and future of AI, buildings and cities
Design	CFA	51884	PRNCPLS SOC INNOV	GR	Service, social innovation, transition: all involve engagement with shifting social patterns. This course addresses theory, approaches, methods and skills needed to address social systems challenges, with an emphasis on equipping students for practice. Through a mix of lecture, readings, classroom activities and short projects, the course covers three scales: system, team, and individual. Topics include theories of change, the nature of social system complexity, current approaches and methods for working toward social system shifts, and the skills needed to apply those methods and approaches. Both classroom activities and homework assignments deal not only with the externals of this work, but also with the "inner game" -- developing the personal stance and capacities necessary to work in uncertainty, in conflict, and in the midst of sometimes difficult social challenges.
					Dietrich College Information Systems 3
Dietrich College Information Systems	DC	67308	HEALTH CARE IS	UG	Healthcare information systems are intended to improve patient outcomes while reducing the cost of clinical care. However, with the highest per person healthcare expenditures, the United States ranks low in healthcare quality compared to other countries. Although healthcare information systems are improving, challenges persist because information workflow, human interface design, and interoperability are not emphasized. In this course, students will learn to solve real-world healthcare information systems challenges in a team-based format. Juniors and Seniors

Department	College	Course #	Course Title	Grad/UG	Description
Dietrich College Information Systems	DC	67327	WEB APPLCTN SECURITY	UG	This is a technical course designed to help students learn how to exploit web applications and to be better able as developers to defend against such exploits. The course covers the process of hacking a web application, starting with initial mapping and analysis, followed by identifying common logic flaws in web apps, database and network exploits, command and SQL injections, and the like. This hands-on course requires students to be familiar with a popular web application framework or language (such as Ruby on Rails, PHP, Django/Python, ASP.NET or the like). Prerequisite: 67-272 or permission of instructor.
Dietrich College Information Systems	DC	67329	CONTP THMS GLBL SYST	UG	Globalization and outsourcing of information systems (IS) is a mainstay of the business environment. The decision to outsource software services to providers in distant places has many risks and thus careful management of critical success factors is essential. Likewise, products and services are being developed and delivered by teams of people in diverse locations working together. Management of these sourcing models and human capital relationships will be an increasingly important skill for students expecting to fully participate in the emerging IS marketplace of the 21st century. This course introduces the effective fundamentals of global project management and the mechanics of sourcing arrangements including offshore outsourcing. Students will also examine the effects of human diversity and cross-cultural considerations in the creation, use and management of information systems. A combination of readings, participation in class discussions, and non-technical collaborative projects will be expected of class participants. Students must have sophomore standing or higher.
				Dietrich College Interdisciplinary	6
Dietrich College Interdisciplinary	DC	66103	HSP FRESHMAN SEMINAR	UG	The Appalachian region - which stretches from Georgia to New York's southern plateau - has a particular place in American history and memory. This course will examine the political, literary, economic and historical narratives that surround the region, as well as examining the role that Appalachia can play as a model for developing regions in other parts of the world. This course fulfills the Freshman Seminar requirement for the Humanities Scholars Program. Enrollment is restricted to first-year HSP students.

Department	College	Course #	Course Title	Grad/UG	Description
Dietrich College Interdisciplinary	DC	66107	DC FRESHMAN SEMINAR	UG	Most of the major issues confronting humanity---such as climate change, financial collapse, ecosystem survival, terrorism, and disease epidemics---are the result of complex systems where the interactions of the pieces of the system create a whole that is rather different thanany of its parts. Unfortunately, traditional scientific methods that focus on reducing systems to their parts and then analyzing each part provide little insight into such systems. This seminar explores the behavior of complex systems as well as how to model and understand them using both traditional tools and computer-based approaches.
Dietrich College Interdisciplinary	DC	66110	DC FRESHMAN SEMINAR	UG	This Grand Challenge freshman seminar on inequality is inspired in part by the specter of global income inequality. Income inequality has reached such a peak that eight men own as much wealth as half the world's population, the world's poorest 3.6 billion people. Inequality may be a feature of all societies across history to some degree. But inequality strikes us an especially timely topic because of the current demands for greater political, social, and economic equality. The four of us will use the disciplines we come from - economics, anthropology, history, psychology, and literary/cultural studies - to introduce you to the concept of inequality in the age of capitalism. We will consider how inequality emerged as a social and political problem in the 18th and 19th centuries, and how it has re-emerged as a key concept for socio-political movements in our current moment. We will conclude with an inquiry into what the future of inequality might look like, especially with the coming of increased automation and the elimination of at least 50% of the jobs currently being done by human beings.

Department	College	Course #	Course Title	Grad/UG	Description
Dietrich College Interdisciplinary	DC	66118	DC FRESHMAN SEMINAR	UG	Grand Challenge Freshman Seminar: Thinking with Evidence: Data, Scientific Discovery, and Society. In a time of big data and widespread skepticism of science, it is crucial to understand how data and facts can be turned into conclusions, and then into public policy. Using topics from medicine, epidemiology, and public health, this course provides students an introduction into the grand challenge of understanding how evidence is used (and abused) in support of scientific conclusions. Questions of health and disease are particularly important areas for thinking about facts and figures because many life-or-death decisions have to be made on the basis of fragmentary and unreliable evidence. Every trip to the doctor, illness, and vaccination involves a complicated mix of public policy, scientific evidence, and emotional and historical factors. This course helps students understand the sciences and the humanities as united in their desire for rigorous argumentation rather than as competing or incompatible ways of thinking. Moreover, by taking a wide-angle lens to the topic, students will see how and why standards of scientific proof have changed over time, and track what these changes mean for thinking about evidence. Co-taught by a statistician and historian, this course draws on many different disciplines, providing students a broad introduction to reasoning across the humanities and social sciences. Students will be required to participate in written and oral arguments, read scientific articles as well as political, historical, and legal documents, and prepare a capstone project in which they will be asked to weigh real-life evidence and recommend a course of action to the Food and Drug Administration. Other topics may include vaccination controversies, regulation of carcinogens and toxic chemicals, mammography screening standards, and the treatment of infectious diseases in global health settings.
Dietrich College Interdisciplinary	DC	66161	DC FRESHMAN SEMINAR	UG	In 1965 British mathematician I.J. Good wrote, "An ultraintelligent machine could design even better machines; there would then unquestionably be an 'intelligence explosion,' and the intelligence of man would be left far behind." As we enter an age where companies like Uber are testing driverless cars in Pittsburgh and innovative interfaces like IBM's Watson can play Jeopardy and learn techniques for medical diagnoses, how are we to negotiate an 'intelligence explosion' that for many individuals might threaten the very notions of what it means to be human? The future of human-to-machine relationships will likely define our historical epoch and yet, many young technologists and humanists underestimate the downstream impact of technological innovations on human society. Presently, we have little choice but to attend to this rapidly anxiety-ridden question. This seminar will attend to the challenge of contemporary existential questions on what it means to be human (read not machine) in the context of a rapidly advancing technological age. We will consider human narratives throughout history that exam how governments and individual citizens defined humanity in the context of slavery and colonialism as a framework for exploring and projecting what it means to be human in the age of rapidly advancing 'intelligent' machines. We will trace the technological advancements of the recent five decades and identify historical precedents and speculative narratives that help us to consider issues like labor, economic disparity, negotiations of power, human dignity and ethical responsibility within the context of human relations with advancing technological tools that are now coined, artificial intelligence.

Department	College	Course #	Course Title	Grad/UG	Description
Dietrich College Interdisciplinary	DC	66221	TOPICS OF LAW	UG	Topics for this course vary, to include such foci as intellectual property, introduction to U.S. law, great American trials, and the U.S. Constitution. Topics and courses are designed to be broadly relevant and interesting for university undergraduates, and not narrowly tailored for students interested in law school.
					Drama 4
Drama	CFA	54277	NEG CON MGMT	UG	This class is a focused exploration of the process of negotiating, both formally and everyday. We will examine interactions on all levels and environments, with an evaluation of tactics, strategies and the measure of success. From there, the class expands into the nature of conflicts and the manager's role in identifying and confronting them. Throughout the class, we hope to find solutions to implement in our lives and work. In-class exercises and roleplay will be a fundamental part of class activity.
Drama	CFA	54360	LEADER: ETHICS & INNOV	UG	This course will be an exploration of both innovative strategies and the ethics of leadership within the performing arts. It will build on the management principles covered in foundational courses and is designed to offer the student an approach to leadership development that is tailored to the individuals strengths and needs as well as their role within theatrical organizations. For PTM students only or with permission from the instructor.
Drama	CFA	54486	UNDSTANDING TEXTILES	UG	Understanding Textiles is a half-semester introduction to the textiles used for the performing arts. This course begins with an overview of the historical development of textile technology and the role cloth plays in world economies. Next it examines weaving structures and how they impact suitability for particular applications. Techniques for identifying fibers, weaves and fabric density are learned. The course culminates with a project that uses all the explored skills, a fabric in history swatch book. Each student takes an era of history, researches cloth production at that time, finds period appropriate swatches, accurately identifies them and suggests uses for each. These individual chapters are combined into a large resource book, a copy of which each participant keeps for future reference.

Department	College	Course #	Course Title	Grad/UG	Description
Drama	CFA	54815	GRD NEG CON MNGT	GR	This class is a focused exploration of the process of negotiating, both formally and everyday. We will examine interactions on all levels and environments, with an evaluation of tactics, strategies and the measure of success. From there, the class expands into the nature of conflicts and the manager's role in identifying and confronting them. Throughout the class, we hope to find solutions to implement in our lives and work. In-class exercises and role play will be a fundamental part of class activity.
					Economics 10
Economics	DC	73060	ECONOMICS: BASECAMP	UG	This short course will launch you into the economics intellectual space and get you thinking like an economist. Through a series of presentations by some of CMU¿s great economics thinkers you will learn how economic reasoning harnessed to data can lead to better policy design and better business decision making. Presentations may cover the economics of bitcoin and crypto-currency, online market design, financial crises, the future of work and other topics. The presentations will be curated by one of CMU's research economists and there will be plenty of opportunities for discussion and debate. The course will also introduce you to the CMU approach to economics and map out the CMU economics major landscape.
Economics	DC	73102	PRINCPLES OF MICROEC	UG	A one-semester course that teaches the fundamentals of microeconomics. Students will learn how microeconomic analysis can explain market successes, market failures, and how government intervention might improve outcomes. In addition to an investigation of firm behavior and consumer behavior, attention will be paid to: Game Theory, Behavioral Economics, Economics of Time and Risk, Economics of Information, Experimental Economics, and Auctions and Market Design. Students will also learn how to integrate basic data analysis and statistics. Not open to students who have received credit for 73-100. (Lecture, 2 hours; Recitation, 1 hour).

Department	College	Course #	Course Title	Grad/UG	Description
Economics	DC	73103	PRINCPLES OF MACROEC	UG	A one-semester course that teaches the fundamentals of macroeconomics. Students will learn how macroeconomic analysis can explain national economic activity and how government intervention might stabilize an economy. Topics include: defining and measuring national wealth, economic growth, credit markets, unemployment, interest rates, inflation, and the monetary system. Additional emphasis will be paid to: long-term economic development, political economy, financial crises and topics that are central to contemporary macroeconomic debates such as the impact of technological change, migration, and trade on the macroeconomy. Students will access macroeconomic databases, and then use basic statistics to describe and isolate empirical patterns in macro-data. Not open to students who have received credit for 73-100. (Lecture, 2 hours; Recitation, 1 hour).
Economics	DC	73210	ECON COLLOQ I	UG	Economics majors meet weekly for discussions about current research by faculty or students, presentations on economics from economists outside academia, and expository talks on selected economics topics not part of the usual curricula. The colloquium provides students with opportunities to grow personally and intellectually by introducing them to campus resources (including special interest to undergraduates such as preparation for graduate school) and using the economic toolbox to examine current economic topics in the press. It is recommended that students take this course during the sophomore year so that economics majors realize the range of resources that exist on campus. (Colloquium, 1 hour)
Economics	DC	73230	INTERMEDT MICRCOMCS	UG	This course is a calculus-based study of microeconomics. Topics in partial equilibrium analysis include supply and demand, consumer theory, theory of the firm, profit maximizing behavior, monopoly theory, and perfect competition. The course concludes with an introduction to general equilibrium analysis and the welfare laws. (Lecture, 3 hours; Recitation, 1 hour). Minimum grade of "C" required in all economics pre-requisite courses. Not open to first year student during S18.
Economics	DC	73240	INTERMD MACROECONOMC	UG	Through macroeconomic models built upon microeconomic foundations, insights are developed into economic growth processes and business cycles. Topics include aggregation and measurement, national income, business cycle measurement, economic welfare theorems and social inefficiencies, the effect of government fiscal policy upon employment and productivity, and the relationship between investment, interest rates and economic growth. (Lecture, 3 hours; Recitation, 1 hour). Minimum grade of "C" required in all economics pre-requisite courses.

Department	College	Course #	Course Title	Grad/UG	Description
Economics	DC	73270	STR PROF COMM FR ECO	UG	A writing course specifically designed for third-year Economics majors and additional majors. Students gain experience with technical writing techniques and skills needed for both their senior thesis and their eventual professional careers. The course emphasizes both individual and group projects. (Seminar, 3 hours). Minimum grade of "C" required in all economics pre-requisite courses.
Economics	DC	73348	BEHAVIORAL ECONOMCS	UG	This course introduces students to behavioral economics which is a subfield of economics that incorporates insights from other social sciences, such as psychology, into economic models and aims to explain the anomalies challenging some of the classical economic models. (Lecture, 3 hours). Minimum grade of "C" required in all economics pre-requisite courses.
Economics	DC	73352	PUBLIC ECONOMICS	UG	In this course, students analyze the role of governments in market economies and their impact on the behavior and welfare of citizens. Reasons for government intervention in markets are examined in light of some of the economic challenges faced by modern societies in an increasingly globalized marketplace. Topics include: taxation and expenditure policies, externalities and market failure, social security, public assistance and income redistribution programs. There will also be some coverage of the role of local governments in the economy with respect to such issues as crime, urban development and education. (Lecture, 3 hours). Minimum grade of "C" required in all economics pre-requisite courses.
Economics	DC	73433	ENVIRONMNTL PLY ECON	UG	The primary objective of this course is to encourage students to apply the tools of microeconomic analysis (and to a lesser degree, macroeconomics) to the problems of environmental protection, natural resource management, and energy production and use. The course will begin by introducing students to how an economist approaches problems of market failure commonly found in environmental contexts. Next, we will explore models that characterize solutions to such environmental issues. We will then address questions regarding measurement, the design of environmental regulations, and, finally, we will apply the tools that we have developed during the semester to the problems of climate change, and the optimal management of forests, water resources, and land use. (Lecture, 3 hours). Minimum grade of "C" required in all economics pre-requisite courses.

Department	College	Course #	Course Title	Grad/UG	Description
Electrical & Computer Engineering	CIT	18200	ECE SOPH SEMINAR	UG	"The class comprises of a series of lectures from our own faculty and alumni, Department and University staff, and student groups. Students are required to attend each lecture. The lectures are designed to serve the following purposes: 1. Introduce to students to the faculty member's research field and the most current world advancements in engineering and technology in that area; 2. Provide students a good understanding of our curriculum structure and the courses in various areas; 3. Present correlations between the present technological developments and our courses for each course area; 4. Introduce new undergraduate courses; 5. Advertise on-campus/off-campus research opportunities for undergraduate students and explain the corresponding research projects; 6. Motivate students with positive presentations on the importance of obtaining education and gaining self-learning ability; 7. Provide basic education on learning and working ethics."
Electrical & Computer Engineering	CIT	18300	FUND ELECTROMAGNETCS	UG	This course introduces electromagnetic principles and describes ways in which those principles are applied in engineering devices and systems. Topics include: vector calculus as a mathematical foundation for field descriptions, Maxwell's equations in integral and differential forms with associated boundary conditions as descriptions of all electromagnetic principles, quasistatic electric fields in free space and in materials, superposition for known charge sources, conduction and polarization, resistance and capacitance, charge relaxation, analytic and numerical methods for electric field boundary value problems, quasistatic magnetic fields in free space and in materials, superposition for known current sources, magnetization, inductance, magnetic diffusion, and analytic and numerical methods for magnetic field boundary value problems. 4 hrs. lec.
Electrical & Computer Engineering	CIT	18482	TELECOM TECH POL & MGT	UG	Modern telecommunications is the nervous system of society. The Internet and wireless communications have transformed every aspect of our modern life. This course provides a comprehensive introduction to basic principles of telecommunications technology and the legal, economic, and regulatory environment of today's networks. Topics covered include the fundamentals of communication network technologies, including video, voice, and data networks; the rising dominance of wireless networks; principles behind telecommunications regulation from common carrier law and natural monopoly to information diversity, privacy and national security; traffic differentiation on the Internet and the debate over network neutrality; universal service and the digital divide; mergers, antitrust, and the changing industrial structure of the communications sector. We will explore current topical questions such as the future of competition; the shift of entertainment video from cable and satellite to Internet delivery; how cloud computing concepts are transforming networks; and communications support for the Internet of Things. Comparison with European approaches to communications regulation. Special emphasis on how new technologies have altered, and are altered by, regulation. Junior, Senior or graduate standing required.

Department	College	Course #	Course Title	Grad/UG	Description
Electrical & Computer Engineering	CIT	18631	INTR INFO SECURITY	GR	Our growing reliance on information systems for daily activities, ranging from remote communications to financial exchanges, has made information security a central issue of our critical infrastructure. The course introduces the technical and policy foundations of information security. The main objective of the course is to enable students to reason about information systems from a security engineering perspective, taking into account technical, economic and policy factors. Topics covered in the course include elementary cryptography; access control; common software vulnerabilities; common network vulnerabilities; policy and export control laws, in the U.S., Japan, and elsewhere; privacy; management and assurance; economics of security; and special topics in information security. Prerequisites: The course assumes a basic working knowledge of computers, networks, C and UNIX programming, as well as an elementary mathematics background, but does not assume any prior exposure to topics in computer or communications security. Students lacking technical background (e.g., students without any prior exposure to programming) are expected to catch up through self-study.
Electrical & Computer Engineering	CIT	18632	INTRO HARDWARE SECUR	UG	This course covers basic concepts in the security of hardware systems. Topics covered include active and passive attacks, reverse engineering, counterfeiting, and design of hardware security primitives (e.g., random number generators, physical unclonable functions, crypto-processors). Lab sessions will give students hands on experience with performing attacks, developing countermeasures, and implementing secure hardware building blocks. Students are expected to have basic knowledge of digital logic and Register-Transfer Level (RTL) design, but no specific background in security/cryptography is necessary.
Electrical & Computer Engineering	CIT	18636	BROWSER SECURITY	GR	The Web continues to grow in popularity as platform for retail transactions, financial services, and rapidly evolving forms of communication. It is becoming an increasingly attractive target for attackers who wish to compromise users' systems or steal data from other sites. Browser vendors must stay ahead of these attacks by providing features that support secure web applications. This course will study vulnerabilities in existing web browsers and the applications they render, as well as new technologies that enable web applications that were never before possible. The material will be largely based on current research problems, and students will be expected to criticize and improve existing defenses. Topics of study include (but are not limited to) browser encryption, JavaScript security, plug-in security, sandboxing, web mashups, and authentication. The course will involve an intensive group research project focusing on protocols/algorithms, vulnerabilities, and attacks as well as several individual homework and programming tasks. Groups will perform a sequence of cumulative tasks (literature review, analysis, simulation, design, implementation) to address aspects of their chosen topic, occasionally reporting their results to the class through brief presentations, leading to a final report.

Department	College	Course #	Course Title	Grad/UG	Description
Electrical & Computer Engineering	CIT	18650	POL WRLSS SYS	GR	This course will address public policy issues related to wireless systems. It investigates policies related to a wide variety of emerging wireless systems and technologies, including current and next-generation cellular systems, wifi and white space devices, emerging methods of accessing spectrum, communications systems for emergency responders (firefighters, police, emergency medical services), current and next-generation television, and satellite communications. This can include the government role in facilitating the creation of infrastructure, in advancing competition among broadcasters and communications service providers, in using scarce spectrum efficiently, in promoting public safety and homeland security, and in protecting privacy and security. Because these are inherently interdisciplinary issues, the course will include detailed discussions of technology, economics, and law, with no prerequisites in any of these areas. This course is cross-listed as 18-650, 19-403, 19-713, and 95-824. Senior or graduate standing required.
Electrical & Computer Engineering	CIT	18730	INTRO COMPUTER SEC	GR	This course provides a principled introduction to techniques for defending against hostile adversaries in modern computer systems and computer networks. Topics covered in the course include operating system security; network security, including cryptography and cryptographic protocols, firewalls, and network denial-of-service attacks and defenses; user authentication technologies; security for network servers; web security; and security for mobile code technologies, such as Java and Javascript. More advanced topics will additionally be covered as time permits, such as: intrusion detection; techniques to provide privacy in Internet applications; and protecting digital content (music, video, software) from unintended use.
Electrical & Computer Engineering	CIT	18731	NETWORK SECURITY	GR	Some of today's most damaging attacks on computer systems involve exploitation of network infrastructure, either as the target of attack or as a vehicle to advance attacks on end systems. This course provides an in-depth study of network attack techniques and methods to defend against them. Topics include firewalls and virtual private networks; network intrusion detection; denial of service (DoS) and distributed denial-of-service (DDoS) attacks; DoS and DDoS detection and reaction; worm and virus propagation; tracing the source of attacks; traffic analysis; techniques for hiding the source or destination of network traffic; secure routing protocols; protocol scrubbing; and advanced techniques for reacting to network attacks. Prerequisite: 18-630 OR 18-730, and senior or graduate standing.

Department	College	Course #	Course Title	Grad/UG	Description
Electrical & Computer Engineering	CIT	18732	SECURE SOFTWR SYSTMS	GR	Poor software design and engineering are the root causes of most security vulnerabilities in deployed systems today. Moreover, with code mobility now commonplace—particularly in the context of web technologies and digital rights management—system designers are increasingly faced with protecting hosts from foreign software and protecting software from foreign hosts running it. This class takes a close look at software as a mechanism for attack, as a tool for protecting resources, and as a resource to be defended. Topics covered include the software design process; choices of programming languages, operating systems, databases and distributed object platforms for building secure systems; common software vulnerabilities, such as buffer overflows and race conditions; auditing software; proving properties of software; software and data watermarking; code obfuscation; tamper resistant software; and the benefits of open and closed source development.
Electrical & Computer Engineering	CIT	18734	FOUNDATION OF PRIVCY	GR	Privacy is a significant concern in modern society. Individuals share personal information with many different organizations - healthcare, financial and educational institutions, the census bureau, web services providers and online social networks - often in electronic form. Privacy violations occur when such personal information is inappropriately collected, shared or used. We will study privacy in a few settings where rigorous definitions and enforcement mechanisms are being developed - statistical disclosure limitation (as may be used by the census bureau in releasing statistics), semantics and logical specification of privacy policies that constrain information flow and use (e.g., by privacy regulations such as the HIPAA Privacy Rule and the Gramm-Leach-Bliley Act), principled audit and accountability mechanisms for enforcing privacy policies, anonymous communication protocols - and other settings in which privacy concerns have prompted much research, such as in social networks, location privacy and Web privacy (in particular, online tracking & targeted advertising).
Electrical & Computer Engineering	CIT	18743	ENERGY AWARE COMPTNG	GR	This course provides a comprehensive coverage of topics related to energy aware and green computing. While it is widely recognized that power consumption has become the limiting factor in keeping up with increasing performance trends, static or point solutions for power reduction are beginning to reach their limits. This course is intended to provide an insight into: (i) power and energy consumption modeling and analysis; (ii) energy aware computing, i.e., how various power reduction techniques can be used and orchestrated such that the best performance can be achieved within a given power budget, or the best power efficiency can be obtained under prescribed performance constraints; and (iii) green computing in the context of large scale computing systems or smart grid-aware computing. Recommended: basic VLSI design, basic computer system organization, basic compiler design and OS knowledge. Prerequisites: Senior or Graduate Standing.

Department	College	Course #	Course Title	Grad/UG	Description
Electrical & Computer Engineering	CIT	18883	SP TPC IN ENGY SYS	GR	Please see the ECE website for a full course description describing the sections of this course.
					Engineering & Public Policy 41
Engineering & Public Policy	CIT	19101	INTRO ENGR & PUB POL	UG	This course examines the processes of public and private decision making and of policy formation, which shape the evolution of a technology and its impact on our society. Technology plays an important role in shaping our worlds. At the same time, social forces often play a central role in the evolution of a technology. A particular technology such as an automobile or computer is chosen to study technology and policy in context. Specific topics covered in the case of the automobile includes automotive design and manufacture, safety, pollution, fuel economy and their interactions. In each area, we discuss the technological and institutional issues, their interaction, the possible need for public policy and the factors that govern the policy. The course will involve several group problem-solving sessions.
Engineering & Public Policy	CIT	19201	EPP SOPHOMORE SEMR	UG	EPP Sophomore Seminar is for students enrolling in the Engineering and Public Policy (EPP) Additional Major and the Science, Technology and Public Policy (STPP) Additional Major. The course presents the interdisciplinary nature of EPP/STPP problems at the interface of technology and society. Students are introduced to the technical and policy dimensions of these problems as well as to skills such as data collection and analysis, group work, and oral and written presentations. Sessions include discussion of case studies dealing with aspects of decision-making and ethics in policy issues with a technological basis. Seminars by EPP faculty and students are included to give the student an idea of careers and problems in this area.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19211	ETHCS POLICY CMPTNG	UG	Should autonomous robots make life and death decisions on their own? Should we allow them to select a target and launch weapons? To diagnose injuries and perform surgery when human doctors are not around? Who should be permitted to observe you, find out who your friends are, what you do and say with them, what you buy, and where you go? Do social media and personalized search restrict our intellectual horizons? Do we live in polarizing information bubbles, just hearing echoes of what we already know and believe? As computing technology becomes ever more pervasive and sophisticated, we are presented with an escalating barrage of decisions about who, how, when, and for what purposes technology should be used. This course will provide an intellectual framework for discussing these pressing issues of our time, as we shape the technologies that in turn shape us. We will seek insight through reading, discussion, guest lectures, and debates. Students will also undertake an analysis of a relevant issue of their choice, developing their own position, and acquiring the research skills needed to lend depth to their thinking. The course will enhance students' ability to think clearly about contentious technology choices, formulate smart positions, and support their views with winning arguments.
Engineering & Public Policy	CIT	19301	DECISION MKG MTH	UG	This course covers various economic, statistical, and decision analysis techniques used for examining complex decisions where technology, society, and policy interconnect. Topics covered include: estimation techniques, benefit-cost analysis, decision trees, dealing with uncertainty, risk perception and analysis, survey design and implementation, utility theory, heuristics and biases in inference and prediction, methods for combining information from different sources and dealing with conflicting objectives.
Engineering & Public Policy	CIT	19351	APPLD MTH TCH PLY AN	UG	This course synthesizes concepts from economics, statistics, decision analysis, and other humanities and social science areas as they relate to analysis of technology and public policy issues. Students will focus on applying skills, tools, and techniques of social science to critically examine issues of current importance to society that have engineering systems at the core, and how public policy can be informed by the results of these analyses. Students will discover the relationship between formulating research questions considering a wide range of perspectives (e.g., political, ethical, social, economic, and legal aspects) and implementing the appropriate research methods for answering them. The course will emphasize interpretation and communication of analysis results in written and oral presentation, especially to non-technical audiences. As a precursor to the EPP Project courses, the course also prepares EPP juniors for structuring real-world problems into a feasible work plan, and to deal with revising work plans as work proceeds.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19402	TELCOM TCH POL & MGT	UG	Modern telecommunications is the nervous system of society. The Internet and wireless communications have transformed every aspect of our modern life. This course provides a comprehensive introduction to basic principles of telecommunications technology and the legal, economic, and regulatory environment of today's networks. Topics covered include the fundamentals of communication network technologies, including video, voice, and data networks; the rising dominance of wireless networks; principles behind telecommunications regulation from common carrier law and natural monopoly to information diversity, privacy and national security; traffic differentiation on the Internet and the debate over network neutrality; universal service and the digital divide; mergers, antitrust, and the changing industrial structure of the communications sector. We will explore current topical questions such as the future of competition; the shift of entertainment video from cable and satellite to Internet delivery; how cloud computing concepts are transforming networks; and communications support for the Internet of Things. Comparison with European approaches to communications regulation. Special emphasis on how new technologies have altered, and are altered by, regulation. Junior, Senior or graduate standing required.
Engineering & Public Policy	CIT	19421	EMG ENERGY	UG	Interested in what's happening in energy policy and how to analyze potential policy options in response? Focusing on current hot topics in energy policy, students will learn the basic principles of public policy analysis and underlying techniques such as program evaluation, cost benefit analysis, life cycle analysis, prince analysis, and risk analysis as well as the variety of policy mechanisms available. Class time will include a combination of faculty and guest speaker lectures, discussion of issues, videos, and problem solving. Students will review and edit Wikipedia entries on an energy policy topic of their choice, and then analyze policy options resulting in an executive summary or paper on that topic. While the course has no prerequisites, students should feel comfortable with scientific and technical topics. Upon completion of this course, students should have a deeper and more strategic understanding of the opportunities and challenges associated with emerging energy policies. Open to seniors. Open to juniors with permission only.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19429	CLIMATE SCI SOL	UG	This course consists of four parts. The first part will provide a primer for those who are curious about the physical mechanisms by which climate is determined, and by which climate change occurs. The treatment of these mechanisms will not be overly quantitative, and no knowledge of meteorology or atmospheric science is needed. College-level physics, as well as basic calculus and basic chemistry, is, however, needed. The second part will describe the projected consequences of climate change, as well as those that are already occurring. This part will also familiarize students with how societies might adapt to these changes. The third part will explore (and critique) some of the tools that decision-makers use to quantify and compare the damages caused by these consequences. The final part of the course will discuss some of the technologies that could be used to prevent dangerous climate change.
Engineering & Public Policy	CIT	19437	ST:GLOBALECO	UG	Ecologists study how organisms interact with each other and their environment to understand patterns of species diversity and abundance in nature. At local, regional and global scales, ecological issues abound in the news and social media, often sparking controversy and heated policy debates. For example, is climate change real or a hoax, and what's the evidence either way? To what extent can humans impact global climate? What are the ecological ramifications, if any, of climate change for individual organisms, populations, communities, and ecosystems? This course is designed to enhance any student's ability to: (1) critically analyze such questions; (2) evaluate the available scientific research; (3 interrogate the public arguments of various stakeholders regarding environmental issues; and (4) make their own informed decisions and evidence-based conclusions. Collaboratively, through highly interactive, discussion-based classroom activities, we will practice applying fundamental ecological principles and concepts to a variety of environmental issues. Our inquirie may include, but not be limited to, conservation of biodiversity and other natural resources (e.g., air and water quality), management of invasive species, fragmentation of natural habitats by human activity, sustainability of agriculture and fisheries, and pros and cons of genetically modified organisms. Although ecology is an empirically and mathematically rigorous science, this course will be "math-lite", focusing primarily on application of concepts and critical thinking, rather than the development of discipline-specific mathematical modeling and computational skills. Previous completion of an introductory statistics course is not required, but encouraged.
Engineering & Public Policy	CIT	19440	CMBSTN AIR POL CNTRL	UG	Formation and control of gaseous and particulate air pollutants in combustion systems. Basic principles of combustion, including thermochemical equilibrium, flame temperature, chemical kinetics, hydrocarbon chemistry, and flame structure. Formation of gaseous and particulate pollutants in combustion systems. Combustion modifications and postcombustion technologies for pollutant control. Relationship between technology and regional, national, and global air pollution control strategies. The internal combustion engine and coal-fired utility boiler are used as examples.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19443	CLIMATE SCI ADAPT	UG	This course consists of four parts. The first part will provide a primer for those who are curious about the physical mechanisms by which climate is determined, and by which climate change occurs. The treatment of these mechanisms will not be overly quantitative, and no knowledge of meteorology or atmospheric science is needed. College-level physics, as well as basic calculus and basic chemistry is, however, needed. The second part will describe the projected consequences of climate change, as well as those that are already occurring. This part will also familiarize students with how societies might adapt to these changes. The third part will explore (and critique) some of the tools that decision-makers use to quantify and compare the damages caused by these consequences. The final part of the course will discuss some of the technologies that could be used to prevent dangerous climate change.
Engineering & Public Policy	CIT	19451	EPP PROJECT	UG	Interdisciplinary problem-solving projects in which students work as leaders or members of project teams. Problem areas are abstracted from local, state and national situations and involve the interaction of technology and public policy, with different projects being chosen each semester. Oral and written presentations concerning the results of project studies are required. NOTE: All students will enroll in section A at first. During the 1st class, students will choose either project A or B. Those choosing B, will be moved into that section.
Engineering & Public Policy	CIT	19452	EPP PROJECT	UG	Interdisciplinary problem-solving projects in which students work as leaders or members of project teams. Problem areas are abstracted from local, state and national situations and involve the interaction of technology and public policy, with different projects being chosen each semester. Oral and written presentations concerning the results of project studies are required.
Engineering & Public Policy	CIT	19458	ST ORG THEORY	UG	Why do so many technical problems of global importance persist even when there exists engineering solutions? This course will explore the organizational challenges that can hinder the deployment of engineering solutions towards solving some of our most critical global technical challenges. We will explore a variety of organizational theories such as institutional theory, network theory, social movement theory, and actor-network theory and then see how they are applied to a variety of engineering systems such as those around energy, mechanical design, water, information and communication technology, and other such civil infrastructure. By the end of the course, students will be able to a) learn how to read and synthesize organizational research from a variety of theoretical lenses, b) understand how such research can apply to a variety of engineering systems, and c) learn how to advance and conduct engineering research that incorporates an organizational perspective. Intended for graduate students; seniors and juniors with permission.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19470	ST:RISKHEALTH	UG	This course will provide an introduction to the practice of risk assessment in the USA, as conducted by federal agencies, for developing regulations and guidance for the protection of human and environmental health. It will cover the basics of toxicology, epidemiology, fate and transport models, exposure assessment, risk analysis, and risk management. It will also touch on philosophical and legal justifications for the federal role in regulating risk. Students will develop an understanding of the role of risk assessment in the context of US environmental health and safety law and become familiar with the elements and principles of risk assessment.
Engineering & Public Policy	CIT	19602	CURNT TPC PRVY SEMR	GR	In this seminar course students will discuss recent papers and current public policy issues related to privacy. Privacy professionals from industry, government, and non-profits will deliver several guest lectures each semester.
Engineering & Public Policy	CIT	19605	ENGN PRIV SOFTWARE	GR	Privacy harms that involve personal data can often be traced back to software design failures, which can be prevented through sound engineering practices. In this course, students will learn how to identify privacy threats due to surveillance activities that enhance modern information systems, including location tracking, behavioral profiling, recommender systems, and social networking. Students will learn to analyze systems to identify the core operating principles and technical means that introduce privacy threats, and they will learn to evaluate and mitigate privacy risks to individuals by investigating system design alternatives. Strategies to mitigating privacy risk will be based on emerging standards and reliable privacy preference data. Students will have the opportunity to study web-, mobile- and cyber-physical systems across a range of domains, including advertising, healthcare, law enforcement and social networking. In addition, students will know how, and when, to interface with relevant stakeholders, including legal, marketing and other developers in order to align software design with privacy policy and law.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19608	PRIVCY POL LAW TEC	GR	This course focuses on policy issues related to privacy from the perspectives of governments, organizations, and individuals. We will begin with a historical and philosophical study of privacy and then explore recent public policy issues. We will examine the privacy protections provided by laws and regulations, as well as the way technology can be used to protect privacy. We will emphasize technology-related privacy concerns and mitigation, for example: social networks, smartphones, behavioral advertising (and tools to prevent targeted advertising and tracking), anonymous communication systems, big data, and drones. This is part of a series of courses offered as part of the MSIT-Privacy Engineering masters program. These courses may be taken in any order or simultaneously. Foundations of Privacy (Fall semester) offers more in-depth coverage of technologies and algorithms used to reason about and protect privacy. Engineering Privacy in Software (Spring semester) focuses on the methods and tools needed to design systems for privacy. This course is intended primarily for graduate students and advanced undergraduate students with some technical background. Programming skills are not required. 8-733, 19-608, and 95-818 are 12-unit courses for PhD students. Students enrolled under these course numbers will have extra assignments and will be expected to do a project suitable for publication. 8-533 is a 9-unit course for undergraduate students. Masters students may register for any of the course numbers permitted by their program. This course will include a lot of reading, writing, and class discussion. Students will be able to tailor their assignments to their skills and interests. However, all students will be expected to do some writing and some technical work.
Engineering & Public Policy	CIT	19617	INFRASTRUCTR MNGMNT	GR	This course takes a broad view of infrastructure systems to include physical infrastructure and information networks. The course will consider the need to protect these critical infrastructures from both degradation as well as malicious attacks. Infrastructure management generally depends on public-private partnerships to ensure long-term viability. We will look at relevant academic literature on the topics of infrastructure needs and requirements. We will explore the use of automated sensing and computer network systems to facilitate management.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19624	EMG ENERGY PLC	GR	Interested in what's happening in energy policy and how to analyze potential policy options in response? Focusing on current hot topics in energy policy, students will learn the basic principles of public policy analysis and underlying techniques such as program evaluation, cost benefit analysis, life cycle analysis, prince analysis, and risk analysis as well as the variety of policy mechanisms available. Class time will include a combination of faculty and guest speaker lectures, discussion of issues, videos, and problem solving. Students will review and edit Wikipedia entries on an energy policy topic of their choice, and then analyze policy options resulting in an executive summary or paper on that topic. While the course has no prerequisites, students should feel comfortable with scientific and technical topics. Upon completion of this course, students should have a deeper and more strategic understanding of the opportunities and challenges associated with emerging energy policies. Open to seniors. Open to juniors with permission only.
Engineering & Public Policy	CIT	19629	CLIMATE CHG SCI SOLN	GR	This course consists of four parts. The first part will provide a primer for those who are curious about the physical mechanisms by which climate is determined, and by which climate change occurs. The treatment of these mechanisms will not be overly quantitative, and no knowledge of meteorology or atmospheric science is needed. College-level physics, as well as basic calculus and basic chemistry, is, however, needed. The second part will describe the projected consequences of climate change, as well as those that are already occurring. This part will also familiarize students with how societies might adapt to these changes. The third part will explore (and critique) some of the tools that decision-makers use to quantify and compare the damages caused by these consequences. The final part of the course will discuss some of the technologies that could be used to prevent dangerous climate change.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19638	SM GRD FTR ELC EN SY	GR	The course offers an advanced presentation of modern electric power systems, starting from a brief review of their structure and their physical components, through modeling, analysis, computation, sensing and control concepts. Great care is taken to avoid presenting "practical" techniques built on dubious theoretical foundations and also to avoid building elaborate "mathematical" models whose physical validity and relevance may be questionable. Mastering both principles and relevant models is important for those who wish to seriously understand how today's electric power grids work and their challenging technical issues. This prepares students for working on applying many novel information processing concepts for designing and operating more reliable, secure, and efficient electric energy systems. Students interested in both applied physics and signals and systems should consider taking this subject. Once the fundamentals of today's power systems are understood, it becomes possible to consider the role of smart electric power grids in enabling evolution of future electric energy systems. Integration of intermittent energy resources into the existing grid by deploying distributed sensors and actuators at the key locations throughout the system (network, energy sources, consumers) and changes in today's Supervisory Control and Data Acquisition (SCADA) for better performance become well-posed problems of modeling, sensing and controlling complex dynamic systems. This opens opportunities to many innovations toward advanced sensing and actuation for enabling better physical performance. Modeling, sensing and control fundamentals for possible next generation SCADA in support of highly distributed operations and design are presented. Prior knowledge in 18-418 or 18-771 is highly recommended.
Engineering & Public Policy	CIT	19656	SP TPC: CRNT ISS EPP	GR	This course covers the design basics of technologies used for CO2 capture from energy conversion processes, such as power plants and industries. A range of technologies including pre-combustion, post-combustion and oxy-combustion CO2 capture will be introduced, along with advanced capture concepts. Relevant concepts from thermodynamics and techno-economic evaluation are covered. Through assignments and course project, the students will design individual CO2 control technologies and then analyze their feasibility when integrated into specific applications. This also deals with transport and storage issues. Economics and policy issues will also be covered. Prior knowledge of basic thermodynamics and mass and energy balances is recommended.
Engineering & Public Policy	CIT	19674	ST:RISKHEALTH	GR	This course will provide an introduction to the practice of risk assessment in the USA, as conducted by federal agencies, for developing regulations and guidance for the protection of human and environmental health. It will cover the basics of toxicology, epidemiology, fate and transport models, exposure assessment, risk analysis, and risk management. It will also touch on philosophical and legal justifications for the federal role in regulating risk. Students will develop an understanding of the role of risk assessment in the context of US environmental health and safety law and become familiar with the elements and principles of risk assessment.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19680	E&TIM SEM INNV MN PC	GR	Innovation has been described as "the intersection of invention and insight, leading to the creation of social and economic value." Companies increasingly rely on innovation to establish and drive their success. Public policy makers see innovation as a critical driver for economic development. This course is an opportunity to learn about innovation management from those in the front lines. How are innovation opportunities identified? What are the challenges to realizing these opportunities, and how can the challenges be addressed? What roles are played by processes, technologies and the business environment, as well as by individuals in organizations? This course will feature speakers who drive innovation in a variety of settings, paired with readings from the innovation literature that will help frame the presentations and discussion.
Engineering & Public Policy	CIT	19682	STRAT MGT TECH INNOV	GR	Strategy is distinctive approaches executives use to realize firm performance goals. In this course, we will prepare you for analyzing how technology and innovation affects how executives formulate and execute strategies. This course teaches how incorporating technology and innovation into the corporate strategy of the firm can achieve profitable and sustainable competitive advantage. It addresses the role of technology management in both emerging and established firms, and examines how all of the firm's activities, assets, and relationships must complement one another in order to capture value from innovation. The course will progress in two parts. We will first cover how strategy is formulate through frameworks, models, and tools essential for those actively engaged in the innovation process within a firm and apply these to case studies illustrating their importance in technology industries. We will then cover the obstacles that prevent firms form executing the ideal strategy. In each framework we analyze during the class, we will have the following objectives: 1) Recognizing the performance metric targeted by each framework 2) Identifying the assumptions each framework makes about firm structure, the speed of market and technological change 3) Analyze the strengths and weakness of each framework 4) Apply tools suited for each framework to determine the appropriate strategy that the firm should undertake 5) Using organizational theory to recognize obstacles that prevent the firm from implementing the desired strategies and how to overcome such barriers to implementation

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19684	ENGR & TECH INNOV MG	GR	Innovation takes place inside organizations, whether it's a small company, a large corporation, a university or a government laboratory or agency. In this course, we will focus on the people who lead innovative organizations, what they do to promote and sustain innovation, and the skills and attributes they need to be successful. The instructor's experience as President of Carnegie Mellon, guest lecturers from industry and the literature will be the sources from which the course will draw. Students will gain insight into the roles they may play in contributing to and leading innovative organizations, and the skills and attributes they will need for success. 19684 is part of the Engineering and Technology Innovation Management (E&TIM) Masters Program. E&TIM students should register for the 6 unit course, reflecting the supplemental course requirements for E&TIM. Other students are welcome to enroll for the 3 unit course.
Engineering & Public Policy	CIT	19687	MANGM RDI	GR	This course considers key issues and trade-off in R&D strategy and organization, paying attention to dynamic competitive contexts where technology plays a key role. These topics are treated assuming the perspective of the decision maker. It addresses typical problems of large, medium and small firms having a structured R&D and operating businesses where R&D is the source of competitive advantages. Although we will heavily focus on R&D, emphasis is placed on viewing R&D as a part (although, a key part) of the process of technological innovation; therefore, as an activity to be strongly and appropriately integrated with other functions to make innovation
Engineering & Public Policy	CIT	19691	SP TPC: DEC INV MNG	GR	In this course, there will be several main elements all focused around the decision-making process that corporations typically use in making decisions regarding innovation / R&D investments. This course will build upon the financial concepts that were initially discussed in Finance of Innovation Management (19-689). Specifically this course will build on the following: Basic concepts around an appropriate decision-making process that should be used for making investment decisions related to innovation management and other strategic decisions. Discussion around the framework of decision quality and how this framework is used to improve the decision-making process around innovation decisions and other strategic decisions. Discussion of decision-making under uncertainty and the use of decision analysis methods that are commonly used to make Innovation / R&D investment decisions to assess the value of potential innovation decisions. Introduction to real options theory to include discussion of various calculation methods including the Black Scholes model and the binomial model and to consider the practical issues of implementing such an evaluation methodology. Should have taken 19-689 or elementary accounting / financial management course or by permission of instructor.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19692	STRA MARK FOR INNOV	GR	The purpose of this master's level course is to develop the knowledge and skills needed to formulate marketing and product strategies for new technological product/service innovations in their market introductory phase. The course introduces the principles, concepts, frameworks and proven practices for analysis and strategic decision-making in an uncertain and constrained environment (i.e. when ample historical data and large budgets don't exist.) The course uses lectures, readings, group exercises, an individual project with instructor feedback, and an optional recitation sessions to achieve the learning objectives. The primary work in this course is hands-on application of the material by the student to create a strategic marketing plan for their own, approved product innovation idea with evaluation and feedback from the instructor. A customer-centric orientation is emphasized throughout the course. The course addresses strategic marketing decisions and activities including identifying value creation opportunities; generating and selecting innovation ideas; understanding the market, competition, customer needs and customer experience; segmenting, targeting markets; developing a positioning strategy and compelling customer value proposition; making marketing-mix decisions for product, pricing, route-to-market/distribution, and customer base development. This course is ideal for students who are interested in becoming a product manager, entrepreneur, innovation manager, strategic marketer or related role. A syllabus and project description are available from the instructor. NOTE: Starting in Week 4 of this course, an optional recitation session with the instructors will be scheduled every 2 weeks on Monday in Hamburg Hall A206. Students can sign up for one of two sections: Group A meets from 4:00 - 5:00 pm. and Group B meets from 5:00 - 6:00 pm.
Engineering & Public Policy	CIT	19694	SP TP LEAD INN MANAG	GR	The attributes and skills of the contributors to innovation are important elements in the effectiveness of the innovation process and the success of the outcome. In this course, we will focus on these skills and attributes, with an emphasis on the leaders of innovation and innovative organizations. Selected literature, case studies, and guest lectures by leaders, as well as the instructor's own experience as Carnegie Mellon's eighth president, will be the sources from which the course will draw. Students will gain insight into the roles they may play in contributing to and leading innovation and organizations and the skills and attributes they will need for success.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19701	INT THY PRAC POL ANL	GR	This course reviews and critically examines a set of problems, assumptions and analytical techniques that are common to research and policy analysis in technology and public policy. Topics covered include the difference between science, trans-science and policy analysis, policy problems formulated in terms of utility maximization, issues in the valuation of intangibles, uncertainty in policy analysis, selected topics in risk analysis, limitations and alternatives to the paradigm of utility maximization, issues in behavioral decision theory, issues related to organizations and multiple agents, and selected topics in policy advice and policy analysis for the federal government. The objective is to look critically at the strengths, limitations and underlying assumptions of key policy research and analysis tools and problem framing and sensitize students to some of the critical issues of taste, professional responsibility, ethics, and values that are associated with policy analysis and research.
Engineering & Public Policy	CIT	19705	WRKSHP APP POL ANALY	GR	This workshop course is about learning how to structure messy un-structured policy problems. It is designed to provide experience in setting up, analyzing, and writing about policy problems of the type that are used in the EPP Part B qualifying exam. Over the course of the semester, the class works through six or seven policy case problems. Much of the work is done in small groups. The principal focus is on integrating the qualitative and quantitative aspects of the problems and on identifying and practicing general problem-solving strategies.
Engineering & Public Policy	CIT	19713	POL WRLSS SYS	GR	This course will address public policy issues related to wireless systems, and to the Internet. It begins by investigating policies related to a wide variety of emerging wireless systems and technologies, including wifi computer networks, broadband to the home, broadcast radio and television, and satellite communications. This can include the government role in facilitating the creation of infrastructure, in advancing competition among broadcasters and communications service providers, in managing spectrum, and in protecting privacy and security. The course will then address Internet policy issues, which can include Internet governance and the domain name system, taxation, privacy and security, and intellectual property. Because these are inherently interdisciplinary issues, the course will include detailed discussions of technology, economics, and law, with no prerequisites in any of these areas. Note: ECE students must take this course under #18-650 only

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19722	TELECM TCH PLY MANGM	GR	Modern telecommunications is the nervous system of society. The Internet and wireless communications have transformed every aspect of our modern life. This course provides a comprehensive introduction to basic principles of telecommunications technology and the legal, economic, and regulatory environment of today's networks. Topics covered include the fundamentals of communication network technologies, including video, voice, and data networks; the rising dominance of wireless networks; principles behind telecommunications regulation from common carrier law and natural monopoly to information diversity, privacy and national security; traffic differentiation on the Internet and the debate over network neutrality; universal service and the digital divide; mergers, antitrust, and the changing industrial structure of the communications sector. We will explore current topical questions such as the future of competition; the shift of entertainment video from cable and satellite to Internet delivery; how cloud computing concepts are transforming networks; and communications support for the Internet of Things. Comparison with European approaches to communications regulation. Special emphasis on how new technologies have altered, and are altered by, regulation. Junior, Senior or graduate standing required.
Engineering & Public Policy	CIT	19726	MATH MDL ENV QUA SY	GR	Development and application of mathematical models for environmental systems. Material balance formulations and their solutions, computer implementation, model validation, uncertainty analysis, and use for projection and policy analysis. Applications to surface water, groundwater, atmospheric transport, indoor air pollution, and human exposure and risk.
Engineering & Public Policy	CIT	19734	USABLE PRVCY & SECUR	GR	There is growing recognition that technology alone will not provide all of the solutions to security and privacy problems. Human factors play an essential role in these areas, and it is important for security and privacy experts to have an understanding of how people will interact with the systems they develop. This course is designed to introduce students to a variety of usability and user-interface problems related to privacy and security and to give them experience in understanding and designing studies aimed at helping to evaluate usability issues in security and privacy systems. The course is suitable both for students interested in privacy and security who would like to learn more about usability, as well as for students interested in usability who would like to learn more about security and privacy. Much of the course will be taught in a graduate seminar style in which all students will be expected to do reading assignments for each class. Students will also work on a group project throughout the semester.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19739	ENG ECON EL ENGY SYS	GR	The course has two parts. The first part introduces basic components and networks used in the electric power industry. This is followed by systematic modeling of these components, as well as of the entire system. Methods for modeling and analyzing both system equilibria and dynamics are presented. Simulations and lab demos are given to simulate and analyze typical system blackouts. This is followed by introducing decision and control methods for preventing these problems, as well as for managing the system more reliably, securely and efficiently over broad ranges of its operating conditions. The emphasis is on IT, software and control (both distributed and coordination) for achieving pre-specified system performance. This part of the course will involve simulation demos and hands on studies in which students create their own power network, simulate it and assess for performance. The second part of the course will review the industry structure, the experience with deregulatio n, and economic issues concerning choice of generating fuel and technology, the costs of blackouts, and environmental discharges. The course will integrate engineering and economic aspects to examine the design, investment, and operations that satisfy public desires for low cost, nonpolluting, reliable, and secure power. Knowledge of basic electric circuits and/or basic economics is assumed. 3 hrs. lec., 1 hr. rec. Prerequisites: Basic electric circuits and/or basic economics and at least graduate standing.
Engineering & Public Policy	CIT	19740	CMBSTN AIR POL CNTRL	GR	Combustion and Air Pollution Control This course examines the generation and control of air pollution from combustion systems. The course's first part provides a brief treatment of combustion fundamentals, including thermochemical equilibrium, flame temperature, chemical kinetics, hydrocarbon chemistry, mass transfer, and flame structure. This foundation forms the basis for exploring the formation of gaseous (oxides of nitrogen, carbon monoxide, hydrocarbons, and sulfur dioxide) and particulate pollutants in combustion systems. The course then describes combustion modifications for pollutant control and theories for pollutant removal from effluent streams. The internal combustion engine and utility boilers serve as prototypical combustion systems for discussion. The course also addresses the relationship between technology and the formulation of rational regional, national, and global air pollution control strategies.
Engineering & Public Policy	CIT	19881	SEMR ELCTY MRK RESTR	GR	This is a reading and discussion seminar for PhD students. We will read some of the seminal literature in the study of the modern electric power industry. We will begin by reading and discussing portions of Power Loss: The Origins of Deregulation and Restructuring in the American Electric Utility System by Richard F. Hirsh (MIT Press, 2001). After this introduction to both the history and the factors that lead to the modern regulatory and industry structure, we will critically review and discuss important and interesting papers from the contemporary literature that will help develop research directions and sharpen analysis skills.

Department	College	Course #	Course Title	Grad/UG	Description
Engineering & Public Policy	CIT	19884	SP TPC IN ENGY SYS	GR	This course introduces basic engineering concepts for photovoltaic systems. Topics covered include solar resource assessment, PV cells and modules, system components, performance modeling, system sizing, loss mechanisms, energy yield assessment and project economics. Different applications and business models for PV technology will be discussed including utility scale PV power plants, rooftop systems and off-grid systems. The implications of relevant policy will be explored including net metering and independent power producers. The course will be interesting to a general audience but is focused in particular on applications in the developing world.
				English	43
English	DC	76108	WRTG ABT PUB PROBS	UG	If all problems required a simple fix, we could don our Avenger costumes, pick up Thors hammer, and right the worlds wrongs. But most problems arent so simple. Most of the problems we encounter require careful investigation and research so that we might propose solutions that connect with others to make change. In this 76101 class (one of two minis students can choose to fulfill their FYW requirement), we will learn how public problems are defined and argued across a range of texts, including proposals, op-ed genres, and white papers. By analyzing a range of proposal texts, we will identify the different kinds of legwork necessary to write a successful proposal, arguably one of the most challenging aspects of writing a persuasive recommendation for change. We will examine how writers unpack problems rhetorically and use evidence to argue solutions for different stakeholders who may not share common values. We will learn strategies for evaluating and synthesizing data from existing research to use in a proposal argument. By the end of the course, students will write their own proposal that recommends a solution and a feasible plan for solving a real problem.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76204	WASTE IN CONTEMP CUL	UG	We usually consider garbage as something we need to keep out of sight. We try to ignore it, ship it someplace else, and simply don't want to admit how much our lives rely on creating junk. But can we better understand ourselves if we pause to look at trash? The garbage we create overwhelms the worldand in some way, we all play a role in a system of waste that ruins environments, poisons communities, and defines how we inhabit our planet. In this course, we investigate the many forms that wastes may take. How much do our daily lives depend on plastics? What happens to our cell phones and computers they turn into "e-wastes"? How do certain communities encounter wastes differently? And what role does waste have in establishing and maintaining social inequalities? We will learn from histories of waste such as Edward Humes' Garbology: Our Dirty Love Affair with Trash. We will watch documentaries on the Great Pacific Garbage Patch, the economy of trash picking, and nuclear waste cleanup. We will read novels and short stories such as Ann Pancake's Strange as This Weather Has Been, Ivan Klima's Love and Garbage, and Andy Mulligan's Trash. We will also examine a range of visual art and design projects that aim to make us more aware of the presence of trash in our daily lives. We will even watch portions of the television show Hoarders. Ultimately, the aim of this course is to learn about how wastes tell a story about who we are as a speciesa story that future societies will ponder when they see the result of how we are reshaping the world today.
English	DC	76221	BOOKS READ BY NOW	UG	In this course students will read a range of classic literary works in the British tradition ranging from some of the earliest novels in the English language such as Daniel Defoe's Robinson Crusoe up to contemporary critically acclaimed works like Zadie Smith's White Teeth. In surveying these British classics we will explore the various ways that literature has served as a cultural register of the major shifts and transformations that have shaped the course of British society during the modern era (1700-2000), such as the rise and fall of the British Empire, processes of urbanization, industrial revolution and decolonization, the trauma of two world wars, and changing norms regarding gender and sexuality. Special attention will also be paid to questions of national identity and cultural belonging in modern Britain, as well as the changing social character of London in it's growth from imperial capital and industrial urban center, into global metropolis and financial hub. While reading these "great books" students are urged to reflect upon the function of the "literary canon" itself, and its relation to debates about representation and political bias in social and cultural institutions like the publishing industry and university. Other authors read in the course may include: Jane Austen, Charles Dickens, George Eliot, Oscar Wilde, Joseph Conrad, James Joyce, Virginia Woolf, D.H. Lawrence, George Orwell, Salman Rushdie, Doris Lessing and Martin Amis.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76222	CRTV WRTG MATTER	UG	This course will explore at least two of the meanings of the word "matters"as in "is of importance," and as in "things, concerns." Through reading and writing in various genres, students will discover and discuss how creative writing engages with the world around us while also learning some of the important techniques of writing creatively in various genres. The class will read a wide variety of books, and students will have the opportunity to interact with the authors through public readings and classroom visits. In addition, the class will take advantage of other literary events happening around Pittsburgh in order to further examine places where writing comes off the page and engages with the world. Revision will be required and emphasized.
English	DC	76241	GENDER STUDIES	UG	Biological sex vs. gender roles. Intersectional feminism. LGBTQIA+ rights. Consent. Masculinity and gender roles. #metoo and gender-based violence. Economic inequity. Sexual politics. This course offers students a scholarly introduction to these social and political issues. Organized around a series of controversies, with interdisciplinary readings both foundational and contemporary, the class will combine theory, literature, and film with texts like law, public policy, and media representations. We will read critically and discuss openly. Readings will include work by Virginia Woolf, Simone de Beauvoir, Judith Butler, Kimberlé Crenshaw, bell hooks, Michael Kimmel, Raewyn Connell, Chimamanda Ngozi Adichie, Roxanne Gay, James Baldwin and Margaret Atwood.
English	DC	76245	SHAKESPR TRAG & HIST	UG	Sometime around the late sixteenth century, enterprising cultural producers in early modern London began to develop a new commercial venture called 'playing': a business that offered ordinary people a few hours of dramatic entertainment for the price of one penny. In addition to watching the professional players onstage, spectators also participated in a form of play themselves, in a sense, because theatrical experience provided a unique opportunity to engage imaginatively with otherwise inaccessible people, worlds, and ideas. More than four hundred years later, the drama of the period now ranks among the most esteemed texts in all English literature, and the name 'Shakespeare' has become a byword for literary genius. This course will offer an introduction to Shakespeare's tragedies and histories, including Hamlet, Macbeth, Antony & Cleopatra, Richard II, Richard III, and Henry IV pt. 1. As we read through these works, we will endeavor to understand whatand howthey meant in their original context, thereby developing a historically informed perspective on their influence over our own cultural landscape.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76247	RENAISSANCE	UG	In the theatrical culture of Elizabethan England, comedy was serious business. This course uses Shakespeare's best-known comedies and romances to introduce students to the Bard's drama, time, and culture. Together, we will read some of Shakespeare's queerest and most delightful comedies such as Midsummer Night's Dream and Twelfth Night in conversation with darker troubling plays that revolve around sexual violence (The Taming of the Shrew, Measure for Measure), racism (The Merchant of Venice), and colonization (The Tempest, Cymbeline). We will also wonder: what does Shakespeare's late romance plays such as The Winter's Tale, or Pericles, often described as "tragicomedies" or as "problem plays," tell us about the strengths and limits of comedy as a genre? In short, valuing those classics of the English literary canon simultaneously for the timeless craft and for the historically located cultural horizon that they evidence, we will explore what it means, as readers of Shakespeare, to take comedy seriously.
English	DC	76265	SURVEY FORMS: POETRY	UG	This course is meant to serve as an introduction to the craft of poetry. We'll look closely at traditional forms in an effort to understand the effects of more formal choices on the page, and we'll read several collections of poetry by contemporary writers. Our analysis of poetry will begin at the level of the syllable and progress to words, lines, stanzas, series, and collections. You will be required to read both published work and the work of your classmates with a critical eye, to write your own poems, both formal and not, to write several analysis essays, and to demonstrate your knowledge on one in-class exam. The most important take-away from this class is the ability to talk knowledgeably and critically about poetry. What you learn here will pave the way for your future as both a writer and a reader.
English	DC	76294	INTERPRETIVE PRACTCS	UG	This course will introduce you to foundational theories and methods that form the practice of interpreting literary, poetic, cinematic, and other artistic modes of expression. We will start with an introduction to poetics through the works of Aristotle then move our way up through specific terms and theories of language, image and narrative as a system of communication and imaginative expression from Ferdinand Saussure to Roland Barthes and Hortense Spillers. I have organized our course around specific art works that I have paired with an interpretive reading practice and/or term. We will read, watch or listen to the works of: T.S. Eliot, Beyoncé, Sergei Eisenstein, Kara Walker, Mary Shelley and Percival Everett to name a few.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76330	COMM IN GLBL MKTPLAC	UG	In this day and age, some of the most exciting employment opportunities are with multinational and international corporations and non-profits. But are you prepared for the challenge of working with professionals from all over the world? Even as more people around the globe learn English, specific cultural values, beliefs, and assumptions continue to influence the way in which they communicate. Often, behind a foreign accent, we encounter an entirely different worldview. The same word or phrase in English might actually carry very distinct connotations for someone whose native language is French, German, Russian, or Japanese. Can we learn to anticipate, understand, and become sensitive to these connotations? How can we mend potential miscommunications that might arise due to these conceptual differences? This course is designed as an introduction to international professional communication. We will talk about the way in which culture influences communication, about the job of translators and interpreters, and about specific communicative norms for the global marketplace. We will look at many concrete example of communication in the international arena, acting as problem- solvers and communication consultants who are focused on understanding and designing plans of action for navigating communicative obstacles. We will also have the opportunity to speak with professionals who are experienced in the field, and we will cover case studies ranging from corporate business to global activism and advocacy.
English	DC	76348	GENDER AND COMM	UG	This mini will examine sociolinguistic research on gender, ethnicity, and communication in a range of settingsboth face-to-face and onlineto investigate how language use intersects with cultures of power. The course operates on the assumption that, not only are men and women socialized to communicate differently, but their genders affect how their communication is perceived by others. We will look at research describing these differences and work together to imagine interventions that can change communication dynamics to allow broader participation. For instance, we will look at barriers to women's discourse in male-dominated settings; we will examine factors that might inhibit men from participating in more feminized and nurturing speech communities; we will look at how a participant's ethnicity interacts with their gender roles, providing unique challenges and opportunities for change. Throughout the course we will ask ourselves both "what dynamics and inequities exist?" and "what can we do to change them?" Graded coursework will include reading responses, a class presentation, and a small research project. Readings will primarily consist of research articles from sociolinguistics, rhetoric, business, and education. Please note that in terms of time commitment, a 4.5 unit mini is equivalent in weekly workload to a 9 unit full semester course. The mini is half the credits because it requires the same workload but only for half the semester.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76360	LITRY JOURNLM WRKSHP	UG	Literary Journalism is non-fiction writing about the people and places in the world that might be overlooked by traditional journalism. Concerned more with those whose lives are outside of the traditional spot-light, literary journalism enriches our sense of who inhabits the contemporary world. Reading the stories of other lives can help us understand our own, by enlarging and deepening the context in which we understand our humanity. In this class, you will read a variety of professional literary journalism, and be asked to write your own. You'll have chances to interview people you know, and don't know, and write their stories, along with an assignment that invites you to capture your family history. You'll write about Pittsburgh places, and you'll learn how the stories of your own life can become literary journalism when you learn to contextualize them, and connect them to larger issues. The concerns and goals of Literary Journalism overlap with memoir, creative non-fiction, and magazine writing. The class is run as a seminar and demands high level of student involvement.
English	DC	76363	RDG IN FORMS: POETRY	UG	This course will serve as an introduction to the theory and practice of literary translation. We will examine the concepts of fidelity to the original, authorial intention, the nuance of tone and style, and the politics of translation. Texts will include essays on theory and a variety of literary works (primarily fiction and poetry) in translation. We will look at multiple translations of the same work, and there will be the option for students to pursue their own project in literary translation. Work outside the classroom will involve several field trips to City of Asylum, a sanctuary for writers in exile. Working knowledge of a language other than English is helpful but is not required for this course.
English	DC	76365	BEGINING POETRY WKSP	UG	This course is designed first and foremost as a workshop, meaning that a large percentage of class time will be devoted to critiquing your and your classmates' creative work. I will expect you to become strong editors and contributors to class discussion, and to accept and learn from criticism. You will be composing individual poems as well as working on a series or longer work. I will also assign a fair amount of reading, mainly contemporary poetry (individual poems and collections) published in the last few years. You will finish the semester by compiling a portfolio of creative work.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76374	CUBAN DOC PROJECT	UG	In this project-based course students will create a computer-based interactive documentary about contemporary Cuban society, which will be filmed in Cuba during the Spring break week of 2018. The class will explore different styles and techniques of storytelling with the flexibility of form offered by the computer through the practice of digression, multiple points of view, disruptions of time and of storyline, etc. Students will work within interdisciplinary teams in the creative areas of English and creative writing, video production, interactive media, data visualization and programming. Students will be encouraged to think about digital interactive media not just in terms of technology but also considering broader issues such as verbal and visual language, design, information architecture, communication and community.
English	DC	76378	LITERACY: ED THRY PR	UG	Literacy has been called the engine of economic development, the road to social advancement, and the prerequisite for critical abstract thought. But is it? And what should count as literacy: using the discourse of an educated elite or laying down a rap? Competing theories of what counts as "literacy" - and how to teach it - shape educational policy and workplace training. However, they may ignore some remarkable ways literacy is also used by people in non-elite communities to speak and act for themselves. In this introduction to the interdisciplinary study of literacy?its history, theory, and problems?we will first explore competing theories of what literacy allows you to do, how people learn to carry off different literate practices, and what schools should teach. Then we will turn ideas into action in a hands-on, community literacy project, helping urban students use writing to take literate action for themselves. As mentors, we meet on campus for 8 weeks with teenagers from Pittsburgh?s inner city neighborhoods who are working on the challenging transition from school to work. They earn the opportunity to come to CMU as part of Start On Success (SOS), an innovative internship that helps urban teenagers with hidden learning disabilities negotiate the new demands of work or college. We mentor them through Decision Makers (a CMU computer-supported learning project that uses writing as a tool for reflective decision making.) As your SOS Scholar creates a personal Decision Maker?s Journey Book and learns new strategies for writing, planning and decision making, you will see literacy in action and develop your own skills in intercultural collaboration and inquiry.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76384	RACE NATION & ENEMY	UG	Conflicts over racial and national identity continue to dominate headlines in the United States as they often have during the nation's history, from debates regarding the immigration, naturalization, and birthright citizenship of racial minorities to debates regarding racial disparities in access to civil rights. This course explores the discursive practices through which racial and national identities are formed and the frequent conflicts between them, particularly by focusing on the role of enemies, threats to the nation, and sacrifices made on behalf of the nation in American public discourse. Alongside primary sources of public discourse regarding wars, the immigration and citizenship of racial minorities, racial segregation and civil rights, and the criminal prosecutions of dissidents during periods of crisis, we will read secondary sources offering multiple theoretical and disciplinary approaches to the study of racial and national identity formation. Along with regular brief responses to readings, assignments will include a short rhetorical analysis paper and a longer research paper.
English	DC	76394	RESEARCH IN ENGLISH	UG	In this course we will explore methods of researching, writing, and presenting original work in English Studies. The field of English Studies is profoundly interdisciplinary. We will strive to understand not just traditionally used methods (such as text analysis), but also more recent developments borrowed from other disciplines (such as history and sociology, anthropology, and visual studies). We will cover methods for developing topics, constructing research plans, finding and using scholarly sources and conducting field research, organizing, writing, revising, and presenting a research paper of 20-25 pages. Students will also learn how to situate their work in the context of scholarly conversation, by testing their hypotheses against alternative and presenting their research to audiences in the field of English studies. Throughout the semester, students will develop and work on an original research project. At the end of the semester, students will give a public presentation of their research to other students and English faculty.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76395	SCIENCE WRITING	UG	This course will teach students how to write clear, well-organized, compelling articles about science, technology and health topics for a general audience. Students will learn how to conduct research on scientific topics using primary and secondary sources, how to conduct interviews, and how to organize that information in a logical fashion for presentation. For writing majors, the course will increase their understanding of scientific research and how to describe it accurately and completely to a general audience. For science majors, this course will teach them how to craft fluid, powerful prose so that they can bring their disciplines to life. The course is not intended just for those who want to become science writers, but for anyone who may have the need to explain technical information to a general audience, whether it is an engineer describing a green building project at a public hearing, a doctor describing the latest research on a disease to a patient advocacy group, or a computer programmer describing new software to his firm's marketing staff. Scientists and educators today are increasingly concerned about the public's lack of understanding about scientific principles and practices, and this course is one step toward remedying that deficit. Students will get a chance to read several examples of high-quality science writing and interview researchers, but the primary emphasis will be on writing a series of articles -- and rewriting them after they've been edited. The articles will range from profiles of scientists to explanations of how something works to explorations of controversies in science. Students should expect to see their writing critiqued in class, in a process similar to what journalists routinely go through. The goal will be clarity and verve; the ethos will be mutual learning and enjoyment.
English	DC	76408	CULT AND GLOBALIZATI	UG	We are often told we live in a period of globalization, but what that means differs widely. Theories of globalization describe such diverse processes as international capital and markets, neo-liberalism and neo-colonialism, transnational labor and migration, secularism, modernity / postmodernity, shifts in spatial and temporal relations, cosmopolitanism, and global cultural production and consumption. In this course we will explore and historicize the concept of globalization from a critical perspective. Using an interdisciplinary approach that pairs theory from cultural studies with scholarship in the fields of sociology, political science, economics and anthropology, we will examine the contradictions, conflicts and possibilities of associated changes. We will elaborate these ideas by considering the work of fiction writers, filmmakers, journalists and activists. The course will be organized as a series of topical foci that might include neoliberalism and labor, the local and the global, secularism and tradition, the globalization of feminism, and global migration and border control. Readings might include Arjun Appadurai, Aihwa Ong, Joseph E. Stiglitz, David Harvey, Saba Mahmood, Wendy Brown, Zygmunt Bauman, Arundhati Roy, Sunjeev Sahota, and Timothy Brennan.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76422	GENDER & SEXUALITY	UG	We will anchor our introduction to this broad and diverse field of theory in the admittedly very limited historical period of feminist, queer, and transgender political activism, circa 1970 to the present day. Instead of attempting "coverage" (an impossible task), we will shuttle between recent work in queer, transgender, and feminist theory and a few key texts that are foundational to the development of academic theory as a reaction to and extension from the political activism of these social movements. Our goals are to strengthen our understanding of the continuities and breaks in politically informed thinking about gender and sexuality, and to deepen our knowledge of the theoretical frameworks available to us from these areas of study. Students will write short response papers to course readings that will help us focus our discussions on their particular interests in literary and cultural studies.
English	DC	76439	RISE OF ART FILM	UG	The years between 1945 and 1970 saw an explosion of filmmaking talent around the world. Directors such as Vittorio De Sica, Jean-Luc Godard, Agnes Varda, Akira Kurosawa, Ingmar Bergman and Satyajit Ray completely changed the way narratives looked on screen. Just as important, however, was the fact that American audiences used to the standards and storytelling strategies of the Hollywood studio system were suddenly presented with a variety of international cinemas which collectively came to be known as "art films." This class will examine a broad cross section of such films while also scrutinizing the impact of the "art film" on Hollywood narrative strategies, domestic distribution networks, film criticism and American culture.
English	DC	76450	LAW, CULT, HUMNITIES	UG	"I'm not a lawyer, but..." How many times have you heard this disclaimer, closely followed by a lay analysis of law? This course, an introduction to the cultural study of law for graduate students and advanced undergraduate students, can be seen as an introduction to what goes into the making of such a statement. Where do we get our ideas about law? What do we mean when we say "law"? What counts as law? How does culture influence law, and law, culture? And to what degree should historical context condition any answers we might be tempted to give? Students in the course will study works in a range of genres (novels, plays, poems, judicial opinions, pamphlets) and develop methods for investigating ways that law and culture have been made by one another from the 16th-century to the present. Readings will include influential theoretical accounts of law (Aristotle, Hobbes, Cover, Habermas, Bordieu, MacKinnon), canonical texts in Law and Literature (Shakespeare's Measure for Measure, Melville's Billy Budd, Kafka's The Trial) and some "weird fiction" by the novelist/legal theorist China Miéville. As a counterpoint to the fiercely anti-historical "law and economics" movement, however, the course will put special emphasis on rooting intersections of law and culture in rich historical context, considering both local and international legal contexts (sometimes in fairly technical detail) alongside so-called "ephemera" of culture. Students will tackle the especially fruitful "case" of Renaissance Britain before developing final research projects, whether on the Renaissance or another period of their choosing.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76460	BEGIN FICTION WRKSHP	UG	This course builds upon survey or introduction courses to exercise the writer's craft in fiction. Several texts will be analyzed, in both the short story and novel forms. We will read closely with a focus on the craft of writing--the voice, point of view, character development, etc. We will develop a vocabulary for speaking about the craft of fiction and hone our skills by reading good fiction, discussing work in class and writing response papers with an eye toward the various aspects of the writing process. We will arrange a schedule in which each student?s work will be reviewed twice via peer review and in-class discussion.
English	DC	76465	ADV POETRY WORKSHOP	UG	In this course, you will be expected to take your knowledge of the principles and techniques of poetry and utilize them in workshop discussions, written analysis, and the composition of your own poems. In addition, readings of books by visiting poets will be required, Participation in a book-making project, cross-genre writing, and/or a mentoring project with high school students will also be included. Students who have not met the prerequisite but are interested in the course should speak directly with the instructor.
English	DC	76472	TPCS IN JOURNALISM	UG	This course explores the craft of journalism in the context of the history, traditions and glory of journalistic nonfiction in the United States. It seeks to help you hone your writing and thinking skills as you produce pieces of substance that reflect those traditions and standards. As a published author, foreign correspondent and Pulitzer-Prize winning editor, the instructor has been a foot soldier in print journalism and media management for 30 years. The practical emphasis of the course reflects his extensive and varied background. The course focuses on the four stages necessary to any nonfiction story: idea, concept, reporting and writing. Subjects include how to make news judgments, gather evidence, make word choices, compose stories and interpret events, unpacking the language and vocabulary of the craft of journalism. As part of our exploration of advanced nonfiction styles, we examine the six major genres of journalistic nonfiction: the trend story, the profile, the explanatory, the narrative, the point-of-view and the investigative. We will read, critique, discuss and analyze examples of each genre, and students will produce work of their own in four of the genres. Students may substitute (for one of the four writing genres) independent research on a topic of their choosing. In addition, we explore journalism's glorious past and its role in the promotion and maintenance of democracy. The last segment of the course examines the evolution of journalism in the digital age and the impact that is having on the media landscape, particularly print. Students will be given assistance and encouragement as they seek outlets for their writings and connections in the media world that could lead to internships and employment.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76475	LAW PERFORM & IDENT	UG	Although rhetoric and law have long been closely associated, the modern professionalization of law has often promoted the idea that legal discourse is not rhetorical but is a rigorously defined technical discourse that can be applied free of social or political influence. This view of legal discourse is disputed by critics who point out the figurative aspects of legal language, the importance of character, emotion, and narrative in legal discourse, and the ways in which law protects social structures of power such as race, class, and gender privilege. In this course we examine the often fraught relationship between rhetoric and law by considering the ways in which a variety of legal discourses constitute identities in global contexts, particularly the ways in which legal systems are portrayed to reflect the ideals of democracy to suit particular foreign relations goals. We begin by studying the ways in which Cold War politics influenced desegregation and civil rights discourse in the United States, then we study the ways in which the prosecutions of deposed rulers have been orchestrated to persuade global audiences that emerging democracies observe the "rule of law" in order to garner international support. Alongside primary sources of legal discourse, we will study a selection of interdisciplinary scholarship about the relationship of rhetoric and law.
English	DC	76476	RHETORIC OF SCIENCE	UG	This course explores questions about scientific argument and communication that are of interest to scientists, rhetoric of science scholars, and professional/technical writing practitioners. These include questions like: How are scientific arguments structured? How is scientific information and argument transformed when it moves from research papers to publications for non-specialist audiences? How does the social, historical, and cultural context of science shape the way it is communicated and/or argued? What contributions do visuals make to scientific argument and communication? To investigate these questions, we will be examining a wide variety of real-world communications in and about science as well as texts in rhetoric, history, and philosophy of science.
English	DC	76492	RHETORIC PBLC POLICY	UG	This course explores a rhetorical approach to public policy which focuses on the interconnected role that data, values, beliefs, and argument play in the policy process. From this perspective we will examine the important public debate over the pros and cons of various forms of energy production including nuclear, natural gas, and solar. In these investigations, we will explore questions like "How do policy makers use rhetoric to shape public perspectives on energy production?" "How can rhetorical approaches to argument function as tools for policy analysis and development?" And "What role does technological expertise play in public debate?" To pursue these questions, we will be reading works in rhetorical theory and public policy and applying the concepts and methods in those works to exploring primary artifacts of public argument like records of public hearings, social media memes, handbooks designed by activists, and stories about energy production in the popular media.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76494	HEALTHCARE COMMNCTNS	UG	Healthcare communications is designed for students with an interest in how medical and health care information is constructed and transferred between medical experts, health care providers, educators, researchers, patients and family members who are often not experts but need a thorough understanding of the information to make important health decisions. Throughout the course, we will explore the interactions of current theory and practice in medical communication and the role of writing in the transfer and adoption of new therapies and promising medical research. We will also study how the web and social media alter the way information is constructed, distributed, and consumed. We will examine the ways medical issues can be presented in communication genres (including entertainment genres) and discuss how communication skills and perceptions about audience can influence clinical research and patient care. Additionally, we will explore clinical trials, grant writing, and press releases, and will feature guest speakers from these fields will discuss their experiences.
English	DC	76719	ENVIRONMNTL RHETORIC	GR	How people think and talk about the environment matters; it reveals what they value and shapes what they do. We will look at how competing discourses define man's relationship to the natural world, frame environmental problems, and argue for public action. As we compare the environmental rhetoric of naturalists, scientists, policy makers, and activists, we will trace an American history that has managed to combine mystical celebration with militant critique, and scientific research with public debate. Equally important, this course will prepare you to act as a rhetorical consultant, by studying how writers communicate the three major "Rs" of environmental rhetoric: man's Relationship with nature, the looming presence of Risk, and the need for a Response.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76730	COMM IN GLBL MRKTPLC	GR	In this day and age, some of the most exciting employment opportunities are with multinational and international corporations and non-profits. But are you prepared for the challenge of working with professionals from all over the world? Even as more people around the globe learn English, specific cultural values, beliefs, and assumptions continue to influence the way in which they communicate. Often, behind a foreign accent, we encounter an entirely different worldview. The same word or phrase in English might actually carry very distinct connotations for someone whose native language is French, German, Russian, or Japanese. Can we learn to anticipate, understand, and become sensitive to these connotations? How can we mend potential miscommunications that might arise due to these conceptual differences? This course is designed as an introduction to international professional communication. We will talk about the way in which culture influences communication, about the job of translators and interpreters, and about specific communicative norms for the global marketplace. We will look at many concrete example of communication in the international arena, acting as problem- solvers and communication consultants who are focused on understanding and designing plans of action for navigating communicative obstacles. We will also have the opportunity to speak with professionals who are experienced in the field, and we will cover case studies ranging from corporate business to global activism and advocacy.
English	DC	76760	LITERARY JOURNALISM	GR	Literary Journalism is non-fiction writing about the people and places in the world that might be overlooked by traditional journalism. Concerned more with those whose lives are outside of the traditional spot-light, literary journalism enriches our sense of who inhabits the contemporary world. Reading the stories of other lives can help us understand our own, by enlarging and deepening the context in which we understand our humanity. In this class, you will read a variety of professional literary journalism, and be asked to write your own. You?ll have chances to interview people you know, and don?t know, and write their stories, along with an assignment that invites you to capture your family history. You?ll write about Pittsburgh places, and you?ll learn how the stories of your own life can become literary journalism when you learn to contextualize them, and connect them to larger issues. The concerns and goals of Literary Journalism overlap with memoir, creative non-fiction, and magazine writing. The class is run as a seminar and demands high level of student involvement.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76778	LITERACY: ED THRY PR	GR	Literacy has been called the engine of economic development, the road to social advancement, and the prerequisite for critical abstract thought. But is it? And what should count as literacy: using the discourse of an educated elite or laying down a rap? Competing theories of what counts as "literacy" and how to teach it shape educational policy and workplace training. However, they may ignore some remarkable ways literacy is also used by people in non-elite communities to speak and act for themselves. In this introduction to the interdisciplinary study of literacy-its history, theory, and problems-we will first explore competing theories of what literacy allows you to do, how people learn to carry off different literate practices, and what schools should teach. Then we will turn ideas into action in a hands-on, community literacy project, helping urban students use writing to take literate action for themselves. As mentors, we meet on campus for 8 weeks with teenagers from Pittsburgh's inner city neighborhoods who are working on the challenging transition from school to work. They earn the opportunity to come to CMU as part of Start On Success (SOS), an innovative internship that helps urban teenagers with hidden learning disabilities negotiate the new demands of work or college.
English	DC	76779	COMM GLOBL MKTPL II	GR	In this day and age, some of the most exciting employment opportunities are with multinational and international corporations and non-profits. But are you prepared for the challenge of working with professionals from all over the world? Even as more people around the globe learn English, specific cultural values, beliefs, and assumptions continue to influence the way in which they communicate. Often, behind a foreign accent, we encounter an entirely different worldview. The same word or phrase in English might actually carry very distinct connotations for someone whose native language is French, German, Russian, or Japanese. Can we learn to anticipate, understand, and become sensitive to these connotations? How can we mend potential miscommunications that might arise due to these conceptual differences? This course is designed as an introduction to international professional communication. We will talk about the way in which culture influences communication, about the job of translators and interpreters, and about specific communicative norms for the global marketplace. We will look at many concrete example of communication in the international arena, acting as problem- solvers and communication consultants who are focused on understanding and designing plans of action for navigating communicative obstacles. We will also have the opportunity to speak with professionals who are experienced in the field, and we will cover case studies ranging from corporate business to global activism and advocacy.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76784	RACE NATION & ENEMY	GR	Conflicts over racial and national identity continue to dominate headlines in the United States as they often have during the nation's history, from debates regarding the immigration, naturalization, and birthright citizenship of racial minorities to debates regarding racial disparities in access to civil rights. This course explores the discursive practices through which racial and national identities are formed and the frequent conflicts between them, particularly by focusing on the role of enemies, threats to the nation, and sacrifices made on behalf of the nation in American public discourse. Alongside primary sources of public discourse regarding wars, the immigration and citizenship of racial minorities, racial segregation and civil rights, and the criminal prosecutions of dissidents during periods of crisis, we will read secondary sources offering multiple theoretical and disciplinary approaches to the study of racial and national identity formation. Along with regular brief responses to readings, assignments will include a short rhetorical analysis paper and a longer research paper.
English	DC	76788	CODING FOR HUMANISTS	GR	This introductory course provides humanities students with the foundational knowledge and skills to develop computer-aided research tools for text analysis. Through a series of hands-on coding exercises, students will explore computation as a means to engage in new questions and expand their thinking about textual artifacts. This course is designed for students with no (or very little) coding experience. During the early part of the semester, students will learn basic programming using Python through examples and problem sets that are relevant to text analysis. Then, students will be introduced to a limited set of commonly used Python packages for text analysis, such as natural language processing, statistical analysis, visualization, web scraping, and social media text mining. Students are expected to complete a small final project that examines how evidence-based data-driven insights derived from text analysis would support humanistic research in their area of interest, including (but not limited to) genre studies, rhetorical criticism, authorship attribution, discourse analysis, cultural analysis, social network analysis, spatial/temporal text analysis, and writing assessment. Doctoral students in the Department of English must register for 12 units, and are expected to write a publishable quality paper. Students who are interested in digital humanities scholarship in literary and cultural studies may also consider Professor Wittek's seminar: 76429/829 "Introduction to Digital Humanities."

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76794	HEALTHCARE COMMNCTNS	GR	Healthcare communications is designed for students with an interest in how medical and health care information is constructed and transferred between medical experts, health care providers, educators, researchers, patients and family members who are often not experts but need a thorough understanding of the information to make important health decisions. Throughout the course, we will explore the interactions of current theory and practice in medical communication and the role of writing in the transfer and adoption of new therapies and promising medical research. We will also study how the web and social media alter the way information is constructed, distributed, and consumed. We will examine the ways medical issues can be presented in communication genres (including entertainment genres) and discuss how communication skills and perceptions about audience can influence clinical research and patient care. Additionally, we will explore clinical trials, grant writing, and press releases, and will feature guest speakers from these fields will discuss their experiences.
English	DC	76795	SCIENCE WRITING	GR	This course will teach students how to write clear, well-organized, compelling articles about science, technology and health topics for a general audience. Students will learn how to conduct research on scientific topics using primary and secondary sources, how to conduct interviews, and how to organize that information in a logical fashion for presentation. For writing majors, the course will increase their understanding of scientific research and how to describe it accurately and completely to a general audience. For science majors, this course will teach them how to craft fluid, powerful prose so that they can bring their disciplines to life. The course is not intended just for those who want to become science writers, but for anyone who may have the need to explain technical information to a general audience, whether it is an engineer describing a green building project at a public hearing, a doctor describing the latest research on a disease to a patient advocacy group, or a computer programmer describing new software to his firm's marketing staff. Scientists and educators today are increasingly concerned about the public's lack of understanding about scientific principles and practices, and this course is one step toward remedying that deficit. Students will get a chance to read several examples of high-quality science writing and interview researchers, but the primary emphasis will be on writing a series of articles -- and rewriting them after they've been edited. The articles will range from profiles of scientists to explanations of how something works to explorations of controversies in science. Students should expect to see their writing critiqued in class, in a process similar to what journalists routinely go through. The goal will be clarity and verve; the ethos will be mutual learning and enjoyment.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76798	RESEARCH IN ENGLISH	GR	In this course we will explore methods of researching, writing, and presenting original work in English Studies. The field of English Studies is profoundly interdisciplinary. We will strive to understand not just traditionally used methods (such as text analysis), but also more recent developments borrowed from other disciplines (such as history and sociology, anthropology, and visual studies). We will cover methods for developing topics, constructing research plans, finding and using scholarly sources and conducting field research, organizing, writing, revising, and presenting a research paper of 20-25 pages. Throughout the semester, students will develop and work on an original research project. At the end of the semester, students will give a public presentation of their research to other students and English faculty. This research paper can serve as a writing sample for PhD program applications, as a conference paper, or even journal submission.
English	DC	76822	GENDER AND SEXUALITY	GR	We will anchor our introduction to this broad and diverse field of theory in the admittedly very limited historical period of feminist, queer, and transgender political activism, circa 1970 to the present day. Instead of attempting "coverage" (an impossible task), we will shuttle between recent work in queer, transgender, and feminist theory and a few key texts that are foundational to the development of academic theory as a reaction to and extension from the political activism of these social movements. Our goals are to strengthen our understanding of the continuities and breaks in politically informed thinking about gender and sexuality, and to deepen our knowledge of the theoretical frameworks available to us from these areas of study. Students will write short response papers to course readings that will help us focus our discussions on their particular interests in literary and cultural studies.

Department	College	Course #	Course Title	Grad/UG	Description
English	DC	76850	LAW, CULT, HUMNITIES	GR	"I'm not a lawyer, but..." How many times have you heard this disclaimer, closely followed by a lay analysis of law? This course, an introduction to the cultural study of law for graduate students and advanced undergraduate students, can be seen as an introduction to what goes into the making of such a statement. Where do we get our ideas about law? What do we mean when we say "law"? What counts as law? How does culture influence law, and law, culture? And to what degree should historical context condition any answers we might be tempted to give? Students in the course will study works in a range of genres (novels, plays, poems, judicial opinions, pamphlets) and develop methods for investigating ways that law and culture have been made by one another from the 16th-century to the present. Readings will include influential theoretical accounts of law (Aristotle, Hobbes, Cover, Habermas, Bordieu, MacKinnon), canonical texts in Law and Literature (Shakespeare's Measure for Measure, Melville's Billy Budd, Kafka's The Trial) and some "weird fiction" by the novelist/legal theorist China Miéville. As a counterpoint to the fiercely anti-historical "law and economics" movement, however, the course will put special emphasis on rooting intersections of law and culture in rich historical context, considering both local and international legal contexts (sometimes in fairly technical detail) alongside so-called "ephemera" of culture. Students will tackle the especially fruitful "case" of Renaissance Britain before developing final research projects, whether on the Renaissance or another period of their choosing.
English	DC	76875	LAW PERFORM & IDENT	GR	Although rhetoric and law have long been closely associated, the modern professionalization of law has often promoted the idea that legal discourse is not rhetorical but is a rigorously defined technical discourse that can be applied free of social or political influence. This view of legal discourse is disputed by critics who point out the figurative aspects of legal language, the importance of character, emotion, and narrative in legal discourse, and the ways in which law protects social structures of power such as race, class, and gender privilege. In this course we examine the often fraught relationship between rhetoric and law by considering the ways in which a variety of legal discourses constitute identities in global contexts, particularly the ways in which legal systems are portrayed to reflect the ideals of democracy to suit particular foreign relations goals. We begin by studying the ways in which Cold War politics influenced desegregation and civil rights discourse in the United States, then we study the ways in which the prosecutions of deposed rulers have been orchestrated to persuade global audiences that emerging democracies observe the ¿rule of law¿ in order to garner international support. Alongside primary sources of legal discourse, we will study a selection of interdisciplinary scholarship about the relationship of rhetoric and law.

Department	College	Course #	Course Title	Grad/UG	Description
Heinz College Wide Courses	HC	94705	HEALTH ECONOMICS	GR	This course will teach the student to use economic analysis to understand critical issues in health care and health policy. We will address issues such as the following: 1. What factors best explain the level and rate of growth of U.S. health expenditures? 2. Does the recent high rate of growth of U.S. health care expenditures make U.S. firms less competitive in international markets? 3. What are some of the likely consequences (intended and unintended) of the proposed reforms to Medicare? 4. Can physicians induce demand for their services? 5. What are the impacts of managed care on the health care system? 6. Do strong affiliations between physicians and health plans hurt competition? The student who successfully completes this course will be able to: 1. Identify the flow of resources in the U.S. health care system how purchasers pay for their services and how providers obtain their revenues. 2. Understand the value of health and health care. 3. Evaluate how health care resources should be allocated. 4. Describe the structure of the health insurance industry explain the incentives facing insurers understand the strategies they use to compete and their impacts on social welfare. 5. Understand the demand for medical care and what role providers play in shaping this demand. 6. Explain the economics of managed care and describe how competition works in health care. Class will consist of lectures and group presentations. Evaluation will include homework problems group projects and exams. This course will interest any individual planning a career in health or related industries. It will also be of interest to students who wish to understand how economics is applied to some of our most prominent and contentious policy issues. Skill.
Heinz College Wide Courses	HC	94706	HEALTHCARE INF SYSTM	GR	In a value-based care delivery environment with its emphasis on improving costs and service efficiency without risking quality of care, information technology has emerged as a powerful driving force in helping to achieve multiple goals within healthcare organizations. The explosive advances in information technology combined with the current challenges facing healthcare delivery have created the need for skilled individuals who can develop, understand, manage, and integrate healthcare information systems in organizations. This course will explore the concepts and application of major information systems methodologies and approaches in the delivery of modern healthcare systems, including traditional face-to-face, online, and mobile and social media enabled care delivery. A semester-long group project that synthesizes the different topics via the design and implementation of a working, integrated, healthcare decision support application will be a required component of the course.

Department	College	Course #	Course Title	Grad/UG	Description
Heinz College Wide Courses	HC	94800	NEGOTIATION	GR	Welcome to Negotiation. You knew it all along: Life isn't fair. Perhaps what you didn't know, though, is that you can learn to do something about it. Negotiation is not only a talent you can be born with, it's also a skill that can be learned! This course focuses on improving fundamental negotiating competencies in personal and organizational contexts. Negotiation is both an art and a science. This course will teach you how to negotiate more effectively through a combination of assessments, exercises and simulations. In subject matter and approach this class is designed to provide understanding and insight into your present negotiating abilities, as well as challenge your comfort zone to allow for continuous improvement going forward. Negotiation is fast-paced, interactive and hands-on. Drawing upon current research and recognized best practices, we will emphasize both basic mastery and practical application of the subject matter covered. In that respect, and perhaps unlike your other classes at the Heinz College, this course will have elements of both education (learning about) and training (learning how to).
Heinz College Wide Courses	HC	94801	ACTING FOR MANGEMNT	GR	Actors use "tools" (their voice, body, focus) to convey emotion and tell stories to audiences. Acting for Management will help you utilize the actor's tools to become a more powerful and persuasive presenter, to feel more confident when communicating with others, to understand your audience and to show the world the best and most authentic version of you. Through in-class exercises, prepared acting scenes and discussion, we will explore the use of physical tools (voice and body) as well as non-physical tools (imagination, emotion, focus, intention). Exercises and scenes will include situations you will encounter in professional organizations such as teamwork, conflict and power, among others. Because success in professional settings depends on your ability to clearly and dynamically communicate your ideas and skillfully navigate the "politics" of the organization, our focus for the class will be how to transfer the actor's tools to real-world situations. Acting for Management is about you and your individual growth. To make the most of it, you will need to attend all classes and participate fully in activities. Learning Outcomes At the conclusion of this class, you should: -Be able to define your strengths as a presenter and areas for continued work -Use the actor's tools to shape your performances and presentations -Exhibit increased confidence in performing and presenting -See an increase in your willingness to be spontaneous and take risks

Department	College	Course #	Course Title	Grad/UG	Description
Heinz College Wide Courses	HC	94806	PRIVACY DIGITAL AGE	GR	Privacy is a complex and multi-faceted concept. This course combines technical, economic, legal, and policy perspectives to present a holistic view of its role and value in the digital age. The reduction of the cost of storing and manipulating information has led organizations to capture increasing amounts of information about individual behavior. New trade-offs have emerged for parties involved with privacy-enhancing or intrusive technologies: individuals want to avoid the misuse of the information they pass along to others, but they also want to share enough information to achieve satisfactory interactions; organizations want to know more about the parties with whom they interact, but they do not want to alienate them with policies deemed as intrusive. Is there a ¿sweet¿ spot that satisfies the interests of all parties? Is there a combination of technological solutions, economic incentives, and legal safeguards that is acceptable for the individual and beneficial to society? This course tries to address the above questions. In particular, the course begins by comparing early definitions of privacy to the current information-focused debate. It then focuses on: - technological aspects of privacy (privacy concerns raised by new IT such as the Internet, wireless communications, and computer matching; tracking techniques and data mining; privacy enhancing technologies and anonymous protocols,), - economic aspects (economic models of the market for privacy, financial risks caused by privacy violations, the value of customer information, - legal aspects (laissez-faire versus regulated approaches, US versus EU legal safeguards,) - managerial implications (the emerging role of Chief Privacy Officers, compulsory directives and self-regulative efforts, and - policy aspects (trade-offs between individual privacy rights and societal needs,)
Heinz College Wide Courses	HC	94808	MANAGEMENT CONSLTG	GR	This is an applications course exploring the profession of management consulting. The course is designed to provide a framework for understanding the art and science of providing management counsel to client organizations in the public and private sectors.
Heinz College Wide Courses	HC	94813	PROJECT MANAGEMENT	GR	As organizations continue to look for ways to reduce costs, managers are often expected to oversee special projects in addition to their traditional responsibilities. When a project is too complex for one person to handle, the project manager is expected to lead a team of diverse employees to complete the assignment. This course will assist the project manager to break down a complex project into manageable segments, lead a diverse project team, and use effective tools to ensure that the project meets its deliverables and is completed within budget and on schedule. Over the course of the mini, students will complete a plan for an actual project, giving them valuable experience with the relevant tools and skills, including Microsoft Project software.

Department	College	Course #	Course Title	Grad/UG	Description
Heinz College Wide Courses	HC	94823	MEASURING SOCIAL	GR	This class reflects an experiential learning environment where students will be placed into teams with students from across Heinz and CMU to work with clients on projects involving measuring social content and activity. Each semester (Spring and Fall), we bring in 7 companies to provide challenging projects for the student teams. Teams are provided with commercially available tools to listen to online social conversations, measure activity, assess different market segments, understand social influence and identify how information get disseminated across social channels. Previous sponsors have included: Under Armour, Netflix, Target, The Washington Post, HBO, Daimler, eBay, Google, AT&T, The Pittsburgh Steelers, etc. The class is designed to teach social analytics, consulting methodologies, critical thinking to weed through ambiguity, project management as well as team and relationship development. Lectures focus on how social is impacting different industries, culture and communication, as well as the future of work. Teams work with their clients throughout the semester and present their findings/deliverables during final presentations when all 7 sponsors come to CMU. In the past, teams have built social applications, social algorithms, experimental methodologies, crowdsourced campaigns and real time information dash boards for their clients. This class offers an opportunity for students interested in analyzing social data, working in a consultative fashion with actual clients on real issues, and learning about global issues associated with an increasingly social culture.
Heinz College Wide Courses	HC	94827	SAS FOR PUBLIC POLCY	GR	Many government agencies, corporations, and think tanks use SAS for analyses and reporting. New employees are often asked to modify existing programs or to create new ones. This course provides introduction to the SAS programming language with examples from real world policy analyses. We will focus primarily on data step programming and some basic SAS procedures, though we will also cover simple statistical procedures like PROC REG and PROC LOGISTIC. Topics covered will include conditional processing, arrays and loops, combining files, macro programming, and best programming practices. We will use SAS procedures to explore data and identify important characteristics and possible errors in the data. By the end of the class students should be able to pick up an existing SAS program and understand what it is doing or create an original SAS program. Students will learn by doing, and all sessions will be taught in the computer lab with hands on programming.

Department	College	Course #	Course Title	Grad/UG	Description
Heinz College Wide Courses	HC	94831	DESGN & PLCY HMN IMP	GR	In this combined lecture and lab course, students will gain a sense of the history and future of social innovation with an emphasis on design-centric applications, and the current and future role public policy, markets, and design have in shaping and defining conditions for change with a positive impact on humanity. This "systems thinking" approach, when applied to challenges at a societal and cultural scale, recognizes the relationship between global and local concerns, the need to inform through verifiable data and evidence, and the role that crafters of public policy and design can have in promoting social innovation. The full course description can be found on the Heinz College website: http://www.heinz.cmu.edu/academic-resources/course-results/course-details/index.aspx?cid=498
Heinz College Wide Courses	HC	94848	PH S MED HUM RIGHTS	GR	This course will examine the ways that social media and the ubiquity of mobile phones with good cameras and Internet access are changing how information about development and human rights is gathered, analyzed, and disseminated. We will ask: What are the new possibilities opened up by these technologies? What are the potential pitfalls—e.g., privacy concerns, risks to sources, or the false confidence that we are now able to know everything about what is happening in the world? What are the biggest technical, cultural, and political challenges in this domain? Who is responding to these challenges and what are they doing? And perhaps most importantly, to what extent can advances in technology ameliorate problems that are fundamentally political in nature
Heinz College Wide Courses	HC	94854	DEV AS A LEADER	GR	This course helps students build their leadership skills via three learning frameworks: models, practice and reflection. Students will be able to experiment and receive feedback regarding different leadership behaviors. Special attention will be given to adjusting leader behavior to different audiences and settings and sustaining leadership development over one's career.
Heinz College Wide Courses	HC	94859	INT'L CRISIS NEGO EX	GR	This introductory course (there are no prerequisite courses) is designed to: 1) increase your understanding of international conflicts and negotiation processes; and 2) improve your effectiveness as a team leader, team member and negotiator. Students will prepare for and participate in an immersive negotiation exercise led by the United States Army War College. All classwork and the actual exercise occur over the following dates: Saturday, April 14th (9:00am-4:00pm*), Saturday, April 21st (8:30am-7:00pm*), and Sunday, April 22nd (8:30am-4:00pm*) - and one weekday - Tuesday, April 24th (12:00-1:20pm*). *Times are subject to change.

Department	College	Course #	Course Title	Grad/UG	Description
Heinz College Wide Courses	HC	94878	AI, SOC HUMANITY	GR	AI and robotic technologies are rapidly developing and spreading, with corresponding social and human impacts & opportunities. Understanding these potential risks and benefits requires a multidisciplinary approach, drawing from ethics, philosophy, psychology, sociology, economics, and more. These diverse perspectives can help us to ensure that new technologies support and advance human and social values & interests. In this course, we will study relevant disciplinary methods & frameworks through a series of case studies of current or near-future AI and robotic technologies. We will learn to apply those techniques to analyze and understand the challenges & opportunities presented by novel technology.

History 61

History	DC	79104	GLOBAL HISTORIES	UG	Human activity transcends political, geographical, and cultural boundaries. From wars to social movements, technological innovations to environmental changes, our world has long been an interconnected one. Acquiring the ability to understand such transnational and even worldwide processes is an indispensable part of any college education. This course provides students with an opportunity to develop the skills and perspectives needed to understand the contemporary world through investigating its global history. All sections are comparable in their composition of lectures and recitations, required amounts of reading, and emphasis on written assignments as the central medium of assessment. The sections all aim to help students: (1) master knowledge through interaction with the instructors, reading material, and other students, (2) think critically about the context and purpose of any given information, (3) craft effective verbal and written arguments by combining evidence, logic, and creativity, and (4) appreciate the relevance of the past in the present and future. For descriptions of specific sections, see "First Year Experience" at the Dietrich College General Education Website: http://www.hss.cmu.edu/gened/.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79200	INTRO HIS RES & WRIT	UG	This course introduces students to methods and materials that historians use to study the past, and how they present and debate findings. We study what historians consider "best practices" for doing research in primary and secondary sources. We discuss how to ask questions or pose problems about the past that will enable students to develop a research topic, find appropriate primary and secondary sources, take notes from those sources, and write a paper that answers the original question using skills we have studied. We will use the topic of World War I as the theme for the semester. The first part of the class will consist of readings from primary sources such as eyewitness accounts, memoirs, poetry, and film to understand the meanings that participants gave to the experience of war. We also read secondary accounts of the war in which historians recount the war and assess the longer-term meanings it. In addition to our discussions of these assigned readings, students will develop, carry out, and report to the class on their research topics, so that , by the end of the semester, the group will have built an understanding of the war in its many dimensions. Work includes reading and discussing course texts, completing short assignments, sharing writing-in-progress, oral reports to classmates, and a final research paper of 10-15 pages.
History	DC	79201	INTRO ANTHROPOLOGY	UG	How do societies make meaning? Is culture a set of shared values or are these values continuously negotiated, altered, and adjusted? How do individuals and societies account for change and how do they aim to incorporate it into their values? This course introduces students to anthropological approaches to these questions. Readings will draw on case studies from very different settings: from a ruined city in Brazil to interethnic conflict in Cyprus, oil and chocolate in post-Soviet Russia, pyramid schemes in postsocialist Romania, and vampires stories in East and Central Africa. We will assess the advantages and pitfalls of comparing cross-cultural data, analyze the workings of power within and between societies, and consider the politics of cultural representations. We will also discuss the anthropologist's relationship to the people s/he studies, and the responsibilities inherent in that relationship. Throughout the course, students will learn the importance of a historical perspective on culture, looking at how and why societies change, and considering how we, as anthropologists, should assess these changes.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79202	FL SP EARLY MOD EUR	UG	This course examines European history from the Black Death to the French Revolution, a period known to history as the "early modern" period. That is, it marks a period in European history that was not quite medieval, and yet not quite modern. Many features of modern society, such as the nation-state, free-trade economies, religious pluralism, scientific rationalism, and secular culture trace their origins to the early modern era, yet the period was also marked by important continuities with the Middle Ages. During this course, we will explore how Europeans re-imagined their world in its transition from the medieval to the modern. Topics to be considered will include the "renaissance" of the arts, the problems of religious reform, exploration and colonialism, the rise of science, and the expansion of the state. Through these developments, we will focus on Europeans' changing notions of the human body, the body politic, and the natural world, as well as their re-interpretations of the proper relation between the human and the divine, the individual and the community, and the present and the past.
History	DC	79205	20TH&21ST CENT EUROP	UG	This course surveys the history of Europe from 1900 to 2000 and beyond. While it covers major political trends and social/economic changes of the last century, it concentrates on the following themes: the extraordinary violence of the two World Wars -- and their continuing impact on politics, society, and culture; social and political movements/regimes of the Far Right and of the Socialist/Communist Left; the rise and crisis of the European welfare state and of the European Union; reactions to U.S. power and to Americanization; cultural and political controversies surrounding Islam and Muslims in Europe today.
History	DC	79208	WITCHCRAFT/WITCH-HUN	UG	Between the late 15th and the early 18th centuries, many Europeans became convinced that their society was threatened by a conspiracy of diabolic witches. Although Western beliefs in witchcraft and diabolism dated back to antiquity, the 16th and 17th centuries witnessed the most intense campaign of witch-hunting in all of Europe's history. Before it was over, the "Great European Witch-Hunt" of the early modern era cost the lives of thousands across Europe and in its American colonies. Ever since, historians have struggled to explain why fears of witchcraft suddenly became so acute in this period and why - seemingly just as suddenly - Europeans ultimately came to repudiate them. This course examines the phenomenon of the early modern witch-hunts in both their European and colonial contexts, focusing on the origin and rationale of early modern witch beliefs and the factors driving the timing and intensity of witch-hunts, the patterns of accusations, and the ultimate end of the prosecutions. Throughout, we will examine the many regional variations in witch beliefs and prosecutions that make the early modern witch-hunts such a complex historical puzzle. In the process, we will explore how early modern witch-hunting reflected major issues in European society, culture, and politics -- including the relationship between "popular" and "elite" culture; religious reform; the formation of the modern state; gender and patriarchy; and the rationalization of law, medicine, and science.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79209	ART HISTORICL DETECT	UG	How do historians determine how and why episodes in the past transpired? This course takes students behind the scenes and acquaints them with the techniques by which historians practice their craft in interpreting historical events. Using dramatic case studies in American history, we will examine a wide array of tools and sources at the historian's disposal, among them oral evidence, photographs and images, maps, official documents, memoirs, psycho-history, popular media, historical films and fiction, and television. Through in-class workshops and solo and group assignments, students will experiment with different methods of historical analysis using a variety of source material. Students will develop a familiarity with the historian's toolbox and a new-found appreciation for the painstaking efforts that go into producing the history books they may otherwise take for granted.
History	DC	79211	MODRN SOUTHEAST ASIA	UG	When you hear the term "Southeast Asia," what comes to mind? The Vietnam War? The ruins of the Angkor civilization? Rich culinary traditions? Or perhaps your own ethnic heritage? However you imagine it, Southeast Asia is an incredibly diverse and dynamic region that has long been integral to world affairs and whose importance continues to grow. This course offers a wide-ranging survey of Southeast Asia's peoples, their histories, and some of the issues they face today. Together we will explore the region as a "global crossroads," where the world's religions, economies, cultures, and politics come together in generative, sometimes traumatic, and often surprising ways.
History	DC	79213	AMERICAN RAILROAD	UG	Railroads in the USA are often considered as a subject for nostalgia or public sector failure, an image largely based on passenger service. However, the USA's private sector freight rail industry is considered a model for the world as the result of its renaissance following deregulation in 1980. This is a "stealth" industry whose history and economics are both intertwined and complex. Starting with the development of the first U. S. railroads, students will gain a basic understanding of the industry's history and economics, with special attention to the past half-century. In addition, students will participate in small group research projects in particular areas of special interest -- for example, economic history, industry culture, network economics, utility regulation or transportation policy.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79214	PARIS IN REVOLT	UG	This course asks a simple question with a complex answer: Why is it that the modern history of the French capital has been so marked by uprisings that challenged and sometimes overthrew the existing political regime? What accounts for this political instability? We answer these questions by studying a selection of well-known examples of Paris uprisings from the period of great the French Revolution (began 1789) through May, 1968. We examine major causes of the revolt, the kinds of people who led and followed it, and its consequences in the short- and longer-term. We also learn about the "culture" that surrounded political and social movements through eyewitness accounts, speeches, literature and the arts. While we are doing this, we'll try to learn as much as we can about continuities and changes in the city itself -- its population and built environment. Coursework will consist of attending lectures, responding orally and in writing to assigned readings and several films, and a comparative final essay.
History	DC	79216	GENGHIS KHAN/MON EMP	UG	This course examines the rise, rule, and impact of the Mongol Empire on global history. In the 13th century, Eurasia was shaken by a force contemporary chroniclers likened to an apocalypse. Within a few decades, horsemen under the command of Chinggis (Genghis) Khan swept out of the northeastern steppe to establish the largest land empire the world would ever know. Few events in world history have inspired such fear and awe. However, the Mongol period also ushered in the so-called pax Mongolica, the first period of sustained contact and exchange across Eurasia as people, technologies, arts, biodiversity, and ideas spread throughout the Mongol domains and beyond. Questions to be examined include: Who was Genghis Khan and how did he lead a little known nomadic people to conquer much of the known world? What cultural and technological innovations aided the Mongols rise and conquest? How did Genghis's successors rule their vast, diverse domains? What role did religion play in Mongol Eurasia? Why did a unified Mongol empire fall apart in such a relatively short period of time? And how did the Mongols and their empire help shape the world we live in today?
History	DC	79223	MEXCO:AZTEC EMP-DRUG	UG	This course provides a survey of Mexican history and culture over a variety of periods, from the rise of the Aztec empire, to Spanish conquest and colonization, to national independence, to the Mexican Revolution and contemporary Mexico. A wide range of topics will be addressed, such as: race, ethnicity, and indigeneity; state formation and politics; national identity and the politics of memory; migration and the border; and the drug war. Students will discuss historical and anthropological scholarship on Mexico, but will also consider cultural documents of various kinds, like Mexican music, art, and food.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79227	MOD AFR:SLAVE/APRTHD	UG	The course is designed to give students an understanding and appreciation of African history and culture from the "inside out." Though it deals with the period of European expansion in Africa, it is centered on African language/ ethnic groups, villages, and individuals as historical actors who daily make collective and personal decisions to pass down, innovate, and borrow practices, technology, spiritual systems, etc. in the face of social, political, and economic realities. The course is also designed to get students thinking critically about how historians select and interpret sources to construct and reconstruct history at these different levels.
History	DC	79235	CARIBBEAN CULTURES	UG	This course will examine the cultures and societies of the Caribbean focusing on their colonial past, their current positioning in the world, their social structure, cultural patterns and current transnationalism. Using social history, film and music we will explore the topics of race, class, family, gender, religion, national identity and underdevelopment. Comparative research projects will provide concrete instances of the differences and similarities between the Anglo-Caribbean, Franco-Caribbean, and Hispanic Caribbean. This course is open to all students.
History	DC	79236	AMERICA: NY PAST/PRE	UG	Immigration became a prominent issue in national politics during the 2016 presidential campaign, and a contentious debate around immigration policy has carried forward into the Trump administration. American immigration history is long and complicated, but by pairing it with the history of a particular place (New York City) we can better understand the social, political, and cultural trends that have affected the policies of the United States government, the perceptions of Americans towards newcomers, and the lived experience of immigrants since as early as the 1600s. This course will explore such issues as whether New York, the nation's quintessential city of immigrants, has been a "melting pot" and entry point to the Land of Liberty. Has the city been a place where diverse groups of people from around the world have acculturated and Americanized? Or have immigrants to New York City mainly struggled to find acceptance, maintain their culture and traditions, and gain an economic foothold?

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79242	AFR AMR HST: REC PRS	UG	This course explores the transformation of African Americans from Reconstruction to the present in the contexts of social, cultural, and political histories. Historical periods include Reconstruction, the Harlem Renaissance, World War II, Civil Rights, and the Age of Barack Obama. From African American perspectives, the issues and themes include: social and political ideologies, cultural development, post-enslavement freedom, citizenship, inter- and intra-racial dynamics, and global connections. Students will improve the following skills: test-taking, essay writing, and communication. Teaching methods combine: 1. student-centered learning based on facilitation and class participation, and 2. digital access including a class website.
History	DC	79245	CAPTLM INDV AMER CLT	UG	This small discussion course traces ideas about individualism and capitalism in the U.S., from colonial times to the present. We will focus on three main themes: 1) the relationship between capitalism, work, and identity; 2) changing definitions of success and failure; and 3) the historical origins of students' attitudes toward 1 & 2. In short, we will study the economics and emotions of the American dream: how class, race, gender, occupation, and ambition shape our identities. Readings include "The Autobiography of Benjamin Franklin," studies by Alexis de Tocqueville and Max Weber, writings of Frederick Douglass, Ralph Waldo Emerson, Herman Melville, Henry Thoreau, Charlotte Perkins Gilman, Andrew Carnegie's classic essay "Gospel of Wealth," Arthur Miller's "Death of a Salesman," and Malcolm Gladwell's "Outliers." Grading is based upon a readings journal, participation in discussion, three short essays and a longer final paper.
History	DC	79260	ADOLF HITLER	UG	Who was Adolf Hitler? What motivated him? What did he believe? Why did Germans support him? How did he rise to power? How did he use his power? This course covers the biography of Hitler, placing his life in the political and economic context of his era. Through a combination of lectures and discussion, the class will consider: Hitler and his political movement, Hitler and his people, Hitler and his enemies, Hitler and his war, Hitler and his crimes, Hitler and his place in history. We will discuss his upbringing, personality, and strengths and weaknesses as a political leader and military strategist. We will study his worldview, including his ethno-nationalism, antisemitism, and anti-Communism. We will examine his role in the origins and implementation of the Holocaust. Readings will include works by historians, excerpts from Mein Kampf, and the writings of his fellow Nazis and other contemporaries. The class will also analyze the portrayal of Hitler in documentary and feature films. Students will write three papers: two papers of 5-6 pages each, based on in-class readings/films, and a final research paper of 12 pages, based on six outside readings.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79262	MODERN CHINA	UG	[Note: students who have already taken this course under its former title 79-262, Modern China, may not enroll.] This course is an introduction to major themes in twentieth-century Chinese history, including the transition from empire to nation, revolution, social change and modernization, western and Japanese imperialism, the rise of the party-state, Chinese socialism, economic liberalization and the so-called "Chinese Dream." The first half of the class is devoted to the period between the fall of the imperial system and the founding of the People's Republic of China (1911-1949). If the victory of the Chinese Communist Party and development of the socialist state are to be considered in historical context, it is necessary to first understand the political, cultural, economic and intellectual currents that immediately preceded them. During the second half of the course, we will examine the Maoist period (1949-1976). We will investigate the Chinese Communist Party as both a state-building institution and an engine of social transformation, and consider the tensions these dual roles produced. Finally, we will look at the Reform Period (1978-present), and reflect on a newly robust China's attempts to come to terms with its own recent past and what the consequences might be for both China and the world.
History	DC	79264	TIBET AND CHINA	UG	[Note: students who have already taken this course under its former title 79-264, Tibet in History and Imagination, may not enroll.] This course is an introduction to the "Tibet Question," the dispute over whether Tibet should be part of China, an independent nation-state, or, as the current Dalai Lama now advocates, something in between. "History" often serves as the battleground on which competing visions of the nation are fought - who should be included and excluded, where "natural" boundaries begin and end. This almost always requires a process of simplification in which inconvenient details are forgotten or repurposed in the service of national agendas. The "Tibet Question" is a telling example. In this class, we investigate the historical relationship between "China" and "Tibet" from the 13th century through the present, and note the ways advocates on both sides of the "Tibet Question" have constructed historical narratives (propaganda) in support of their political positions. We will also discuss the prospects for a political solution and consider the lessons the "Tibet Question" may hold for understanding other outstanding "historical" disputes.
History	DC	79266	RUSSIA: COMM/CAPTLSM	UG	This course covers a broad sweep of Russian history from the socialist revolution in 1917 to the collapse of the Soviet Union in the 1990s. Spanning almost a century of upheaval and transformation, the course examines the October revolution in 1917, the ruthless power struggles of the 1920s, the triumph of Stalin, the costly industrialization and collectivization drives, the battle against fascism, and the "wild west" capitalism and collapse of the social welfare state. The course provides essential background for anyone interested in understanding Russia's place in the world today and its relationship with the West.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79273	JEWS& MUSLIMS IN HIS	UG	What is the history of Muslim-Jewish interaction beyond the Palestinian-Israeli conflict and the images of violence in the Middle East that permeate the media? The overarching goal of this course is to explore this question through close study of the history of Jews and Muslims who lived as neighbors, in cooperation as well as in conflict in the Middle East, North Africa and Europe, from the rise of Islam in the seventh century to the present day. Our sources will include works of scholarship, primary source texts such as religious queries and government documents, journalistic materials, memoirs, and films.
History	DC	79275	INTRO TO GLOBAL STDS	UG	"Globalization" is a familiar term that is often used to invoke the idea that places around the world are rapidly becoming more interconnected. This is so, but it is also true that this is far being from a simple or harmonious process. Rather, "globalization" involves a wide range of uneven and disputed cultural, political, economic, and social developments that often influence one another but vary markedly in their significance, impact, and intensity. Economic crisis, impoverishment, rising inequality, environmental degradation, pandemic disease, and militant ethnic, religious, and nationalist movements are just as much a part of the contemporary global landscape as are technological innovation, instantaneous communication, shifts in the global division of labor, the creation of new wealth and knowledge, the promotion and defense of human rights, and the rise of cosmopolitan values and perspectives. This course introduces you to important ways of thinking about globalization and will acquaint you with the kinds of research, evidence, and information upon which these kinds of thinking rely. It serves as a foundation for further study of the contemporary world in advanced Global Studies courses.
History	DC	79278	HOW(NOT)CHANGE WORLD	UG	Everyone, it seems, wants to "change the world." Aspiring to enact positive change is what motivates me as a professor and, I suspect, what has drawn many of you to pursue higher education. But what form do our noble aspirations take in practice? What assumptions do we bring with us when we set out to change the world and with what (unintended) consequences? How do others go about pursuing change and how might we engage with their efforts? In this course, we will critically examine a diverse set of attempts to bring about change, taking time to interrogate the cultural assumptions and social formations that underpin them. These will include some of our own engagements (e.g., campus activism, volunteering abroad), those of nearby communities (e.g., regional environmental-justice activism), and some that may be more distant from our everyday lives (e.g., Indigenous resurgence). Applying concepts from anthropology and critical social theory, we will examine case studies from around the world while engaging with diverse perspectives, including those of scholar-activists in the fields of Indigenous studies, feminism, critical race theory, and more.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79281	INTRO TO RELIGION	UG	Religion can be viewed from the "outside," through the academic lenses of history, sociology, psychology, philosophy, etc., and from the "inside," listening to the experiences and reflections of those who practice various faiths. The course will examine major religious traditions from several perspectives, and begin to explore such topics as the relationship between religion and science, faith and reason, and religion in public life. For students with a general interest in religion as well as those contemplating a religious studies minor.
History	DC	79288	HIS LATIN AMER-U.S.	UG	This course will use readings, film/video, and popular music to examine the tumultuous and paradoxical relationship between Latin America and the United States from the early 1800s to the present, with an emphasis on Mexico, Central America, and the Caribbean during the Cold War era (1945-1989) and its aftermath (1989-2014). During the Cold War years, the United States intervened frequently in Latin America; following the Cold War, a new geopolitics emerged shaped by trade policies, immigration, and illicit drug trades. We will study relationships between U.S. and Latin American governments ("state-state" relations), but we will also consider many other kinds of people and institutions including artists, athletes, businessmen, coffee farmers, consumers, corporations, Hollywood studios, journalists, migrant workers, musicians, rebels, scientists, and tourists. Evaluation will be based on class discussions, quizzes, mini-presentations, and written analysis of historical documents.
History	DC	79289	ENV HIS PEOPLE/ANIML	UG	Why do modern societies go to great lengths to protect some animals and slaughter others? How do people use animals to demarcate boundaries among themselves and between "humans" and "nature?" What are the environmental ramifications of domestication? What role do animals play in visual culture? These are some of the questions that we will seek to answer as we explore the role of human--animal relationships in making the modern world (ca. 1400-present). We will pay particular attention to visual representations of animals across time and cultures. Evaluation will be based on active participation in class discussions, submission of weekly field notes, and a final assignment focused on visual representations of people and animals.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79296	RELIGION IN AMER POL	UG	"Separation of church and state" is an expression widely used but poorly understood. Thomas Jefferson's phrase, which does not actually appear in the Constitution, reminds us that religious institutions are kept separate from government in America, even though religious commitments and motivations have always played an important part in American politics. This course will provide an historical perspective on the role of religion in public life from the late 18th century to the present, including religion's influence on political parties and public policies, and the boundaries set by the Constitution on such activity.
History	DC	79300	HSTRY AMRC PUBC PLCY	UG	This course will describe and analyze aspects of the development of public policy in the United States from the colonial era to the present, with a focus on the post-Civil War era. For the purposes of this course, public policy will be defined as the making of rules and laws and their implementation by government in an attempt to achieve a particular normative vision of what society ought to be like. This course will require extensive reading of policy positions, legal decisions, and historical analyses of policy debates. Particular emphasis will be placed on changing views about the authority of the government to intervene in economic and social issues; the best way to balance individual and collective interests; and the variability within society of the life courses of individuals. Topics to be covered include immigration, health care and health insurance, and education; assignments may include reading quizzes, in-class debates, and policy position papers.
History	DC	79302	KILLER ROBOTS	UG	Unmanned aerial vehicles (drones) have become a central feature of the United States' global counterterrorism strategy since September 11, 2001, and autonomous weapons systems (often called "killer robots" by critics) are increasingly being integrated into military arsenals around the world. According to proponents, drones and autonomous weapons systems are much safer than manned systems, so accurate that they can be used to target individuals and detect threats in real time, and efficient and inexpensive enough to be used for long-term surveillance and protection missions around the globe. According to critics, the use of such systems is problematic because of the obfuscation of historically accepted chains of accountability and responsibility, and the difficulty of translating complex ethical decision making processes into computer code. This course will evaluate these issues through the lenses of law, politics, morality, history, and military strategy.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79303	PGH TRNSFM MDN UB AM	UG	This course will focus on the transformations, both negative and positive, of Pittsburgh and the Pittsburgh region in the period from 1945 through the present. It will explore the following themes: the redevelopment of the city in the Pittsburgh Renaissances, the collapse of the steel industry and the development of an Eds/Meds service economy, and the city's changing economy, demography, and neighborhoods. In addition, environmental conditions and change will be examined.
History	DC	79312	ARCHAEOLOGY OF DEATH	UG	Ancient tombs, dusty crypts, frozen bodies, mummies, and cemeteries are the stuff of adventure and fiction. Archaeologists examine causes of death in the past, and study how ancient peoples dealt with the dead, to learn about life in the past. This course will explore mortuary patterns (the treatment of the dead) in order to reconstruct prehistoric social organization. We will also discuss archaeological approaches to paleopathology and patterns of mortality in past populations.
History	DC	79313	REFUGEES/ASYLUM	UG	What is home? What does it mean to belong, or not belong? What does it mean to be mobile? Is mobility a privilege or a curse? How do experiences of migration, exile, and displacement shift one's understanding of home? This course will examine the emerging patterns of migration, mobility, and displacement in today's world. We will engage with anthropological and sociological analyses of global migrations of people, capital, and ideas; social inequalities; "economic" and "environmental" refugees; new forms of political organization and governance (international, grass-roots, supranational); and new forms of political control (surveillance, "profiling," militarization of borders, and race-related forms of rejection and violence). The grade will be based on participation in class discussions, one in-class presentation, and a reading diary, which will include written comments on the class readings posted weekly on Canvas.
History	DC	79319	INDIA THROUGH FILM	UG	Bollywood films attract hundreds of millions of viewers, not just in India but throughout the world. The name "Bollywood" makes it seem that the Indian film industry is a junior partner, merely an echo of Hollywood. But more films are made in Mumbai every year than in Los Angeles. And Mumbai is only one of many film hubs in India. The rich diversity of Indian cinema speaks to the equally rich history of India itself. This course uses Indian movies to examine several key themes in India's history. We will focus on the twentieth century and on questions of democracy, diversity, and development. This course includes a mandatory film screening on Wednesday evenings beginning at 6:30pm.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79324	#METOO-GNDRVIOLENCE	UG	#metoo represents a sea change in society's response to gender-based violence. But what is sexual harassment, exactly? When does something cross over into being inappropriate? Would you always know violence when you see it? Chances are, you wouldn't. Focusing on the U.S., this class dives into where we are, and how we got here. It addresses gender-based violence as a public health & human rights issue. It will delineate the legal and social definitions of gender violence, explore how those definitions function both positively and negatively, and examine the long history of protest that has culminated in this moment. Come join the conversation!
History	DC	79325	US GAY & LESBIAN HIS	UG	US Gay and Lesbian History offers an overview of the changing context and circumstances of sexual minorities in American culture. From early constructions of moral opprobrium, criminal deviance or medical pathology, the LGBT community emerged in the twentieth and twenty-first century as a political constituency and a vital part of contemporary society. Students should be aware that this course will necessarily address issues of intimate relations and sexuality as well as broader historical issues.
History	DC	79327	MODERN GIRLHOOD	UG	Through primary documents, film and popular media, material culture, and interdisciplinary scholarship from the emerging field of girl(hood) studies, this course will examine historical conceptions of girlhood and accounts of girls' lives, to contemporary concerns and representations. In seeking to understand the meaning and experience of "modern" girlhood, our focus will primarily be on the 20th and 21st century American experiences, though at times we may look to perspectives from earlier periods and elsewhere in the world. Because there is no single experience or representation of girlhood, we will pay attention to the ways that girlhood is lived and constructed through the frameworks of race, class, culture, and geographic specificity.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79328	PHTGR & PHOTGY WW II	UG	Invented in 1839, photography was a form of visual expression that immediately attracted a large public following. Starting around 1900, photography was practiced with two dominant strands. One of these firmly believed in the power of photographs to provide a window on the world, and was led by Lewis Hine, whose documentary photographs for the National Child Labor Committee helped to ameliorate living and working conditions for thousands of immigrant children. The other strand adhered to the philosophy of Alfred Stieglitz who adamantly affirmed that photographs were first and foremost reflections of the soul and were art objects, equal to painting, drawing and sculpture. These two schools of thought guided photographers throughout the twentieth century. This course explores in depth the tremendous range of photographic expression since World War II and examines in particular the contributions of significant image-makers such as Helen Levitt, W. Eugene Smith, Robert Frank, Diane Arbus, Garry Winogrand, Charles "Teenie" Harris, Cindy Sherman, Carrie Mae Weems, Nan Goldin, James Nachtwey, and many others. Classes include a slide lecture, student presentation, and video segments that introduce a focused selection of images by major photographers in an attempt to understand their intentions, styles, and influences. In Spring 2018, students will be expected to make one or more visits to photography exhibitions on view in Pittsburgh (locations to be announced at the first class in January.)
History	DC	79331	BDY PLTC: WM HLT AM	UG	This course takes a topical, intersectional approach to the history of U.S. women's health in the nineteenth and twentieth centuries. It is less about governmental politics, although we do some of that. Rather, it sees bodies as cultural texts through which power is built and contested. The course covers topics such as the history of anatomy, menstruation, reproductive rights, body image, mental health, sexuality, violence, childbirth, and menopause. We explore how science and American culture both have constructed these issues over time (some of it is super whacky!), while also examining women's organizing around them. This course is open to all students.
History	DC	79333	SEX GENDER & ANTHRO	UG	This course introduces students to an anthropological perspective on the relationship between sex (biological) and gender (cultural). In order to understand the various debates we will examine the ideas of manhood, womanhood, third genders and sexuality in cross-cultural perspective. The focus will be primarily on non-western cultures and will examine the construction of status, sexuality, and gender roles within the broader context of ritual, symbolism, marriage, and kinship. Utilizing film, the popular media, and anthropological case studies, this course will provide students with ways to understand and question how and why we express ourselves as "men," "women," and "other."

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79334	CLIMATE CHNGE/JUSTIC	UG	There remains no credible doubt that human activities are a leading cause of climate change, but profound questions persist over what measures to take, whom to hold accountable, and how to help those affected. What does an effective and just response look like when those who are most responsible for climate change are also often the most protected from its consequences? Who gets to participate in international negotiations and whose cosmologies or values are recognized there? How do debates about climate change relate to those concerning social policy? In this mini-course, we will examine these questions through the lens of Climate Justice. Both a transnational movement and an analytical orientation, Climate Justice compels us to consider how climate change reflects (and exacerbates) systemic inequalities within and between societies. Our exploration will engage case studies and perspectives from different parts of the world, including climate-related health disparities in the US, Indigenous Peoples' calls for climate reparations, island nations facing displacement, and efforts by various parties to influence scientific and popular knowledge.
History	DC	79339	JVN DLQ&FILM-1920-61	UG	How have American films portrayed juvenile delinquency and the juvenile justice system? What does filmmakers' portrayal of juvenile delinquency tell us about American culture and society? Do films vividly capture or badly distort the "realities" of crime and the operations of the justice system? This course uses feature films (to be viewed in advance of class) from the 1920s to the early 1960s, as well as various sociological, psychological, and historical readings, to explore these issues. The course is run as a colloquium, with students playing central leadership roles in launching and guiding class discussions. The course will have a take-home midterm exam, a final exam (in-class or take-home are optional), and a few short, written assignments linked to students' oral presentations.
History	DC	79340	DLQ&FILM-1990S/2000S	UG	How have American films portrayed juvenile crime, drug use, gang violence, and law enforcement responses (especially police and prisons) to juvenile crime and violence? How have American films portrayed individual juvenile delinquents, their families, and the communities in which they live? Do films vividly capture or distort the "realities" of juvenile crime and the operations of law enforcement? This course uses feature films from the late 20th and early 21st centuries, as well as social science and historical readings, to explore these issues. The course is run as a colloquium, with students playing central leadership roles in launching and guiding class discussions.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79341	COLD WAR DOCMNTS FLM	UG	This course is based on use of historical documents and films to study problems that reshaped the world during and after the Cold War. We will examine how documentary and feature films depicted the most important events of the Cold War, such as the Korean War, the construction of the Berlin Wall, the Cuban missile crisis, and others. In addition to films, sources will include documents, lectures and readings.
History	DC	79343	EDU, DEM,& CIV RIGHT	UG	What is the relationship between education and democracy? By examining a series of case studies at the intersection of education and the civil rights movement, this course will prepare students to approach contemporary educational debates as historically-informed critical thinkers. The controversy surrounding charter schools, vouchers, the common core, and the role of standardized testing cannot be understood outside the long history of debates regarding the relationship between education and democracy. Are schools meant to perpetuate the status quo? How did both traditional and more radical forms of education advance the struggle for civil rights? What role have students played in advancing civil rights and democracy? While exploring these questions, we will also partner with local high school students and teachers to bring our learning beyond the classroom.
History	DC	79344	PUBLIC HISTORY	UG	Museums and other non-academic institutions reach large audiences with an array of history offerings, including exhibitions, films, publications, performances, oral history, workshops, lectures, events, research, reenactments, lectures, social media, webinars, online, radio and television programming. These educational tools are calculated to engage diverse audiences. Museums and educational nonprofits are also actively collecting and preserving artifacts and archival materials. This course will focus on Pittsburgh history as students examine best practices in Public History. The class will study the inner workings of a large history museum's collection, exhibition, conservation and education programs. Students will participate in field trips and behind-the-scenes tours, virtual explorations, and "hands-on history" outside the classroom at the Heinz History Center and other Pittsburgh attractions. This course will especially interest students considering non-traditional careers in history, education, communications, and nonprofits. MAXIMUM ENROLLMENT IS 15. ALL CLASSES WILL BE HELD ONCE PER WEEK OFF CAMPUS, STARTING AT THE HEINZ HISTORY CENTER IN THE STRIP DISTRICT (1212 SMALLMAN STREET). PROFESSOR MASICH IS THE HISTORY CENTER'S CEO.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79350	EARLY CHRISTIANITY	UG	This course examines the origins of Christianity in historical perspective. Using both Christian and non-Christian sources from the period, we will examine how and why Christianity assumed the form that it did by analyzing its background in the Jewish community of Palestine, its place in the classical world, and its relationship to other religious and philosophical traditions of the time. We will also examine historically how the earliest Christians understood the life and message of Jesus, the debates about belief and practice that arose among them, and the factors influencing the extraordinary spread of the movement in its earliest centuries.
History	DC	79355	FAKE NEWS/JNLSM HIST	UG	Scandal, conspiracy, and partisan propaganda have been among the stuff of media ever since newspapers first appeared in America 200+ years ago, and now they figure prominently in electronic media as well. The question "What is truth?" is not just a matter of philosophical speculation, but an essential issue at every level of American life, from individuals on social media to citizens, journalists, and politicians responsible for sustaining a democratic society. This course is literally "ripped from the headlines," examining contemporary conflicts over credibility in print and online, in the context of historical experience. My goal is to help you think in new ways about how to assess - in both past and present -- when news really is "fake" and when it's just "an inconvenient truth"?
History	DC	79358	NAZI GHETTOS	UG	The Nazis demarcated more than 800 ghettos for interning the Jewish population of the territory they occupied during WWII. Some ghettos lasted for only a short period before they were destroyed; some lasted for years. Most were placed in towns or cities, but others were in rural areas. Some were designed as labor camps, and in a few, families and communities did manage to survive the war. This course will focus on the East European ghettos, examining how they emerged, their function in the Nazi system, and their development from areas of spatial segregation to killing zones aimed at the annihilation of the people they contained. The course will examine Jewish life within the ghettos, social and cultural gaps, the Judenrat (Jewish councils appointed by the Nazis), and Jewish alternative leadership. We will also look at the uprising within the Warsaw ghetto, which resulted in its total destruction. By analyzing the development of the Ghetto as an urban disaster zone, we will seek to comprehend changes in the concept of ghettos by their inhabitants and by the oppressors. Using a case study approach, we will focus on the Warsaw Ghetto as a blockade within the surrounding city, the Lodz Ghetto as labor camp, the Mogilev and Zhmerinka ghettos (which remained relatively open under Romanian occupation but were part of a program of ethnic cleansing), and the ghettos in Vilnius and Bialystok, each of which raised horrific dilemmas of leadership among the imprisoned Jewish population.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79371	AFRN AMRCN URBN HSTY	UG	Popular perceptions of poor and working class people occupy a prominent place in discussions of today's African American urban community in the unfolding Age of Donald Trump. In the contemporary quest to build livable urban communities, however, journalistic, public policy, and academic analysts often discuss the black poor and working class as "consumers" rather than "producers," as "takers" rather than "givers," and as "liabilities" instead of "assets" in the present moment of the nation's history. Effective public policies, movement strategies, educational programs, media campaigns, and sensitive philanthropic decisions require deeper and more thoughtful perspectives on the history of urban race and class relations in the past. Focusing on the development of African American urban history from its colonial beginnings through today's "Black Lives Matter Movement," this course will emphasize the many ways that people of African descent shaped American and African American urban life through their roles as workers, community-builders, and social justice activists. In addition to weekly classroom discussions of assigned readings, students will write a series of short essays (based upon a mix of secondary and primary sources) on selected topics/themes in the development of African American urban life, culture, and politics.
History	DC	79374	AMRCN ENVIRON HSTY	UG	This course explores critical issues in the history of the American environment during the last three centuries. Among the specific topics to be covered are changing attitudes toward nature; forms of rural and urban development and environmental effects; the impacts of technology and industrialism; the conservation and environmental movements; and environmental problems and prospects today.
History	DC	79377	FOOD: HISTORY EATING	UG	This course explores food production and consumption in the modern world. This semester, we will focus on ongoing debates over how to feed a world of seven billion people on a planet undergoing major climate change. We will explore the historical roots of the problem of "feeding the world" and consider the overlapping yet competing ideas of food security and food sovereignty. What are the cultural, economic, environmental and political contexts that create opportunities and constraints for changing food systems? After exploring this big question through readings and group discussions, the second half of the semester will be devoted to individual research projects focused on the historical and cultural dimensions of food provisioning.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79379	EXTREME ETHNOGRAPHY	UG	Observation, participation and direct experience of "the field" are hallmarks of anthropological ways of knowing, and their representation has played a foundational role in ethnographic writing both past and present. Yet reflexive and postmodernist explorations of these topics have triggered contentious debates over the nature of anthropology as a scientific or humanistic enterprise, and over its ethical, political and epistemological value. In this seminar, we will approach such questions through an exploration of the extremes of ethnographic fieldwork and writing. We will consider such topics as: the colonial history and politics of explorers and ethnographers; liminality and the place of extreme experience--such as cultural dislocation, violence, derangement, intoxication, sex, possession, and dreaming-in fieldwork and writing; field-notes as an ethnographic genre, and their relationship to "official" published ethnography; ethnographic surrealism and surrealist ethnography; the dimensions of sensory experience (visual, auditory, olfactory, etc.) in fieldwork and ethnography; collecting and the powers of "exotic" objects; inter-subjectivity and its implications; and experimentation with alternate ethnographic forms, such as autobiography, film, diary, and poetry.
History	DC	79382	VOTING/DEMOCRACY	UG	Voter participation in free and fair elections is one of the most basic principles of the American republic, yet our country's history is fraught with examples of citizens having to fight to exercise this right. From literacy tests to poll taxes, gerrymandered districts to controversial campaign financing rules, the federal and state governments have been called upon to establish protections for citizens and, when these protections fail, determine a remedy. This course will examine various key elements of voting and elections especially relevant to the current body politic, including campaign finance and gerrymandering.
History	DC	79385	MKG AFRCN DIASPORA	UG	The trans-Atlantic slave trade dispersed Africans in the New World and the Old, creating the African Diaspora. Generations of scholars have disputed whether descendants of enslaved Africans could have retained any of their African culture and/ or fully assimilated into New World societies. This course will combine a chronological, geographical, and a thematic approach to the creation of new Africa-inspired cultures in both Africa and the African Diaspora. It will explore societies in the Caribbean, the US South, Latin America, and Africa and address themes, such as Africanisms, African survivals, African retentions, Creole languages, and religion.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79392	AMERICA AT WAR	UG	In this course we will look at fundamental changes in the approach of the United States to preparing for and engaging in armed conflict that have taken place since the War in Vietnam. The lowering of the voting age to eighteen and the end of conscription ("the Draft"), committed the United States to the challenge of continuing the Cold War and winning - there has been no acceptable alternative since the fall of Saigon - post-Cold War conflicts with an all-volunteer military whose members were now enfranchised. At the same time, the U.S. defense establishment continued its pursuit of advanced technologies in all facets and at all levels of warfare, evolving through various regional interventions and culminating in the Gulf War, "Operation Desert Storm," in 1991. We will examine the continuing and increasing role of hi-tech in the chaotic decade after the collapse of the Warsaw Pact and in the American-led "War on Terror" since 9/11, waged by a much smaller, highly professionalized military, and we will engage some ethical and social issues about the American Way of War in the recent past and the citizens who practice it.
History	DC	79395	ARTS IN PITTSBURGH	UG	This course will examine the arts in Pittsburgh, both historically and in the present. We will focus especially on art exhibits and musical events scheduled by the city's museums and concert halls during the semester. The "curriculum" will derive from the artistic presentations themselves, which will provide a springboard for reading assignments, seminar discussions, and research papers in the history of music and art. We will also examine the historical development of cultural institutions in Pittsburgh. The History Department will pay for students' admission to all museums and studios. However, students will be charged a supplemental fee of approximately $275 to help subsidize the considerable expense of purchasing tickets for concerts and performances by the Pittsburgh Symphony, Pittsburgh Opera, Chamber Music Society, and Renaissance and Baroque Society. Attendance at all art exhibits and musical events is required. Prerequisite: Please check your overall course schedule: you must be available to attend art exhibits on several Fridays and Saturdays, and to attend musical events on several Thursday, Friday and Saturday evenings.
History	DC	79396	MUSIC & SOCIETY CNTY	UG	This course will explore the interrelations between society and classical and popular music in the nineteenth and twentieth centuries in Europe and the United States. We will examine the importance of different musical forms in the life of society and how music contributed to the making of political consciousness, especially in the twentieth century. In addition to reading assignments, seminar discussions, and research papers in the history of music, students will be taken to the performances of the Pittsburgh Symphony, Pittsburgh Opera, and Chamber Music Society. A supplemental fee of a minimum of $275 will be charged to subsidize part of the considerable expense of purchasing tickets for concerts and performances.Prerequisite: Availability to attend musical events on several Friday and Saturday evenings.

Department	College	Course #	Course Title	Grad/UG	Description
History	DC	79400	GLOBL STUDES RES SEM	UG	This research seminar is the capstone course for Global Studies majors. The course is designed to give you a chance to define and carry out a research project of personal interest. The first few weeks of the course will be devoted to developing a research topic and locating sources. We will then work on how to interpret and synthesize sources into a coherent and compelling thesis before you begin drafting your paper. Your research may be based on in-depth reading of a body of scholarly work, field notes from ethnographic observations, archival research, analysis of literary or visual media, or some combination of these sources. Incorporation of some non-English language sources is strongly encouraged where possible. Independent work, self-initiative, participation in discussion, and peer evaluations are required. There are several interim deadlines that will be strictly enforced in order to ensure successful completion of the course. Prerequisites: 79-275 and Theoretical and Topical Core must be complete or concurrently enrolled. Corequisite: 79-275.
History	DC	79418	INTRO RUSSIAN CULTUR	UG	In the 19th century, Russian writers produced some of the most beloved works of Western literature, among them Dostoevsky's Crime and Punishment, Gogol's Dead Souls, and Tolstoy's Anna Karenina, to name just a few. These novels continue to captivate audiences and have inspired innumerable adaptations in theater, film, and television. This course will examine the fertile century that yielded these masterpieces. In addition to the novels mentioned above, students will encounter texts by writers who may be less well known but are no less significant, including Pushkin, Lermontov, and Turgenev. We will consider the social and cultural circumstances in which these works were produced and reflect on the reasons these Russian masterpieces have appealed to audiences well beyond the Russian-speaking world. By analyzing some of Russia's key cultural achievements, students will come to better understand contemporary Russian society and its place in world culture. Students will be asked to critically analyze literary and historical texts, participate actively in class discussions, and write three short essays. This is a 9-unit course taught in English. For those proficient in Russian, however, a total of 12 units can be earned by conducting some portion of the work in Russian and meeting outside of class for some additional hours. Details are to be worked out in advance, in consultation with the instructor.
History	DC	79449	EHPP PROJECT COURSE	UG	The Ethics, History and Public Policy Project Course is required for the Ethics, History and Public Policy major and is taken in the fall semester of the senior year. In this capstone course, Ethics, History and Public Policy majors carry out a collaborative research project that examines a compelling current policy issue that can be illuminated with historical research and philosophical and policy analysis for a chosen client. The students develop an original research report based on both archival and contemporary policy analysis and they present their results to their client and a review panel.

Department	College	Course #	Course Title	Grad/UG	Description
Information Networking Institute	CIT	14741	INTRO INFO SECURITY	GR	Fall: 12 units. The growing importance of information systems, and their use to support safety-critical applications, has made information security a central issue for modern systems. The course introduces the technical and policy foundations of information security. The main objective of the course is to enable students to reason about information systems from a security engineering perspective. Topics covered in the course include elementary cryptography; access control; common software vulnerabilities; common network vulnerabilities; digital rights management; policy and export control law; privacy; management and assurance; and special topics in information security. Prerequisites: The course assumes a basic working knowledge of computers, networks, C and UNIX programming, as well as an elementary mathematics background, but does not assume any prior exposure to topics in computer or communications security.
Information Networking Institute	CIT	14782	INFO SEC RISK MAN I	GR	This course and its follow-on Information Security Risk Management II (14-784) examine information security as a risk management problem where the organization identifies information security risks, evaluates those risks, and makes risk mitigation and acceptance decisions given its resource constraints. In part one of this class students will learn foundational concepts in risk management and economic valuation and will be introduced standard risk management approaches for identifying, analyzing, and responding to risk, as well as the analytical tools for calculating the costs and benefits of investment security decisions. Learning Objectives: * Understand and use security risk management terminology * Understand and apply tools for evaluating decisions under uncertainty * Develop critical thinking and evaluation * Demonstrate basic proficiency in qualitative and quantitative risk analysis methods (OCTAVE, FAIR) * Understand and explain risk responses, including risk transfer and insurance

Department	College	Course #	Course Title	Grad/UG	Description
Information Networking Institute	CIT	14784	INFO SEC RISK MAN II	GR	This course approaches information security as a risk management problem where the organization has to identify information security risks, decide how to resolve these risks, and make trade-off, economic, and investment decisions about controls, practices, and solutions to mitigate risk. Students will learn a standard risk management process for identifying, analyzing, and responding to risk, as well as the analytical tools for calculating the costs and benefits of investment security decisions. Students will perform a case study using the OCTAVE risk assessment method developed by the CERT program at the Software Engineering Institute. Additional topics covered include an introduction of how to use classical financial analysis techniques to evaluate information security security investments. *This course uses a Harvard Business School case study. Students will be charged a fee for the course materials. The fee for these materials will be charged to the student's account. Learning Objectives: Upon completion of this course students will understand: * Basic understanding of the information security risk management process and how to identify, analyze, and respond to risk. * Key economic concepts in uncertainty decision making and financial analysis. * How to calculate ROI on a security investment.
Information Networking Institute	CIT	14788	INFO SEC POL MGT	GR	The goal of this course is to provide an overview of security marketplace, an understanding of decision making when multiple parties are involved and the role of policy making in the context of information security. Policy is treated broadly and need not be necessarily government laws and regulations. Policy can be intra-organization. For example, it is an organization policy to disconnect an unpatched computer from its network. We will discuss the role of market and competition on security provision and then some of the key causes of market failure, namely externalities. We will then analyze how various policy tools can be applied to mitigate market failure. We will also discuss some key laws and regulation on product liability, and security standards. The course also aims to provide an overview of security industry (that is key trends, technologies and various strategies by vendors and users) as well. By the end of the course, the students are expected to know key managerial and policy issues surrounding information security provision and when and how policy intervention is needed. There is no textbook and all the reading material is provided on the first day of class. Some understanding of economics is expected. Students are expected to have read the relevant reading material before class and come prepared for discussion. All reading material can be downloaded from blackboard. Case material will be distributed in class.

Department	College	Course #	Course Title	Grad/UG	Description
Information Networking Institute	CIT	14828	BROWSER SECURITY	GR	The Web continues to grow in popularity as platform for retail transactions, financial services, and rapidly evolving forms of communication. It is becoming an increasingly attractive target for attackers who wish to compromise users' systems or steal data from other sites. Browser vendors must stay ahead of these attacks by providing features that support secure web applications. This course will study vulnerabilities in existing web browsers and the applications they render, as well as new technologies that enable web applications that were never before possible. The material will be largely based on current research problems, and students will be expected to criticize and improve existing defenses. Topics of study include (but are not limited to) browser encryption, JavaScript security, plug-in security, sandboxing, web mashups, and authentication. The course will involve an intensive group research project focusing on protocols/algorithms, vulnerabilities, and attacks as well as several individual homework and programming tasks. Groups will perform a sequence of cumulative tasks (literature review, analysis, simulation, design, implementation) to address aspects of their chosen topic, occasionally reporting their results to the class through brief presentations, leading to a final report.
Information Networking Institute	CIT	14829	MOBILE IOT SECURITY	GR	For many people, mobile and embedded devices have become an essential part of life and work. As such devices represent many and varied combinations of technologies, they have unique security and privacy issues that potentially impact users, developers, service providers, manufacturers, and regulators. This course will focus on various aspects of security and privacy that are faced by mobile and Internet of Things devices, including aspects of wireless communication and networking, mobile computing, data analytics, security, and privacy. The course will include studies of security and privacy aspects of networking (including telecom, enterprise, personal, etc.), applications, and data analytics as relevant to mobile and embedded/IoT devices. One of the main goals of the course is to improve knowledge and awareness of security issues faced by mobile application developers, embedded system builders, and smart system designers. Material will cover standards, best practices, and research challenges in both deployed and emerging systems. Topics of study include (but are not limited to) telecom protocols and vulnerabilities; mobile/IoT network security; security and privacy in edge computing; mobile application security; and location and activity privacy. In addition to individual homework assignments, students will participate in an intensive group project involving significant research, development, and experimentation. Graduate standing is required to register for this course.

Department	College	Course #	Course Title	Grad/UG	Description
Information Systems:Sch of IS & Mgt	HC	95705	TELECOMMNCTNS MNGMNT	GR	The purpose of this course is to provide an understanding of the key technical, managerial and policy issues in the effective development and use of broadband telecommunication by organizations. Discussion of technology, business and policy issues will be set in the context of services and contents. Topics covered will include basic concepts of telecommunication technology (data and voice), Internet and intranet technologies, issues related to the operational and strategic use of the technology, economics and policy aspects of telecommunication, and the changing structure of the telecommunications industry. A number of case studies will be included in the curriculum providing students the opportunity to apply the concepts to real world situations.
Information Systems:Sch of IS & Mgt	HC	95710	ECONOMIC ANALYSIS	GR	This is a course in microeconomics and its implications for management and strategy - particularly (but not exclusively) in the context of information technology firms. Microeconomics, as discussed in this course, focuses on the models and methods by which managers can analyze their market and organizational environment to make optimal decisions. The key to such optimal decision- making is an understanding of the trade-offs in allocating scarce resources. The core models of microeconomics are fundamental to more applied areas of management such as strategy, marketing, production, and finance. The course will begin with an examination of the underlying structure and models of competitive markets, and the efficiency and welfare implications of those models. We will then examine economic models that describe firm output, pricing and entry/exit decisions. These models will then be applied to a variety of market contexts, including monopoly, oligopoly, and competition. As we go through this analysis, we will seek to understand the implications of the theory for information technology firms. We will also examine interesting dynamics between information, agents and economic outcomes in the context of game theory.

Department	College	Course #	Course Title	Grad/UG	Description
Information Systems:Sch of IS & Mgt	HC	95722	DIGITAL TRANSFORMATN	GR	This course serves as a capstone course integrating technological and managerial aspects of information technology. Information and communication technologies play multiple roles within an organizational context: From a technological perspective they define the information and communication infrastructure of the firm and they enable new ways to digitize business processes. From a managerial perspective they facilitate new coordination and communication within and across entities enable new organizational forms change the information environment underlying the business and permit new incentive structures. Successful efforts at digitization have to keep both technological and managerial perspectives in mind. Using a collection of cases this course will study how the deployment of information technology changes interactions and processes within organizations across organizations within industries and across society. The case analyses will require students to engage in both technical and managerial problem solving. The technical component of the analysis requires students to propose IT architectures for the problems highlighted in the case. The managerial component of the analysis requires students to analyze the business value of the proposed solution and address the change management issues that arise in implementing any digital transformation initiative....Read More
Information Systems:Sch of IS & Mgt	HC	95743	CYBRSEC POL & GOV II	GR	Across the board, IT managers in government and industry are concerned with regulatory compliance. This course is designed to introduce students to key Information Security industry and government policies, regulations and standards. The course is structured to familiarize students with base standards, like NIST, and more specific regulatory requirements, and to help students understand how those requirements are met, using frameworks, controls and training. The goal of this course is provide students with an understanding of how to develop an organization's information security policy and procedures to comply with government and industry regulations. This course is an elective for graduate students seeking to work or manage an information security and privacy department.

Department	College	Course #	Course Title	Grad/UG	Description
Information Systems:Sch of IS & Mgt	HC	95744	CYBRSEC POL & GOV I	GR	The ability to secure information within a modern enterprise is a growing challenge. Threats to information security are global, persistent, and increasingly sophisticated. Long gone are the days when managers could hope to secure the enterprise through ad hoc means. Effective information security at the enterprise level requires participation, planning, and practice. Fortunately, the information security community has developed a variety of resources, methods, and best practices to help modern enterprises address the challenge. However, employing these tools demands a high degree of commitment, understanding, and skill-attributes that must be sustained through constant awareness and training. An essential part of the information security plan is cyber security policy - this includes the written plans for how the enterprise IT assets will be protected. This course provides students with information on the origin of cyber security policy, governance structures for policy creation, selection and implementation of policy, and audit and control functions to ensure compliance and efficacy. Students will be exposed to the national and international policy and legal considerations related to cybersecurity and cyberspace such as privacy, intellectual property, cybercrime, homeland security (i.e., critical infrastructure protection) and cyberwarfare, and the organizations involved in the formulation of such policies. Broader technology issues also are discussed to demonstrate the interdisciplinary influences and concerns that must be addressed in developing or implementing effective national cybersecurity laws and policies.
Information Systems:Sch of IS & Mgt	HC	95748	SOFTWARE & SECURITY	GR	This course exposes students with limited exposure to programming and software engineering development foundational concepts to enable further understanding of the challenges of insecure and vulnerable software. Students are exposed to basic programming constructs (such as variables, control structures, data structures, programming syntax) as well as the specific principles of object-oriented programming languages. The course also surveys the types of threats and vulnerabilities inherent in software and the origins of these deficiencies. A brief overview of secure coding concepts and techniques are provided to students to provide exposure to how software can be made more secure and resilient and how security can be part of overall software development process.

Department	College	Course #	Course Title	Grad/UG	Description
Information Systems:Sch of IS & Mgt	HC	95752	INTRO INFO SEC MGT	GR	This course is intended to give students an introduction to a variety of information and cyber security topics. As a survey course, it will cover foundational technical concepts as well as managerial and policy topics. Coverage includes foundations of information security; introductory cryptography; program, data, and operating system security; security of user-web interaction; safeguarding the Internet of Things; cyberwarfare; securing virtual, cloud, and mobile environments; network concepts and network security; incident management and IT auditing processes; security risk management; legal and ethical issues of security and privacy. Students are exposed to common sources of vulnerability information and how to incorporate this information into information security management processes. The purpose of the course lectures, assignments, readings, and examinations are to ensure students have sufficient technical awareness and managerial competence that will enable them to pursue advanced study in information security policy and management. There is no prerequisite for this course, however successful students will have fundamental knowledge of information and computer systems, and a general awareness of security issues in these systems.
Information Systems:Sch of IS & Mgt	HC	95755	INF SEC RISK MGT I	GR	This course and its follow-on Information Security Risk Management II (95-756) examine information security as a risk management problem where the organization identifies information security risks, evaluates those risks, and makes risk mitigation and acceptance decisions given its resource constraints. In part one of this class, students will learn foundational concepts in risk management and economic valuation and will be introduced to standard risk management approaches for identifying, analyzing, responding, and monitoring risks. It is recommended that student complete the course, 95752 Introduction to Information Security Management, prior to enrolling in his course.
Information Systems:Sch of IS & Mgt	HC	95756	INO SEC RISK MGT II	GR	This course approaches information security as a management problem where the organization has to apply a finite set of resources on information security and decide how to prioritize information security risks alongside other risks. Students will learn analytical tools for calculating the costs and benefits of investment security decisions and how to calculate the return on investments in a hands-on setting. Additional topics covered include a brief introduction to commercially available tools for risk management and an introduction to vulnerability management risk aversion and insurance. ...Read More

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Information Systems:Sch of IS & Mgt	HC	95757	INFO SEC POL & MGT	GR	The goal of this course is to provide an overview of security marketplace an understanding of decision making when multiple parties are involved and the role of policy making in the context of information security. Policy is treated broadly and need not be necessarily government laws and regulations. Policy can be intra-organization. For example it is an organization policy to disconnect an unpatched computer from its network. We will discuss the role of market and competition on security provision and then some of the key causes of market failure namely externalities. We will then analyze how various policy tools can be applied to mitigate market failure. We will also discuss some key laws and regulation on product liability and security standards. The course also aims to provide an overview of security industry (that is key trends technologies and various strategies by vendors and users) as well. By the end of the course the students are expected to know key managerial and policy issues surrounding information security provision and when and how policy intervention is needed. There is no text book and all the reading material is provided on the first day of class. Some understanding of economics is expected. Students are expected to have read the relevant reading material before class and come prepared for discussion. All reading material can be downloaded from blackboard. Case material will be distributed in class. *This course uses a course packet or case studies. Students will be charged a fee for the course materials. The fee for these materials will be charged to the student's account. ...Read More
Information Systems:Sch of IS & Mgt	HC	95758	NETWK & INTERNET SEC	GR	This course is intended to give students an introduction to the design, operation and security of enterprise data networks. The course will focus on applying infrastructure and security principles related to organizational networks as well as managerial and policy topics. The purpose of the course lectures, assignments, readings, and examinations are to ensure students have sufficient technical awareness and managerial competence that will enable them to pursue advanced study in information security policy and management as they progress through the program. There is no prerequisite for this course, however successful students will have fundamental knowledge of information and computer systems, and a general awareness of security issues in these systems. Learning Objectives: A working knowledge of the need to properly design networks to properly support an organization, properly accommodate networking protocols, and properly secure an organization's cyber assets through its network infrastructure Specific topics covered include: Application of security principles to computer networking The OSI and TCP/IP models of network communication Network security at different layers of the OSI and TCP/IP models Enterprise systems for AAA Designing networks on selected protocols to support business operations while maintaining identified levels of network security Supporting secondary network connectivity (wireless, VPNs, BYOD devices, partner networks, cross-domain and other connectivity types) Designing networks to support Resiliency Management, Business Continuity, Disaster Recovery and other principles to avoid network failures that negatively impact the organization's ability to deliver on its core mission Methods to prevent, detect and respond to security breaches, including the role of Incident Response Teams.

Department	College	Course #	Course Title	Grad/UG	Description
Information Systems:Sch of IS & Mgt	HC	95805	BUSINESS COMMUNCTN	GR	The Harvard Business Review calls communication, "the most important skill you will ever learn." Unfortunately, the HBR also said "one third of executives write poorly," and we know that public speaking frightens many, especially if they must negotiate with a client or supervisor. Nonetheless, executives, managers, and staff have an opportunity to create strong business relationships and achieve their professional goals by mastering fundamental communication skills. This course intends to introduce participants to the fundamentals of writing, speaking and negotiation in a story-centered, context-rich experience that allows participants to learn by doing. This course is intended to: Provide a model for strategic thinking and planning, Increase appreciation of audiences, Improve writing, speaking and expression of ideas, Increase understanding and skills at negotiation, and Reduce fear of writing, presenting and negotiating while increasing ability to achieve business objectives.
Information Systems:Sch of IS & Mgt	HC	95818	PRVCY POL TECH & LAW	GR	This course focuses on policy issues related to privacy from the perspectives of governments, organizations, and individuals. We will begin with a historical and philosophical study of privacy and then explore recent public policy issues. We will examine the privacy protections provided by laws and regulations, as well as the way technology can be used to protect privacy. We will emphasize technology-related privacy concerns and mitigation, for example: social networks, smartphones, behavioral advertising (and tools to prevent targeted advertising and tracking), anonymous communication systems, big data, and drones. This course is part of a three-course series of privacy courses offered as part of the MSIT-Privacy Engineering masters program. These courses may be taken in any order or simultaneously. Foundations of Privacy (offered in the Fall semester) offers more indepth coverage of technologies and algorithms used to reason about and protect privacy. Engineering Privacy in Software (offered in the Spring semester) focuses on the methods and tools needed to design systems for privacy.
Information Systems:Sch of IS & Mgt	HC	95824	POLCY WIRELESS SYSTM	GR	This course will address public policy issues related to wireless systems. It investigates policies related to a wide variety of emerging wireless systems and technologies, including current and next-generation cellular systems, wifi and white space devices, emerging methods of accessing spectrum, communications systems for emergency responders (firefighters, police, emergency medical services), current and next-generation television, and satellite communications. This can include the government role in facilitating the creation of infrastructure, in advancing competition among broadcasters and communications service providers, in using scarce spectrum efficiently, in promoting public safety and homeland security, and in protecting privacy and security. Because these are inherently interdisciplinary issues, the course will include detailed discussions of technology, economics, and law, with no prerequisites in any of these areas. This course is cross-listed as 18-650, 19-403, 19-713, and 95-824. Senior or graduate standing required.

Department	College	Course #	Course Title	Grad/UG	Description
Information Systems:Sch of IS & Mgt	HC	95833	GLBL IT MNGT SRCG &	GR	This course provides a full perspective on why and how organizations make decisions on delivering IT services internally or externally, locally or abroad, and via humans or machines. You will gain an understanding of how the global IT delivery model works and what controls and practices need to be in place to effectively lead dispersed teams. The goal of the course is to better prepare you to work on the client side, consulting side, or service provider side of a dynamic multi-sourced IT environment. Topics covered include best practices in workload selection, vendor relations, risk management, principal agent theory, ownership models, automation planning and execution, and supplier governance. We will explore the unique business drivers in the global sourcing of application support, software development, and IT enabled services. Classes will typically consist of lectures, guest speakers, and cases. Our classroom provides a truly global perspective as your fellow classmates are participating from several countries, job functions, and cultures. Intelligent sourcing of knowledge-based services will be a key differentiator in an organization's ability to successfully outperform its competition. Your ability to lead a global workforce of both people and machines and add value in decisions in this domain will make you an increasingly valuable asset to any global organization. Learning Objectives: 1. Develop an understanding of how the global IT delivery model works and what controls and practices need to be in place to make it successful. 2. View problems from the perspective of the client, of the consultant, and of the service provider of a multi-sourced IT environment. 3. Have confidence in the ability to discuss global sourcing problems with industry experts.
Information Systems:Sch of IS & Mgt	HC	95878	ENG PRIV IN SOFTWARE	GR	Privacy harms that involve personal data can often be traced back to software design failures, which can be prevented through sound engineering practices. In this course, students will learn how to identify privacy threats due to surveillance activities that enhance modern information systems, including location tracking, behavioral profiling, recommender systems, and social networking. Students will learn to analyze systems to identify the core operating principles and technical means that introduce privacy threats, and they will learn to evaluate and mitigate privacy risks to individuals by investigating system design alternatives. Strategies to mitigating privacy risk will be based on emerging standards and reliable privacy preference data. Students will have the opportunity to study web-, mobile- and cyber-physical systems across a range of domains, including advertising, healthcare, law enforcement and social networking. In addition, students will know how, and when, to interface with relevant stakeholders, including legal, marketing and other developers in order to align software design with privacy policy and law.

Department	College	Course #	Course Title	Grad/UG	Description
Information Systems:Sch of IS & Mgt	HC	95883	ETH PENETRATION TSTG	GR	This course will introduce students to professional penetration testing by teaching offensive tactics along with the appropriate methodologies and responsibilities it takes to ethically attack systems. The majority of time will be spent in hands-on labs performing reconnaissance, discovering vulnerabilities, developing exploits, and carefully penetrating targets. Student will be required have a basic understanding of networking concepts (TCP/IP) and will be expected to put in the additional time to research solutions on their own.
					Institute for Politics and Strategy 31
Institute for Politics and Strategy	DC	84104	DEC PROC AMER POL IN	UG	This is an interdisciplinary introduction to the study of politics and government in the United States. It familiarizes the student with the basic structures and processes of American government, but moves beyond the purely descriptive into the realm of the analytical. The main theoretical tools are spatial models of political decision-making, and models of collective action problems. The position taken in this course is that understanding American philosophical ideas about authority, power, and freedom is as central to demystifying the U.S. form of democracy as is understanding how decision-making institutions function. Thus, on one side, this course looks at how American political thought is infused into political institutions and society. On the other side, it investigates institutional arrangements using rationalistic theories. In addition, scientific writings at the intersection of psychology and economics are used to probe the possibility of gaining explanatory leverage on U.S. politics from the perspective of behavioral decision-making theories.
Institute for Politics and Strategy	DC	84265	POL SCI RSRCH MTHD	UG	This course provides an overview of research methods in political science. Students will learn to think like social scientists and develop skills required by the discipline. The course emphasizes the nature of causality and how causal claims can be made in the social sciences. The goal for the class is for students think critically about the strengths and weaknesses of various methodological approaches and identify the methodological tools that are most appropriate for answering different research questions. Furthermore, students will increase their ability to consume political science research from a variety of subfields while also learning to design and present their own research.

Department	College	Course #	Course Title	Grad/UG	Description
Institute for Politics and Strategy	DC	84275	COMPARATIVE POLITICS	UG	This course is an introduction to the subfield of Political Science called Comparative Politics. Scholars in this subfield - comparativists - use comparative methods to study the political systems of countries around the world, trying to understand how they differ and why. In this course, we aim to learn about how political systems differ, discuss alternative explanations of why they differ and explore the different observed outcomes of political variations. To do so, in the first part of the course we will examine the core concepts and main theories of the subfield. In the second part, we will examine some of the main themes studied in Comparative Politics, such as the differences between democracy and non-democracies, presidentialism versus parliamentarism, developed countries versus developing countries, types of electoral rules, party systems, social cleavages and political cultures. The discussion will focus mainly on the Americas and Europe, but not exclusively. Students will be required to apply the comparative methods discussed in the course to explore the history, political systems, and current events of different countries.
Institute for Politics and Strategy	DC	84310	INT POLITICAL ECON	UG	This course is an introduction to basic tools of modern political economy such as game theory and hypothesis testing and their applications to study international politics. This course will familiarize students with these theoretical approaches and will demonstrate how we can use them to address contemporary policy questions. We will analyze, for example, how various factors such as the interaction between the state and market, interest groups, and domestic institutions affect trade policies. We will also analyze the roles of international organizations such as the World Trade Organization and the International Court of Justice in the state of "anarchy."
Institute for Politics and Strategy	DC	84318	POLITICS DEV NATIONS	UG	Be it on our feet, in our grocery bags or in the news, our daily lives connect us to people in the developing world. Despite such an intricate relationship, we tend to know very little about developing nations and their challenges beyond a common stereotype of poverty. What are developing nations? What is their place in the world? What challenges do those nations and their populations face? In this class, we will strive to answer those questions through readings of political science and political economy scholarship and in-class activities and discussions. We will explore the socio-economic and political issues that developing nations face and take special care to practice perspective taking (i.e. we will put ourselves in specific nations' shoes and consider situations from their point of view). We will adopt various lenses (e.g. post colonialism, liberalism, feminism) throughout the semester to inform our understanding of the various positions taken by global actors. By addressing the unequal power balance between developed and developing nations as well as among developing nations, we will enrich our world view and understanding of major global issues, such as development. We will practice those skills in class through discussions and activities (you should expect very little lecturing) and outside of class through guided readings. Your learning in the course will be assessed through various writing assignments (take home exams, a final paper, weekly responses) where you will practice composing arguments based on evidence.

Department	College	Course #	Course Title	Grad/UG	Description
Institute for Politics and Strategy	DC	84322	NONVIOLENT CONFLICT	UG	Conflict and revolution are usually associated with armed struggle and violence. But over the course of the last century, nonviolent conflict has become an increasingly prominent source of institutional change and political revolution around the world, from Gandhi's salt march to Filipino "people power" to the post-Soviet "color revolutions" to the Arab Spring. What are the causes, strategies, tactics, dynamics, and consequences of nonviolent conflict, and how do these differ from violent or armed conflict? When and how do unarmed "people power" campaigns topple repressive authoritarian regimes? This course addresses these questions and in the process engages contending theories of power, revolution, and insurgency. The first half of the course introduces students to key concepts, theories, and historical patterns of nonviolent conflict. In the second half of the course, the class analyzes case studies of landmark nonviolent campaigns, both successful and failed. By the end, students will be expected to write an original 10 page analysis of a particular historical nonviolent conflict, or an intelligence estimate that assesses the prospects for the onset or outcome of nonviolent conflict in a contemporary country.
Institute for Politics and Strategy	DC	84326	THEORIES INTL RELTNS	UG	This course focuses on teaching the main approaches for the study of international relations. Although you will learn about some current international issues and about the evolution of international relations, and see how various theories would explain important past international events, the focus of this course is analytic rather than substantive. In other words, it will focus on general arguments and their underlying logic rather than on specific events and details or, for that matter, definitive answers as to 'which side is right'. As such, this course will help you to better understand the world we live in and provide you with tools for analyzing various international events. It will also acquaint you with many of the frameworks frequently used by statesmen, either implicitly or explicitly, in order to understand the world and to make policy on various issue areas. The course will begin by analyzing approaches from the three main levels of analysis: the individual, domestic (liberal and non-liberal theories) and systemic (neorealism, etc.). It will move on to discuss approaches which focus on, for example, the effects of strategic interactions between states, of international institutions and of norms and of the overall 'social environment' that states live in. The course will then conclude by discussing the future of international relations.

Department	College	Course #	Course Title	Grad/UG	Description
Institute for Politics and Strategy	DC	84362	DIPLOMCY & STATECRFT	UG	Diplomacy and statecraft are the driving forces behind foreign policy and international politics. In the first half of the course, the class surveys the evolution of great power politics from the Peace of Westphalia to the Global War on Terror and examines the history and practice of different types of statecraft, including military statecraft (e.g. deterrence and coercive diplomacy), diplomacy (e.g. crisis management and democracy promotion), and economic statecraft (e.g. trade, foreign aid, financial bailouts, and exchange rate policy). In the second half of the course, the class surveys contemporary diplomatic challenges, including challenges posed by human trafficking, global climate change, nuclear proliferation, and major powers such as Russia and China. Both in the classroom and in writing, students are encouraged to think, act, and write like diplomats and to appreciate diplomacy as a vocation. Throughout the course, students build skills in foreign policy memo writing, participate in various diplomatic role-playing simulations, and connect diplomatic trend lines with today's international headlines.
Institute for Politics and Strategy	DC	84369	DEC SCIENCE FOR IR	UG	Decision Science looks at choices from three interrelated perspectives: analysis, characterizing decision makers' options, in terms of expected effects on outcomes that they value; description, characterizing decision makers' beliefs and preferences; and interventions, helping decision makers to choose among the options available to them or create better ones. The course integrates foundational research in Decision Science with applications to international relations and politics.
Institute for Politics and Strategy	DC	84380	GRAND STRATEGY IN US	UG	This course introduces students to the concept of grand strategy in the United States, broadly defined as the combination of diplomatic, economic, military, and political factors used by American presidents and their administrations to advance U.S. interests throughout the world. In the context of highly interdependent domestic and international politics, leaders must develop strategies that address a diverse range of internal, state, and non-state challenges while also dealing with the myriad challenges resulting from globalization, or the intersection of international politics, culture, markets, and technology. This course will review American diplomatic history over the ages, with a focus on both Cold War and post- Cold War American presidencies and their respective approaches to defending American national security whilst also playing a role as one of the world's leading powers. The course will conclude with an assessment of American grand strategy over the course of the past decade and how the United States manages relations with rising powers like China, revanchist states like Russia, and host of near-peer and other adversaries, including Iran and North Korea.

Department	College	Course #	Course Title	Grad/UG	Description
Institute for Politics and Strategy	DC	84387	TECH POLICY CYBER	UG	This course examines underlying and emerging technologies and policies associated with cyber war and cyber threats. The technological concepts reviewed in this course include but are not limited to the internet, networks and sensors, and trends associated with "hyperconnectivity" (e.g., The Internet of Things). The course will review history, international policy, military doctrine, and lessons learned from the use of cyber operations and cyberspace in conflicts. The principle objective of this course is to introduce students to the technological and policy variables that affect the ability to manage cyber conflicts.
Institute for Politics and Strategy	DC	84388	CONCEPTS CYBER WAR	UG	This course examines traditional theories, concepts, and practices in international relations and warfare- conventional, unconventional, and modern- and relates them to the emerging dynamics of cyber war. The principle concepts examined in this course reflect, have shaped, and continue to shape state and non-state actor behaviors and their calculations of how to prepare for and prosecute warfare. These include, among others, conventional and nuclear deterrence, offense-defense dynamics, first strike capabilities, and irregular warfare. The course will focus on theory but will leverage history, military doctrine, and cases to highlight the challenges of integrating cyber war into defense planning and practice. Students will be challenged to consider how the 2009 introduction of cyberspace as a warfighting domain- in addition to land, maritime, air, and space- affects the ways that scholars and practitioners- operating with force structures and strategic, operational, and tactical concepts that are decades, if not centuries old- conceive of and practice warfare in the 21st Century. The principle objective of this course is to introduce students to cyber war within the context of traditional, and emerging, concepts of armed and unarmed warfare. This course will focus on two core areas: 1) a discussion of traditional concepts of warfare in the physical domains; and, 2) a discussion of cyber war and its intersection with these traditional concepts.
Institute for Politics and Strategy	DC	84389	TERRORSM & INSURGNCY	UG	There are many forms of political violence but not all are created equal. Some, like terrorism, are a tactic while others, like insurgency, are a strategy. How important is it to define terrorism and insurgency? What are the differences and similarities between them? This course will go into depth to analyze both terrorism and insurgency and their various manifestations. The course will provide a historical overview of how terrorism and insurgency have evolved over time, while also focusing on groups, methods, ideologies and organizational structures. Is the terrorism conducted by Salafist groups like Al-Qaida and the Islamic State significantly different than that perpetrated by ethno-nationalist groups like the Provisional Irish Republican Army and Tamil Tigers? What are the best methods to counter-terrorism and how successful have states been- both historically and more recently- at combating the threat posed by terrorism and insurgency?

Department	College	Course #	Course Title	Grad/UG	Description
Institute for Politics and Strategy	DC	84405	FUTURE OF WARFARE	UG	Warfare is constantly evolving. Long gone are the days of set-piece battles involving conventional military forces. In the contemporary conflict environment, hybrid actors and proxy groups wage war in an asymmetric and irregular manner, relying on ambiguity, strategic surprise and deception to accomplish their objectives. This course will examine new trends in warfare, from the onset of cyber war to the development of violent non-state actors with conventional military capabilities. Moreover, this course will explore the concept of the "gray zone," an area of neither declared nor undeclared hostilities where U.S. adversaries like Russia, China, Iran and others are gradually allocating resources. Case studies examined in this course will include Russian hybrid warfare in Crimea and Ukraine, Chinese cyberwarfare and information operations, Iranian sponsorship of proxy militias in Syria and Lebanon and a range of other emerging trends in areas such as technology, demographics, urbanization and social media, all of which are combining to radically alter the way wars are fought today.
Institute for Politics and Strategy	DC	84450	POLICY FORUM	UG	The Policy Forum course takes a critical look at decision making in domestic politics and US foreign policy. It does so through weekly roundtable discussions with a diverse set of thought leaders. Based on intellectually significant essays that students are expected to read in advance of each class, these discussions give students an opportunity to ask probing questions about the three branches of the US government, media, embassies, advocacy groups, international organizations, and nongovernmental organizations. This course seeks to help students understand the responsibilities and activities that leaders and decision makers carry out on behalf of their organizations. Students are instructed in how to confidently and respectfully ask critical questions of those shaping policy. The term "roundtabling" is used to describe submitting an issue for critical discussion among relevant stakeholders. Knowing how to direct a roundtable is a significant element in the professional development of anyone interested in taking part in the policy arena, and this course helps students hone this important skill. In requiring students to read important essays related to each class session and then step back from discussions with leaders to write analytical essays, this course teaches students how to develop strong arguments based on solid logic and credible evidence, an essential component in making democracy work.
Institute for Politics and Strategy	DC	84498	UNDERGRAD RESEARCH	UG	Students conduct research under the supervision of an Institute for Politics and Strategy faculty member. Students who wish to engage in research should seek out a faculty member whose interests are appropriate to the research. Prerequisite: Students must also complete an "Independent Study/Research for Credit" form, available from the Academic Program Manager. Permission of a faculty sponsor.

Department	College	Course #	Course Title	Grad/UG	Description
Institute for Politics and Strategy	DC	84605	FUTURE OF WARFARE	GR	Warfare is constantly evolving. Long gone are the days of set-piece battles involving conventional military forces. In the contemporary conflict environment, hybrid actors and proxy groups wage war in an asymmetric and irregular manner, relying on ambiguity, strategic surprise and deception to accomplish their objectives. This course will examine new trends in warfare, from the onset of cyber war to the development of violent non-state actors with conventional military capabilities. Moreover, this course will explore the concept of the "gray zone," an area of neither declared nor undeclared hostilities where U.S. adversaries like Russia, China, Iran and others are gradually allocating resources. Case studies examined in this course will include Russian hybrid warfare in Crimea and Ukraine, Chinese cyberwarfare and information operations, Iranian sponsorship of proxy militias in Syria and Lebanon and a range of other emerging trends in areas such as technology, demographics, urbanization and social media, all of which are combining to radically alter the way wars are fought today.
Institute for Politics and Strategy	DC	84610	INT POLITICAL ECON	GR	This course explores how political institutions, process, and actors influence economic interactions both domestically and internationally. During the semester, we will address two key questions: 1) how do governments collaborate to regulate, and stabilize, the trans-boundary flow of capital, goods, and services?; 2) what are the distributional effects of the current world economic order? In exploring these question from diverse theoretical lenses, we will discuss topics ranging from monetary and exchange rate policies, intentional trade, and global integration of production to the role of multinational corporations, social movements and civil society organizations, as well as institutions for corporate social responsibility, in the global economy. By the end of the course, students will be prepared to compare and contrast the theoretical propositions, and policy recommendations, of rival schools of thought.
Institute for Politics and Strategy	DC	84622	NONVIOLENT CONFLICT	GR	Conflict and revolution are usually associated with armed struggle and violence. But over the course of the last century, nonviolent conflict has become an increasingly prominent source of institutional change and political revolution around the world, from Gandhi's salt march to Filipino "people power" to the post-Soviet "color revolutions" to the Arab Spring. What are the causes, strategies, tactics, dynamics, and consequences of nonviolent conflict, and how do these differ from violent or armed conflict? When and how do unarmed "people power" campaigns topple repressive authoritarian regimes? This course addresses these questions and in the process engages contending theories of power, revolution, and insurgency. The first half of the course introduces students to key concepts, theories, and historical patterns of nonviolent conflict. In the second half of the course, the class analyzes case studies of landmark nonviolent campaigns, both successful and failed. By the end, students will be expected to write an original 10 page analysis of a particular historical nonviolent conflict, or an intelligence estimate that assesses the prospects for the onset or outcome of nonviolent conflict in a contemporary country.

Department	College	Course #	Course Title	Grad/UG	Description
Institute for Politics and Strategy	DC	84662	DIPLOMCY & STATECRFT	GR	Diplomacy and statecraft are the driving forces behind foreign policy and international politics. In the first half of the course, the class surveys the evolution of great power politics from the Peace of Westphalia to the Global War on Terror and examines the history and practice of different types of statecraft, including military statecraft (e.g. deterrence and coercive diplomacy), diplomacy (e.g. crisis management and democracy promotion), and economic statecraft (e.g. trade, foreign aid, financial bailouts, and exchange rate policy). In the second half of the course, the class surveys contemporary diplomatic challenges, including challenges posed by human trafficking, global climate change, nuclear proliferation, and major powers such as Russia and China. Both in the classroom and in writing, students are encouraged to think, act, and write like diplomats and to appreciate diplomacy as a vocation. Throughout the course, students build skills in foreign policy memo writing, participate in various diplomatic role-playing simulations, and connect diplomatic trend lines with today's international headlines.
Institute for Politics and Strategy	DC	84669	DEC SCIENCE FOR IR	GR	Decision Science looks at choices from three interrelated perspectives: analysis, characterizing decision makers' options, in terms of expected effects on outcomes that they value; description, characterizing decision makers' beliefs and preferences; and interventions, helping decision makers to choose among the options available to them or create better ones. The first half of the course will introduce foundational research in Decision Science. The second half will apply that research to issues in international relations and politics.
Institute for Politics and Strategy	DC	84670	GLOB NUCLEAR POLITIC	GR	The taming of the atom is one of the defining features of the modern era. The awesome creative and destructive potential of nuclear energy has had enormous impact on great power politics, the environment, economic development, and international institutions. Limiting the risk of nuclear Armageddon is one of the dominant challenges in US foreign policy and global governance alike. In this course, we will study 1) why and how countries pursue nuclear weapons and what happens when they acquire them; 2) the national policies and international regimes that have been devised to curb their spread and use, while allowing for the diffusion of energy technology, 3) the national and transnational civil society movements that have fought to roll back the nuclear age or limit its harmful effects, and 4) the role of private actors such as scientists and corporations.

Department	College	Course #	Course Title	Grad/UG	Description
Institute for Politics and Strategy	DC	84680	GRAND STATEGY IN US	GR	This course introduces students to the concept of grand strategy in the United States, broadly defined as the combination of diplomatic, economic, military, and political factors used by American presidents and their administrations to advance U.S. interests throughout the world. In the context of highly interdependent domestic and international politics, leaders must develop strategies that address a diverse range of internal, state, and non-state challenges while also dealing with the myriad challenges resulting from globalization, or the intersection of international politics, culture, markets, and technology. This course will review American diplomatic history over the ages, with a focus on both Cold War and post- Cold War American presidencies and their respective approaches to defending American national security whilst also playing a role as one of the world's leading powers. The course will conclude with an assessment of American grand strategy over the course of the past decade and how the United States manages relations with rising powers like China, revanchist states like Russia, and host of near-peer and other adversaries, including Iran and North Korea.
Institute for Politics and Strategy	DC	84687	TECH POLICY CYBER	GR	This course examines underlying and emerging technologies and policies associated with cyber war and cyber threats. The technological concepts reviewed in this course include but are not limited to the internet, networks and sensors, and trends associated with "hyperconnectivity" (e.g., The Internet of Things). The course will review history, international policy, military doctrine, and lessons learned from the use of cyber operations and cyberspace in conflicts. The principle objective of this course is to introduce students to the technological and policy variables that affect the ability to manage cyber conflicts.
Institute for Politics and Strategy	DC	84688	CONCEPTS CYBER WAR	GR	This course examines traditional theories, concepts, and practices in international relations and warfare- conventional, unconventional, and modern- and relates them to the emerging dynamics of cyber war. The principle concepts examined in this course reflect, have shaped, and continue to shape state and non-state actor behaviors and their calculations of how to prepare for and prosecute warfare. These include, among others, conventional and nuclear deterrence, offense-defense dynamics, first strike capabilities, and irregular warfare. The course will focus on theory but will leverage history, military doctrine, and cases to highlight the challenges of integrating cyber war into defense planning and practice. Students will be challenged to consider how the 2009 introduction of cyberspace as a warfighting domain- in addition to land, maritime, air, and space- affects the ways that scholars and practitioners- operating with force structures and strategic, operational, and tactical concepts that are decades, if not centuries old- conceive of and practice warfare in the 21st Century. The principle objective of this course is to introduce students to cyber war within the context of traditional, and emerging, concepts of armed and unarmed warfare. This course will focus on two core areas: 1) a discussion of traditional concepts of warfare in the physical domains; and, 2) a discussion of cyber war and its intersection with these traditional concepts.

Department	College	Course #	Course Title	Grad/UG	Description
Institute for Politics and Strategy	DC	84689	TERRORISM & INSRGNCY	GR	There are many forms of political violence but not all are created equal. Some, like terrorism, are a tactic while others, like insurgency, are a strategy. How important is it to define terrorism and insurgency? What are the differences and similarities between them? This course will go into depth to analyze both terrorism and insurgency and their various manifestations. The course will provide a historical overview of how terrorism and insurgency have evolved over time, while also focusing on groups, methods, ideologies and organizational structures. Is the terrorism conducted by Salafist groups like Al-Qaida and the Islamic State significantly different than that perpetrated by ethno-nationalist groups like the Provisional Irish Republican Army and Tamil Tigers? What are the best methods to counter-terrorism and how successful have states been- both historically and more recently- at combating the threat posed by terrorism and insurgency?
Institute for Politics and Strategy	DC	84720	INTL SECURITY GRAD	GR	This seminar is a graduate-level introduction to the field of international security. The course focuses on issues concerning the conduct of war and military strategy, surveying both classic texts and recent works on important security policy issues. The course has three main objectives: (1) to introduce students to the complexities of the relationship between political ends, military means, and the strategy linking the two; (2) to familiarize students with major theoretical perspectives in international security; and (3) to survey key substantive areas and debates in the field, with reference where appropriate to particular case studies. Questions animating this course include: Why is force used? What causes peace? How does the possibility of war shape international relations and domestic socio-economic arrangements? By what criteria should the use of force be considered legitimate? How can governments effectively prepare to prevent wars, or to win them if they occur? Is the world safer after the Cold War? What are the similarities and differences between inter-state wars, civil wars, and armed conflict between states and transnational actors (such as terrorist groups)?

Department	College	Course #	Course Title	Grad/UG	Description
Institute for Politics and Strategy	DC	84722	COMP POLITICAL INST	GR	This course examines the foundations of the comparative analysis of political institutions, analyzes how institutions vary across countries, and explores some of the main consequences of such variation. The first section introduces the analysis of institutions, discusses the predominant theories that address institutional variation and change, and presents the development of modern state institutions. The second segment discusses how relevant political institutions differ worldwide, including regime types (democracies versus nondemocracies), forms of democratic regime (presidential and parliamentary systems), constitutions, electoral rules, legislatures, political parties, informal institutions, veto players, federalisms, judicial powers and bureaucracies. The third section centers on the consequences of political institutions, with an emphasis on the analysis of empirical evidence from developing and developed countries. A primary concern throughout the course is how the potential endogeneity among institutions affects our capacity to achieve reliable inferences. Methodologically, this course mainly builds on the rational choice school, but also integrates other perspectives.
Institute for Politics and Strategy	DC	84736	SOC SCI NAT SECURITY	GR	Seminar on Emerging Challenges in National Security. This course applies leading theories, ideas, historical analyses and policy-oriented research in the examination of emerging challenges in national security. In particular, the course addresses the following: why so many people in the United States and elsewhere thought the end of the Cold War would usher in an era of international peace; the emergence and evolution of global terrorism; military revolutions, transformations, and offsets; cyber threats in peace and war; the reemergence of state threats; emerging technologies and war; and the enduring need for hard power. Understanding emerging trends in the global security environment requires assessing contemporary ideas from thought leaders in the field. Thus, this course focuses on arguments that have shaped the thinking of policy makers at key turning points in the post-Cold War environment and some of the most influential arguments shaping the national security policy debate today.

Department	College	Course #	Course Title	Grad/UG	Description
Institute for Politics and Strategy	DC	84750	GRAD POLICY FORUM	GR	The IRP Graduate Policy Forum course takes a critical look at decision making in domestic politics and US foreign policy. It does so through weekly roundtable discussions with a diverse set of thought leaders. Based on intellectually significant essays that students are expected to read in advance of each class, these discussions give students an opportunity to ask probing questions about the three branches of the US government, media, embassies, advocacy groups, international organizations, and nongovernmental organizations. This course seeks to help students understand the responsibilities and activities that leaders and decision makers carry out on behalf of their organizations. Students are instructed in how to confidently and respectfully ask critical questions of those shaping policy. The term "roundtabling" is used to describe submitting an issue for critical discussion among relevant stakeholders. Knowing how to direct a roundtable is a significant element in the professional development of anyone interested in taking part in the policy arena, and this course helps students hone this important skill. In requiring students to read important essays related to each class session and then step back from discussions with leaders to write analytical essays, this course teaches students how to develop strong arguments based on solid logic and credible evidence, an essential component in making democracy work.
Institute for Politics and Strategy	DC	84765	ADV RESEARCH METHODS	GR	The purpose of the course is to prepare master's students to critically evaluate and analyze scholarly research in international relations and politics and to facilitate skills in both applied quantitative and qualitative research methods. The course surveys critical problems in the philosophy of science, logic of causal inference, research design, and program evaluation. Throughout the course, students will develop skills in applied data analysis, regression techniques, survey methods, forecasting, and scenario analysis. By the end of the courses, students will have submitted a fully developed thesis proposal, research design, literature review, and preliminary data analysis for their Graduate Thesis.
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Integrated Innovation Institute	CMU	49701	ID FUNDAMENTALS	GR	IDF introduces non-design students of the MII-PS program to the placement of products in the marketplace. Through lectures, discussions and assignments students will gain an understanding of the evolution of products in preparation to conceive of products in the IPD Capstone course. This course is intended for MII-PS students; all other students by permission of the instructor.

Department	College	Course #	Course Title	Grad/UG	Description
Integrated Innovation Institute	CMU	49717	ST: DGL ETHNO	GR	Students will study the basic principles of ethnography and then conduct a 6-week project as a participant observer in a digital setting. This course provides an opportunity to hone and refine skills from the User Research Methods course, and dive deeper into one method. You will plan the research, collect data, analyze and synthesize what was learned and present a research report that identifies not only what was observed but also interpret its meaning and make indications about opportunities to innovate with new offerings. Research topics will be provided, however you may propose a topic. Priority enrollment to III graduate students; students outside the III can register with the permission of the instructor.
Integrated Innovation Institute	CMU	49730	DFMS	GR	TBD. This course is intended for MIIPS (Pittsburgh) student status, or permission of instructor.
Integrated Innovation Institute	CMU	49733	DESIGNING SMART SYST	GR	Driven by the combination of increased access to data, computational power, and improved algorithms, data science and artificial intelligence technologies have become mainstream. These technologies include machine learning, natural language and speech processing, expert systems. robotics, and vision. Historically, early programs applying these capabilities were designed to operate on their own, on very narrow tasks, based on pre-programmed knowledge. Today, we have the ability to design human-computer systems in which both human and computers act intelligently, adapt to the world and learn from experience, improving their performance over time. How do we design such collaborative systems, taking advantage of the fundamentally different ways in which humans and computers act and learn? How do we build smart systems that achieve their intended goals, with a minimum of unintended side effects? The mini-course will give students the opportunity to address such questions. After an introduction of some basic concepts and techniques in AI and data science (only a basic familiarity with statistics is assumed), the course illustrates both the potential and current limitations of these techniques with examples from a variety of applications. We spend some time on understanding the strengths and weaknesses of human decision-making and learning, specifically in combination with AI systems. Exercises will include close examination of the inputs and outputs of various technologies with the goal of learning to select appropriate technologies for a given problem and anticipate design implications. Each student will also complete a final project that takes a project from start to finish (framing the problem, choosing data sources, exploratory data analysis, basic modeling, communicating results).

Department	College	Course #	Course Title	Grad/UG	Description
Integrated Innovation Institute	CMU	49804	LEADERSHIP CHALLENGE	GR	This course studies the emerging contexts for leadership - key attributes and skills, key development points, and key actions. Leadership will be discussed in changing contexts such as agile/lean environments, emerging technology such as mobility, big data, and global issues. Other topics include decision making under uncertainty, leadership and followership, acting as a connector in an ecosystem. A leader is someone who will take you somewhere that you didn't think you could go; what does this mean for teams, businesses and you personally? There will be key readings, case studies, and a retrospective. This course is intended for MIIPS (Pittsburgh) and MS-SM (SV) student status, or permission of instructor.
				Materials Science & Engineering	12
Materials Science & Engineering	CIT	27100	ENG MATERLS OF FUTRE	UG	Materials form the foundation for all engineering applications. Advances in materials and their processing are driving all technologies, including the broad areas of nano-, bio-, energy, and electronic (information) technology. Performance requirements for future applications require that engineers continue to design both new structures and new processing methods in order to engineer materials having improved properties. Applications such as optical communication, tissue and bone replacement, fuel cells, and information storage, to name a few, exemplify areas where new materials are required to realize many of the envisioned future technologies. This course provides an introduction to how science and engineering can be exploited to design materials for many applications. The principles behind the design and exploitation of metals, ceramics, polymers, and composites are presented using examples from everyday life, as well as from existing, new, and future technologies. A series of laboratory experiments are used as a hands-on approach to illustrating modern practices used in the processing and characterization of materials and for understanding and improving materials' properties.
Materials Science & Engineering	CIT	27210	MATLS ENG ESSENTIALS	UG	This course approaches professional skill holistically, having materials science and engineering students understand that being a professional includes having competencies and responsibilities that are personal, organizational and professional.

Department	College	Course #	Course Title	Grad/UG	Description
Materials Science & Engineering	CIT	27215	THERMODYNMC OF MTRLS	UG	The first half of the course will focus on the laws of thermodynamics and the inter-relations between heat, work and energy. The concept of an equilibrium state of a system will be introduced and conditions which must be satisfied for a system to be at equilibrium will be established and discussed and the concepts of activity and chemical potential introduced. The second half of the course will focus on chemical reactions, liquid and solid solutions, and relationships between the thermodynamics of solutions and binary phase diagrams.
Materials Science & Engineering	CIT	27216	TRANSPRT IN MATERIAL	UG	This course is designed to allow the student to become familiar with the fundamental principles of heat flow, fluid flow, mass transport and reaction kinetics. In addition, the student will develop the skills and methodologies necessary to apply these principles to problems related to materials manufacture and processing. Topics will include thermal conductivity, convection, heat transfer equations, an introduction to fluid phenomena viscosity, etc., Newtons and Stokes Laws, mass momentum balances in fluids, boundary layer theory, diffusion and absolute reaction rate theory. Where appropriate, examples will be taken from problems related to the design of components and the processing of materials.
Materials Science & Engineering	CIT	27357	INTRO TO MATLS SELEC	UG	The objective of this course is to teach the fundamentals of materials science as related to metals and metal alloys. The topics to be covered include crystal structure, defects, diffusion, binary phase diagrams, microstructure and processing, elastic and plastic deformation, equations of elasticity for isotropic materials, deformation of single crystal, slip systems, the tensile test, Von Mises yield criteria, strengthening mechanisms, phase transformations in steels, microstructures of steels, fracture and toughness, creep and corrosion.
Materials Science & Engineering	CIT	27367	SELECT PERFRMC MATRL	UG	This course teaches the selection methodologies for materials and processes for satisfaction of a design goal. Topics such as performance under load, shape effects, material properties (intrinsic and as influenced by processing) are discussed and applied so as to determine the fitness of use of materials for applications. Expanded topics include economics, codes and standards, environmental and safety regulations, professional ethics and life cycle analysis where applicable. The course incorporates a project where virtual teams work to provide material selection for a specific application problem. Prerequisites: 27-100

Department	College	Course #	Course Title	Grad/UG	Description
Materials Science & Engineering	CIT	27421	PROCESSING DESIGN	UG	In this course, the concepts of materials and process design are developed, integrating the relevant fundamental phenomena in a case study of a process design. The course includes basic science and engineering as well as economic and environmental considerations. The case study is on environmentally acceptable sustainable steelmaking. Other case studies in materials processing could be used.
Materials Science & Engineering	CIT	27433	DI MAG SPRCOND PROP	UG	Fall odd years: 9 units This is Part II of a two-part course sequence (Part I is 27-432) concerned with the electrical, dielectric, magnetic and superconducting properties of materials. Students taking Part II will develop an in-depth understanding, based on the modern theories of solids, of the dielectric, magnetic and superconducting properties of materials and the principles of operation of selected products and devices made from these materials. Topics will include relationships between chemical bonds and energy bands in dielectric and magnetic materials; polarization mechanisms in materials and their relationship to capacitance, piezeoelectricity, ferroelectricity, and pyroelectricity; magnetization and its classification among materials; magnetic domains; soft and hard magnets; and the origin, theory and application of superconductivity. Examples of commercial products will be introduced to demonstrate the application of the information presented in the text and reference books and class presentations.
Materials Science & Engineering	CIT	27514	BIO-NANOTECH	UG	"Have you ever wondered what is nanoscience and nanotechnology and their impact on our lives? In this class we will go through the key concepts related to synthesis (including growth methodologies and characterizations techniques) and chemical/physical properties of nanomaterials from zero-dimensional (0D) materials such as nanoparticles or quantum dots (QDs), one-dimensional materials such as nanowires and nanotubes to two-dimensional materials such as graphene. The students will then survey a range of biological applications of nanomaterials through problem-oriented discussions, with the goal of developing design strategies based on basic understanding of nanoscience. Examples include, but are not limited to, biomedical applications such as nanosensors for DNA and protein detection, nanodevices for bioelectrical interfaces, nanomaterials as building blocks in tissue engineering and drug delivery, and nanomaterials in cancer therapy."

Department	College	Course #	Course Title	Grad/UG	Description
Materials Science & Engineering	CIT	27700	ENER STOR MATLS SYST	GR	Contemporary energy needs require energy storage and conversion for a range of mobile and stationary applications. This course will examine electrochemically functional materials, devices, and systems that are used to convert, store, and release electrical energy. The principles and mathematical models of electrochemical energy conversion and storage will be examined in depth; students will study thermodynamics and reaction kinetics pertaining to electrochemical reactions, phase transformations, transport, and processing relating to a wide range of related technologies. This course also will also cover the practical aspects associated with the application of batteries, fuel cells, supercapacitor technologies. Students are asked to conduct a class project that involves interacting with outside industry and culminates in a end-of-semester poster session.
Materials Science & Engineering	CIT	27721	PROCESSING DESIGN	GR	In this course, the concepts of materials and process design are developed, integrating the relevant fundamental phenomena in a case study of a process design. The course includes basic science and engineering as well as economic and environmental considerations. The case study is on environmentally acceptable sustainable steelmaking. Other case studies in materials processing could be used.
Materials Science & Engineering	CIT	27729	SLD ST DEV ENG CONVN	GR	Intensive research efforts have yielded promising new materials approaches to 'alternative' energy conversion technologies, such as solar cells or photovoltaics; thermoelectric materials, which convert waste heat to electricity; metal/semiconductor superlattices for thermionic energy conversion; and fuel cells. At the same time, notable advances have been made in devices that substantially enhance our energy efficiency: e.g., chemical sensors and light-emitting diodes for solid-state lighting. In all of these devices, interfaces between dissimilar materials often govern and/or limit the behavior. In addition to the basic structures and operating principles, this course will cover practical materials interface issues, such as electrical transport, thermal stability, contact resistance, and bandgap engineering, that significantly affect the performance of a variety of energy conversion and energy-saving devices.

Department	College	Course #	Course Title	Grad/UG	Description
MCS Interdisciplinary	MCS	38101	EUREKA DISC & IMPACT	UG	The MCS first-year seminar "EUREKA: Discovery and Its Impact" will equip new students with foundational knowledge, skills and perspectives that will support their development as emerging scientists. During the seminar, students will be presented with opportunities and experiences designed to help them frame how the MCS curriculum aspires to shape their evolving identities in the areas of scholar, person, professional and citizen, while also engendering a sense of excitement about science and scientific inquiry. The seminar will offer information and strategies that are employed both by successful students and by successful scientists in optimizing their approach to work and life, with a key focus on areas such as cognitive learning skills, research, teamwork, goal setting, time management, innovation, community engagement, ethics, resources and assessment. Additionally, the seminar will introduce first-year students to the learning outcomes and requirements associated with the MCS core curriculum, with a particular emphasis on the self-directed ENGAGE courses and the role of the e-portfolio system in documenting and framing student growth and development.
MCS Interdisciplinary	MCS	38110	ENGAGE IN SERVICE	UG	ENGAGE in Service is a 1-unit course (9 hours of work, minimum requirement for a passing grade) designed to promote MCS students' direct engagement with community development and service learning. To fulfill this requirement, students must engage in a minimum of 9 hours of work devoted to a non-profit organization or organizations of their choice, 3 of which must have a direct benefit to the local Pittsburgh community. Students may complete the requirements anytime during their undergraduate years, but must register for the class during the semester that they intend to complete it, no later than their penultimate semester. Coursework includes documentation of service via completion of a form for each eligible activity that includes a time log, a description of the activity, the name and contact information for their supervisor and the supervisor's signature. In addition, during the last semester of the project/course students will prepare a 1-2 page reflective paper on the lessons learned from their immersion in the organization(s) and its (their) work. No pay or other compensation can be received, and, in special cases, students may petition for a waiver if they have completed another service-learning course at Carnegie Mellon.

Department	College	Course #	Course Title	Grad/UG	Description
MCS Interdisciplinary	MCS	38220	ENGAGE IN THE ARTS	UG	ENGAGE in the Arts is part of Mellon College of Science's Core Curriculum. In this 2-unit full-semester course, students will broaden their knowledge of the fine arts, extend their global and cultural awareness, and facilitate the further development of their self-identity. Coursework requires that students attend 8 distinct arts events, two of which must engage with a culture different from one's personal cultural background. In choosing events, students should be imbued with an attitude of openness to new ideas and a willingness to try something new. The course requires students to share, reflect, and document their participation in a variety of arts events by engaging with classmates and instructors through MyCORE, where they can upload coursework and find postings for events. Coursework can be completed at any time during students' undergraduate years, but they must register for the class during the semester that they intend to complete it.
MCS Interdisciplinary	MCS	38230	ENGAGE IN WELLNESS:	UG	ENGAGE in Wellness: Looking Inward is a 1-unit mini-course that MCS students will enroll in the fall of the sophomore year, designed to give students a holistic understanding of their own personal wellness. The course is structured around the concept of a Wellness Wheel, a model for personal wellness that is used to describe the various areas that students should reflect upon when describing, and ultimately improving, their overall wellness. The MCS Wellness Wheel has nine components: intellectual, physical, emotional, spiritual, environmental, institutional or community, financial, social, and occupational health. During this first course, taken in the first mini of the sophomore year, students will select one of three areas on which to focus: intellectual, emotional or physical health. They will be asked to engage in a recursive, reflective process to assess their own level of wellness in this area, develop short-term goals for the next year and a statement of a longer-term goal in this area, identify possible resources and then choose activities that promote this aspect of wellness. Students should expect to devote 9-14 hours to the development and articulation of their plan in order to earn a passing grade. These hours are tied to completion of the requested assessments and not to the activities students' elect to pursue in fulfillment of their wellness plan. THIS COURSE IS FOR SOPHOMORES ONLY.

Department	College	Course #	Course Title	Grad/UG	Description
MCS Interdisciplinary	MCS	38301	PROPEL	UG	PROPEL: Preparation, Readiness, and Optimization for Professional Excellence in Life - is a 6-unit seminar course that MCS students will enroll in the spring of their junior year. The course will leverage students' deepening disciplinary perspective in service of the development of competencies, skills and perspectives that are necessary to achieve professional excellence in today's society. The course will use traditional career development activities, such as interviewing, resume writing and networking, as a starting point for students to begin the process of reflecting on, and preparing for, their impending transitions into professional life. From there, the course will seek to expand students' conceptualization of the scientific workplace by exploring the interplay of science, innovation, public policy, entrepreneurism and business in professional settings today. The seminar will also equip students with significant insight into the ways in which global policy, societal and political forces, environmental issues and ethical considerations shape and influence the activity and research of working scientists. The course will offer additional experiences for students to refine their multidisciplinary teamwork and communication skills via small group projects focusing on the aforementioned course themes. Finally, "PROPEL" will include a formal academic advising component to ensure that all students are well positioned to complete the MCS core requirements and departmental requirements in the following year. THIS COURSE IS FOR MCS JUNIORS ONLY.
MCS Interdisciplinary	MCS	38330	ENG WELLN LKG OUTWD	UG	ENGAGE in Wellness: Looking Outward is a 1-unit mini-course that MCS students will enroll in the fall of the junior year, designed to give students a holistic understanding of their own personal wellness. The course is structured around the concept of a Wellness Wheel, a model for personal wellness that is used to describe the various areas that students should reflect upon when describing, and ultimately improving, their overall wellness. The MCS Wellness Wheel has nine components: intellectual, physical, emotional, spiritual, environmental, institutional or community, financial, social, and occupational health. During this second course, taken in the first mini of the junior year, students will select one of three areas on which to focus: spiritual, environmental and institutional or community health. They will be asked to engage in a recursive, reflective process to assess their own level of wellness in this area, develop short-term goals for the next year and a statement of a longer-term goal in this area, identify possible resources and then choose activities that promote this aspect of wellness. Students should expect to devote 9-14 hours to the development and articulation of their plan in order to earn a passing grade. These hours are tied to completion of the requested assessments and not to the activities students' elect to pursue in fulfillment of their wellness plan. This course is intended for juniors only. THIS COURSE IS FOR JUNIORS ONLY.

Department	College	Course #	Course Title	Grad/UG	Description
MCS Interdisciplinary	MCS	38430	ENG WELLN LKG FORWD	UG	ENGAGE in Wellness: Looking Forward is a 1-unit mini-course that MCS students will enroll in the fall of the senior year, designed to give students a holistic understanding of their own personal wellness. The course is structured around the concept of a Wellness Wheel, a model for personal wellness that is used to describe the various areas that students should reflect upon when describing, and ultimately improving, their overall wellness. The MCS Wellness Wheel has nine components: intellectual, physical, emotional, spiritual, environmental, institutional or community, financial, social, and occupational health. During this third course, taken in the first mini of the senior year, students will select one of three areas on which to focus: financial, social and occupational health. They will be asked to engage in a recursive, reflective process to assess their own level of wellness in this area, develop short-term goals for the next year and a statement of a longer-term goal in this area, identify possible resources and then choose activities that promote this aspect of wellness. Students should expect to devote 9-14 hours to the development and articulation of their plan in order to earn a passing grade. These hours are tied to completion of the requested assessments and not to the activities students' elect to pursue in fulfillment of their wellness plan. THIS COURSE IS FOR SENIORS ONLY.
				Mechanical Engineering	10
Mechanical Engineering	CIT	24101	FUND OF MECH ENGR	UG	The purpose of this course is to introduce the student to the field of mechanical engineering through an exposition of its disciplines, including structural analysis, mechanism design, fluid flows, and thermal systems. By using principles and methods of analysis developed in lectures, students will complete two major projects. These projects will begin with conceptualization, proceed with the analysis of candidate designs, and culminate in the construction and testing of a prototype. The creative process will be encouraged throughout. The course is intended primarily for CIT freshmen. 3 hrs. lec., 2 hrs. rec./lab.
Mechanical Engineering	CIT	24221	THERMODYNAMICS I	UG	Temperature and thermometry; equations of state for fluids and solids; work, heat, and the first law; internal energy, enthalpy, and specific heats; energy equations for flow; change of phase; the second law, reversibility, absolute temperature, and entropy; combined first and second laws; availability; power and refrigeration cycles. Applications to a wide range of processes and devices. 3 hrs. lec., 1 hour recitation

Department	College	Course #	Course Title	Grad/UG	Description
Mechanical Engineering	CIT	24302	MECHNCL ENG SEM I	UG	The purpose of this course is to help students develop good presentation skills and to provide a forum for presentations and discussions of professional ethics. Students will make at least two presentations, one of which is related to professional ethics. Student grades will be based on their presentation skills and their participation in class discussions. 1 hr. rec. Prerequisites: Junior standing or permission of instructor
Mechanical Engineering	CIT	24421	INTERNL COMBST ENGNS	UG	This course discusses working principles of internal combustion engines found in many practical applications. Focus is given to understanding the design of air handing system, in-cylinder fuel/air mixing, geometric design of the combustion chamber, engine performance and calibration, and mechanism of pollutant formation and reduction. Introductory discussion of advanced automotive engine concepts, alternative fuels, gas turbine engines, rocket engines, and hybrid electric vehicles is also provided. The course relies on a number of lab experiments, analysis of actual experimental data, and a combination of analytical and numerical homework assignments. 3 hrs. lecture 2 hrs. lab
Mechanical Engineering	CIT	24629	DR SLR THM ENG	GR	This course introduces graduates and senior undergraduates the principles and technologies for directly converting heat and solar light into electricity using solid-state devices. The first part of the course reviews the fundamentals of quantum mechanics, solid state physics and semiconductor device physics for understanding solid-state energy conversion. The second part discusses the underlying principles of thermoelectric energy conversion, thermionic energy conversion, and photovoltaics. Various solar thermal technologies will be reviewed, followed by an introduction to the principles of solar thermophotovoltaics and solar thermoelectrics. Spectral control techniques which are critical for solar thermal systems will also be discussed. By applying the basic energy conversion theory and principles covered in lectures, students will finish a set of 4 homework assignments. This course also requires one project in which students will work individually to review one present solar or thermal energy conversion technology 12 units
Mechanical Engineering	CIT	24643	SP TPC: EL EN STR SY	GR	Contemporary energy needs require large scale electrochemical energy conversion and storage systems. Batteries are playing a prominent role in portable electronics and electric vehicles. This course introduces principles and mathematical models of electrochemical energy conversion and storage. Students will study thermodynamics, reaction kinetics pertaining to electrochemical reactions, phase transformations relating to batteries. This course includes applications to batteries, fuel cells, supercapacitors

Department	College	Course #	Course Title	Grad/UG	Description
Mechanical Engineering	CIT	24651	MAT SLC ENGR	GR	This course provides a methodology for selecting materials for a given application. It aims to provide an overview of the different classes of materials (metal, ceramic, glass, polymer, elastomer or hybrid) and their properties including modulus, strength, ductility, toughness, thermal conductivity, and resistance to corrosion in various environments. Students will also learn how materials are processed and shaped (e.g., injection molding, casting, forging, extrusion, etc.), and will explore the origins of the properties, which vary by orders of magnitude. Topics include: Materials selection by stiffness, strength, fracture toughness and fatigue. Shape factors and materials processing. Binary phase and time temperature transformation diagrams, microstructure. Polymer types and structures. Alloying and strengthening of metals, types of steels. Corrosion, oxidation, tribology and thermal properties.
Mechanical Engineering	CIT	24680	QUAN ENTPR TECH COMM	GR	This course provides engineers with a multidisciplinary mathematical foundation for integrated modeling of engineering design and enterprise planning decisions in an uncertain, competitive market. Topics include economics in product design, manufacturing and operations modeling and accounting, consumer choice modeling, survey design, conjoint analysis, decision-tree analysis, optimization, model integration and interpretation, and professional communication skills. Students will apply theory and methods to a team project for a new product or emerging technology, developing a business plan to defend technical and economic competitiveness. This course assumes fluency with basic calculus, linear algebra, and probability theory.
Mechanical Engineering	CIT	24722	ENGRY SYSTEMS MODLNG	GR	This course focuses on the thermodynamic modeling of energy systems with emphasis on energy/availability analysis techniques. These techniques are developed and applied to both established and emerging energy technologies, such as internal combustion engines, gas- and coal-fired power plants, solar and wind energy systems, thermochemical hydrogen production cycles, and fuel cells. The course will also consider the integration of components such as reformers and electrolyzers. Modern computational tools are used throughout the course. The course culminates with a group project that requires developing sophisticated, quantitative models of an integrated energy system. Students are expected to have completed an undergraduate course in thermodynamics comparable to 24-221.

Department	College	Course #	Course Title	Grad/UG	Description
Mechanical Engineering	CIT	24774	ST: ADV CNTL SYS INT	GR	This course focuses on the practical implementation of feedback / feedforward controllers. The entire controller design process is presented, including system modeling and identification, compensator design, simulation, and hardware prototyping. This is a project-based course in which students complete the controller design process on a nonlinear, MIMO hardware system. The goal is train students on the system integration skills necessary for success in industry or experimental laboratory work.
					Medical Management:Sch of Pub Pol & Mgt 7
Medical Management:Sch of Pub Pol & Mgt	HC	92873	LEAN HEALTHCARE QULY	GR	to be determined by department
Medical Management:Sch of Pub Pol & Mgt	HC	92882	HEALTH FINANCE	GR	To be determined by department
Medical Management:Sch of Pub Pol & Mgt	HC	92886	NEGOTATN CONFLCT RES	GR	No course description provided.
Medical Management:Sch of Pub Pol & Mgt	HC	92889	HEALTH ECONOMICS	GR	Course description will be available on Heinz College website.
Medical Management:Sch of Pub Pol & Mgt	HC	92891	HEALTH POLICY	GR	Course description will be available on Heinz College website.
Medical Management:Sch of Pub Pol & Mgt	HC	92894	HEALTH LAW	GR	Description to be provided by the department

Department	College	Course #	Course Title	Grad/UG	Description
Medical Management:Sch of Pub Pol & Mgt	HC	92897	HEALTH CARE QUALITY	GR	Description to be provided by the department
					Modern Languages 2
Modern Languages	DC	82103	NAV CHINESE CULTURE	UG	This course introduces students to the basics of Chinese culture in order to assist them to better understand and appreciate traditional Chinese humanistic ideas, thoughts and value systems, with a focus on the Confucian point of view. Through the study of the classic novel, ?The Three Kingdoms?, the most valued virtues within Chinese culture and society - loyalty, filial piety, benevolence and righteousness ?are presented and discussed. Different aspects of the daily life culture will be introduced as well. Supplementary readings, video clips as well as video games will be used to provide students with a deeper insight, observation and motivation to explore more issues related to Chinese culture, history and philosophy. Assessment will be based on short essays, group projects and individual presentations. Some basic Chinese language instruction will be included to give students a taste of the Chinese language. After taking this course, students will - develop a basic understanding of the essence of Chinese culture - build an awareness of cultural differences between different countries - understand some basic characteristics of Chinese language This course is conducted in English; no prior knowledge of the Chinese culture is required.
Modern Languages	DC	82214	MOD ARAB LANG LIT CULT	UG	An integrated approach to the study of the Arabic language, literature and culture by means of literary and cultural readings.This course explores definitions of culture and analyzes the dynamic role of language in culture and culture in language, with an aim to foster cross-cultural awareness and self-realization while developing proficiency in Arabic. This course is designed to strengthen listening, speaking, reading and writing, within the context of an evolving Arabic culture.
					Music 5
Music	CFA	57306	WORLD MUSIC	UG	A study of major musical traditions from around the world, including classical music from Asia (broadly defined) and the Middle East, as well as traditional musics in Africa, Europe, and the Americas. This course will examine music in its socio-cultural context, and will demonstrate how learning about music from diverse cultures increases cross-cultural understanding. This course will engage with readings, listening examples, multi-media presentations, in-class discussions, music-making activities, and special guests (virtual and in person).

Department	College	Course #	Course Title	Grad/UG	Description
Music	CFA	57331	PRNCPLS OF EDUCATION	UG	This course introduces students to the art and science of being an educator. Content includes views of the academic and social structure of the school, physiological & social characteristics of learners that influence instruction, widely recognized research on learning & teaching, and appropriate & effective class preparation and teaching strategies.
Music	CFA	57374	MUSIC IN URBN SCHOOL	UG	This course will involve workshops with nationally known instructors in eurhythmics, world drumming, contemporary popular music, and classroom management. The course will require attendance at workshops, classroom observations and closely supervised teaching experiences. Schools involved are all inner city schools with a poverty level of 75% or above. This course is offered as the result of a grant received from the Federal Department of Education by the School of Music, the Pittsburgh Public Schools, and the Wilkinsburg School District.
Music	CFA	57829	CONTEMPORARY SOUNDSC	GR	In the late 1960s on Canada's West Coast, composer R. Murray Schafer started the "World Soundscape Project" (WSP). Originally conceived as an inquiry into the growing problem of noise pollution in Vancouver, the Project expanded to encompass the wider study of the relationship between sonic environments and human communities, both historical and present. From a small group of sound researchers making field recordings in natural landscapes and urban areas has grown the modern study of Acoustic Ecology on a global scale, and also the creative practice of Soundscape Composition, in which recorded elements of sound environments are expressively explored through electronic music. Beginning with a history of the WSP, this course surveys aspects of the field of Acoustic Ecology as an aesthetic, political, and ethical phenomenon, with special attention to its relationship with the creative and sound practices of "Soundwalking," "Deep Listening," and Soundscape Composition. This course will also contextualize the WSP within a broader history of music and sound in the background, including Satie's Furniture Music, Muzak®, and coffee shop music. Throughout the course, students will participate in the activity and design of soundwalking, sonic field documentation / recording and sonic-environmental sampling, and the performance of background music. The course will culminate in a soundscape project entailing the composition of a Soundscape work, or the presentation of a creative mapping of aspects of their own sound environments; special guests will provide students with instruction in sound capture and manipulation.

Department	College	Course #	Course Title	Grad/UG	Description
Music	CFA	57831	PRNCPLS OF EDUCATION	GR	This course introduces the student to basic issues in education. Content includes views of the academic and social structure of the school and the review and application of widely recognized theories of learning. Special emphasis is placed on the study of pedagogy as a series of options from which the educator constructs learning activities.
					Philosophy 10
Philosophy	DC	80130	INTRO TO ETHICS	UG	As human beings, we frequently grapple with difficult moral questions. How ought I treat my friends and peers? What kinds of policies should a government adopt? When, if ever, can we justify harm? These are the kinds of questions we will consider as we survey the most prominent, contemporary ethical theories. Along the way, we will consider the implications of those theories for real world ethical issues, including capital punishment, pornography, and universalized
Philosophy	DC	80136	SOC STR PUB POL ETCS	UG	The course will consider ethical questions surrounding social structure and public policy. It will analyze the role of political institutions and individual citizens in dealing with some of the greatest challenges facing our world: Global health crises, the spread of (and threats to) democracy worldwide, and world poverty. Some of the questions we will consider include: Are developed countries obligated to ameliorate poverty by providing foreign aid? What is democratic governance, and what do democratic representatives owe to their constituents? Should wealthy nations and corporations assist in the fight against life-threatening diseases worldwide? The course uses ethical and political theory, case studies, and empirical evidence to consider these questions.
Philosophy	DC	80201	KNOWL JUSTF BELIEF	UG	What does it mean to have knowledge? How do we know things, and what can be known? These are some of the central questions in the discipline of epistemology ("the theory of knowledge"). The answers to these questions are not as obvious as some casual thought may suggest. If you think the senses provide us with knowledge, how will you know when your senses deceive you? If you think knowledge is gained through reasoning, where will you start reasoning? This course investigates these questions, focusing on both classic questions and treatments and more recent work in the field of social epistemology. There are no prerequisites, but students may find previous experience with philosophical reasoning to be helpful. Students both with and without such experience are encouraged to take the class.

Department	College	Course #	Course Title	Grad/UG	Description
Philosophy	DC	80221	PHILOS OF SOCIAL SCI	UG	This course will explore various philosophical issues germane to social science. The central question of the course asks whether we can use traditional scientific tools to understand social phenomena, e.g. wars and religions, in the same way that we use them to understand natural phenomena, e.g. gases, lasers and planetary orbits. Some of the more specific questions we address: Because humans possess free will and act with intentions while light rays and planets in motion do not, are we forced to use logically different species of explanations in the two cases? How can we explain social institutions that depend upon cooperation? Whereas natural scientists actively conduct experiments, social scientists can often only collect statistical data. Does this difference prevent social scientists from inferring causal relations? Is our understanding of social phenomena always value laden?
Philosophy	DC	80224	RACE GENDER SCI	UG	In this course, we will focus on the interplay between science, technology, & medicine, on the one hand, and race & gender on the other. Taking up a series of controversial issues and cases from the past and the present, we will consider the implications of developments in the life sciences for politics, social identity, and cultural belonging. In our readings and discussions, we will examine the roles of science, technology, and medicine in defining and redefining race and gender; the ways in which cultural beliefs about race and gender have influenced scientific research and the development of knowledge; and the efforts by individuals and social movements to challenge scientific institutions and assert new claims about identity, difference, and inequality.
Philosophy	DC	80245	MEDICAL ETHICS	UG	This course provides an introduction to core ethical issues in health care, medical research, and public policy. Topics include: the moral responsibilities of health care providers to patients and various third parties such as the government or insurance companies, the status of health as a social good, and questions of individual liberty and social responsibility at the ends of life including issues such as abortion, physician assisted suicide, and the definition of death. We will also examine specific ethical issues in the conduct of medical research and look at the impact of technological innovation on our notions of health, disease, life, death, and the family. If time permits, we may also discuss issues related to genetics and cloning. While the course engages such substantive ethical issues it also attempts to sharpen students' skills in practical reasoning through argument analysis, analogical reasoning, and the application of theory and principles to particular cases.

Department	College	Course #	Course Title	Grad/UG	Description
Philosophy	DC	80263	CHINESE PHILO: TXTS	UG	This course focuses on ancient texts of Chinese philosophy, which have had a foundational role in Chinese society and culture. We will look at original texts from the Chinese classics, including the I Ching (Book of Changes) and the Tao Te Ching (basic treatise on Taoism). We will consider the role and place of science and explanation in Chinese society. We will also discuss the difficulty of translation from one language to another or from the writings of one era into another. The course will seek to connect the ancient literature and practice with modern perspectives on science, metaphysics, mind/body dualism, and causation. We will take the ancient texts in their original form as points of departure for our exploration. No prior knowledge of the Chinese language is assumed. The course is relevant for cultural and language studies, as well as studies in history and philosophy of science.
Philosophy	DC	80321	CASTN LAW SOCL POLCY	UG	Policy makers face causal questions. For example, does violence on TV cause violence in life, and if so, what policies can we institute that will actually curb it? Does the death penalty actually deter criminals? Do tough drug laws reduce drug use? This course investigates how scientists establish causal claims, and how policy makers and the courts rely on or systematically ignore such science. We examine what causal claims mean and how they connect to statistical data, and we discuss the limits of standard techniques for establishing causal claims. We will consider all of these issues first theoretically, and then in the context of several case studies chosen mostly by the students.
Philosophy	DC	80330	ETHICAL THEORY	UG	Every day, even in very subtle ways, we make judgments of value that shape our lives and our conduct. This course will examine four influential attempts at providing a systematic account of the source and nature of moral value, its relationship to other kinds of value, and the practical implications of different answers to these questions. This focus on the fundamental structure of moral value will frequently engage topics such as the nature of the good, subjectivist and objectivist accounts of value, forms of moral naturalism verses attempts at moral constructivism, and will draw on historical as well as more contemporary sources. Particular attention will be paid to articulating the specific sources of disagreement that distinguish competing moral theories in order to facilitate our ability to adjudicate between them on a reasoned basis.

Department	College	Course #	Course Title	Grad/UG	Description
Philosophy	DC	80335	SOC POL PHILO	UG	Broadly speaking, political philosophers are interested in whether, and to what extent, government use of coercion can be justified, and how social and political institutions should be structured in order to be legitimate. This is an advanced course in social and political philosophy, aimed at providing students with a more in-depth familiarity with classic and contemporary questions both theoretical and applied. The course is topical, and course topics will vary from year to year. Typically 4-5 topics are covered in a term. Previous years' topics have included the nature and value of freedom, social contract theory, racial and epistemic injustice and the nature of white ignorance, the intersecting concepts of justice and equality, structural injustice, responsibility for injustice, and immigration. Students are expected to come away from the course with a strong understanding of some of the major debates in social and political theory as well as the tools to analyze ongoing debates within contemporary US and global politics regarding the appropriate way to organize our social and political reality. This course is primarily conducted as a seminar and is discussion- rather than lecture-based.
					Physics 2
Physics	MCS	33115	PHYC FTR PRESIDENTS	UG	Countless topics of social and political importance are intimately related to science in general and physics in particular. Examples include energy production, global warming, radioactivity, terrorism, and space travel. This course aims to provide key bits of knowledge based on which such issues can be discussed in a meaningful way, i.e., on the level of arguments and not just vague beliefs. We will cover an unusually wide range of topics, including energy, heat, gravity, atoms, radioactivity, chain reactions, electricity, magnetism, waves, light, weather, and climate. No calculus or algebra will be required. The course is open for all students at CMU.
Physics	MCS	33120	SCI & SCIENCE FICTN	UG	We will view and critique the science content in a selection of science fiction films, spanning more than 100 years of cinematic history, and from sci-fi TV shows from the past 50+ years. Guided by selected readings from current scientific literature, and aided by order-of-magnitude estimates and careful calculations, we will ponder whether the films are showing things which may fall into one of the following categories: Science fiction at the time of production, but currently possible, due to recent breakthroughs. Possible, in principle, but beyond our current technology. Impossible by any science we know. Topics to be covered include the future of the technological society, the physics of Star Trek, the nature of space and time, extraterrestrial intelligence, robotics and artificial intelligence, biotechnology and more. Success of this course will depend upon class participation. Students will be expected to contribute to discussion of assigned readings and problems, and to give brief presentations in class on assigned films.
					Psychology 5

Department	College	Course #	Course Title	Grad/UG	Description
Psychology	DC	85241	SOCIAL PSYCHOLOGY	UG	The focus of this course will be on how peoples behavior, feelings and thoughts are influenced or determined by their social environment. The course will begin with lectures and readings on how social psychologists go about studying social behavior. Next, various topics on which social psychologists have done research will be covered. These topics will include: person perception, prejudice and discrimination, the nature of attitudes and how attitudes are formed and changed, interpersonal attraction, conformity, compliance, altruism, aggression, group behavior, and applications of psychology to problems in health care, law, politics, and the environment. Through readings and lectures on these topics, students will also be exposed to social psychological theories.
Psychology	DC	85412	COGNITIVE MODELING	UG	This course will be concerned with modeling of agent behavior in a range of applications from laboratory experiments on human cognition, high-performance simulations such as flight simulators, and video game environments like Unreal Tournament. The first half of the course will teach a high-level modeling language for simulating human perception, cognition, and action. The second half of the course will be a project in which students develop a simulated agent or agents for the application of their choice.
Psychology	DC	85438	ED GOALS INST ASSESS	UG	The aim of this course is to teach students how to develop educational goals based on a detailed task analysis of the knowledge, skills, and dispositions required for mastery of a particular aspect of a domain. Goals for early childhood, elementary, middle school, and high school will be discussed and related to the state and national standards. A comprehensive understanding of student achievement will be developed. The importance of matching the instructional program and its assessment to goals will be discussed and demonstrated. Assessment that focuses on covering the full range of specified goals will be studied along with diverse approaches for valid assessment. Other topics include making instructional material choices, funding, classroom management, ethics, and relation to system-level policies. Assignments will emphasize linking goals - instruction ¬assessment. A term project will consist of an in-depth study of one central unit in a discipline or grade level.
Psychology	DC	85446	PSYCHOLOGY OF GENDER	UG	This course is devoted to the investigation of psychological gender rather than biological sex. That is, sex differences will be explored from a social psychological (e.g., socialization) perspective. Implications of both male gender role and female gender role in the areas of relationships and health will be the course focus.

Department	College	Course #	Course Title	Grad/UG	Description
Psychology	DC	85738	ED GOALS INST ASSESS	GR	The aim of this course is to teach students how to develop educational goals based on a detailed task analysis of the knowledge, skills, and dispositions required for mastery of a particular aspect of a domain. Goals for early childhood, elementary, middle school, and high school will be discussed and related to the state and national standards. A comprehensive understanding of student achievement will be developed. The importance of matching the instructional program and its assessment to goals will be discussed and demonstrated. Assessment that focuses on covering the full range of specified goals will be studied along with diverse approaches for valid assessment. Other topics include making instructional material choices, funding, classroom management, ethics, and relation to system-level policies. Assignments will emphasize linking goals - instruction ¬assessment. A term project will consist of an in-depth study of one central unit in a discipline or grade level.
					Public Management:Sch of Pub Pol & Mgt 3
Public Management:Sch of Pub Pol & Mgt	HC	91717	BUS WRTG FOR LEADERS	GR	Business Writing for Leaders is an online course designed for experienced writers who want to take their skill set to the next level. Assignments focus on how and when to use persuasion, positive messaging, appropriate tone, and powerful openings and closings to capture the attention of readers and motive them into action. Whether currently in a leadership position or practicing for a future role, effective writing in the workplace is requisite for building rapport with employees, colleagues, and clients, establishing professional relationships, and inspiring others to be their best. In this course, students will practice writing various types of business correspondence to interact in a globally connected society.
Public Management:Sch of Pub Pol & Mgt	HC	91803	ECO PRINC PLCY ANLYS	GR	Microeconomics is the study of how individuals and firms make choices, and how these choices interact in society. Economics shares with other behavioral sciences the general goal of explaining and predicting human behavior. The distinguishing feature of the economic approach is the emphasis on rational decision making under conditions of scarcity. This course is an introduction to the basic concepts and tools of microeconomics. We study how markets work, with an emphasis on analysis of the effects of public policy on the welfare of society.

Department	College	Course #	Course Title	Grad/UG	Description
Public Management:Sch of Pub Pol & Mgt	HC	91869	CONFLICT RESOLUTION	GR	Conflict Resolution is NEVER a set of techniques. The goal of this course is to grow in your understanding of conflict and your skill in dealing with it. We have all been touched by conflict in some way; our past experiences become the basis for the many personal ways in which we think and feel about conflict. Our approach to conflict, in turn, determines our behaviors and responses in conflict situations. My goal is to challenge the way you currently think about conflict and to provide you with experiences that will increase your self awareness and confidence when you face conflict. In addition, you will have the opportunity to identify and practice constructive conflict behaviors. This is online (on-demand) course with ONE MANDATORY LIVE SESSION which will be held on Thursday April 5 at 6:00 PM.
					Public Policy & Mgt:Sch of Pub Pol & Mgt 24
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90704	POV INEQ & SOC POL	GR	In her book Social Forces and States Judith Teichman argues that significant and long term improvement in distributional outcomes is a daunting political task [that requires] a strong societal consensus on the importance of the reduction in inequality, one that compels political leaders to make difficult policy changes. This new course will provide an overview of approaches to this difficult process of social policy making with a focus on the role that social forces and the state play in the generation of policy responses to poverty and inequality. The course will discuss the role that new approaches to social policy play in the alleviation of poverty and inequality, including the impact of Conditional Cash Transfers such as Bolsa de Familia. Ongoing debates on the advantages and disadvantages of public versus private programs in the areas of social security and health will also be analyzed. The first section of the course will focus on approaches to poverty and inequality in the US and Western Europe and the second one on Africa and Latin America.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90706	HEALTCARE INF SYSTM	GR	In a value-based care delivery environment with its emphasis on improving costs and service efficiency without risking quality of care, information technology has emerged as a powerful driving force in helping to achieve multiple goals within healthcare organizations. The explosive advances in information technology combined with the current challenges facing healthcare delivery have created the need for skilled individuals who can develop, understand, manage, and integrate healthcare information systems in organizations. This course will explore the concepts and application of major information systems methodologies and approaches in the delivery of modern healthcare systems, including traditional face-to-face, online, and mobile and social media enabled care delivery. A semester-long group project that synthesizes the different topics via the design and implementation of a working, integrated, healthcare decision support application will be a required component of the course

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Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90717	WRTNG PUBLIC POLICY	GR	Professional writing, or writing for business-focused, industry-specific contexts, differs from academic writing in objective, audience, structure, style, and format. It focuses more on problem solving than on exposition of ideas and is generally targeted to diverse audiences with varying levels of expertise. Therefore, effective writing in the workplace often requires adapting writing skills and habits to meet reader's needs. Additionally, when hiring recent graduates for a mid-level position, employers identify writing skills as one of the top five factors signaling leadership potential. Whether you're looking to maximize the impact of your communications at work, seeking project funding, or looking to increase your visibility on-line, this seven-week mini course will prepare you to assume a leadership role in your industry through effective written communication. This course will not only help you refine the essentials of workplace writing, but will also provide strategies, guidelines, and best practices for writing the kinds of industry-specific documents that policy, information security/systems, and creative industry professionals need. This course is designed for experienced writers who want to take their skills to the next level. This course assumes basic proficiency in English grammar.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90721	HEALTHCARE MGT	GR	This course introduces students to the knowledge and skills required to strategically manage the rapidly changing internal and external environment of health care organizations. Through readings, lectures, class discussions and case reviews, the course is designed to provide students with a foundation in contemporary health care organizational structures and management practices. Students will explore problems and decisions facing health care executives in areas such as clinical quality, organizational effectiveness, efficiency, growth, stakeholder conflicts, provider incentives, margin versus mission tradeoffs, human resources, strategic planning and the like, all in a highly complex political environment. A primary theme of this course is the application of ethical management practices as codified in the American College of Healthcare Executives Code of Ethics. By providing a general overview of the responsibilities of health care leaders and managers, students will have a contextual reference for the application of future coursework.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90748	REAL EST DEVLPMENT	GR	A comprehensive study of the main elements of the real estate development process. The course will examine risk control, site selection and physical feasibility; the value of market research and analysis; entitlements and government regulation; legal issues; valuation and financial analysis techniques; borrower and lender underwriting; design and construction, property, asset and portfolio management....Read More

Department	College	Course #	Course Title	Grad/UG	Description
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90752	RISE ASIAN ECON	GR	For most of the past 40 years, no region of the world has been more economically dynamic than Asia. This economic growth transformed the patterns of world trade, lifted millions out of absolute poverty, and so captivated the attention of Western economists and business leaders that it was commonplace by the early 1990s to refer to the economic achievements of these countries as the "East Asian miracle." The nature of this apparent miracle changed dramatically over the course of the 1990s as the most advanced economy in the region, Japan, suffered a sharp growth slowdown, and a number of the other "miracle" economies were engulfed in a regional economic crisis in the latter half of the decade. These events highlighted weaknesses in the East Asian growth model that had been hidden during the boom years. Despite these economic problems, accelerating growth in the world's most populous countries, China and India, helped sustain regional progress and kept global attention focused on economic growth in Asia through the 2000s, even though the growth and the international attention were largely concentrated in a different set of countries. However, new worries about Chinese economic growth have shaken global markets in recent years. Is China's growth miracle ending? How does the economic history of Asia's more advanced economies inform our view of the future economic prospects for India and China? In what ways are China and India pursuing a different path to economic development than that taken by their predecessors? How can investors, consumers, and producers in the United States benefit from continued Asian growth? What can U.S. policymakers do to support continued growth in the region and ensure that America continues to benefit from it? The economic future of billions of human beings depends quite significantly on the answers to these questions.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90763	HMN RGHTS CONF DVLPM	GR	The course is organized around the premise that seventy-three percent of people living in poor countries have recently been, or are in a civil war (Collier, The Bottom Billion). As a result, the course will explore the deep connections between conflict and development because conflict happens largely in developing countries and because conflict interferes with the development process and with the capacity of countries to have a sustainable development model. This course will focus on the struggle that selected Latin American and African countries have had in achieving a satisfactory level of development and the negative impact of conflict on development. Conversely, we will examine why conflicts and the human rights abuses resulting from those conflicts happen mostly in countries at a low level of development. In brief, the course will examine: a) Development approaches pursued in Africa and Latin America, b) Civil wars that have taken place in those continents and the human rights abuses that took place during those conflicts. c) The role of international organizations, peacekeepers, and foreign aid have played in both the development process, during and after major conflicts. d) Lastly, we'll look at the human rights abuses suffered by people in selected countries and the policies pursued to confront the abusers known as Transitional Justice Policies

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Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90798	ENVRNMNTL POL & PLNG	GR	Environmental Policy and Planning provides an introduction to how environmental policies have been and can be designed/created implemented and evaluated amidst complex information-based social political and cultural processes. The course emphasizes a systems-based methodological approach for addressing the complexities involved in framing analyzing and designing an implementation plan for policy construction. The course also explores through landmark and contemporary case studies several dimensions of environmental policymaking: * Contextual historical and structural aspects of environmental policymaking at the local state federal and international levels * Use of quantitative and qualitative analytical tools (from the core program as well as new tools) * The process of how policies derive their meaning. Students in this course work on a final environmental policy project to demonstrate mastery of the knowledge and skill-based exercises explored during the term.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90808	ENERGY POLICY	GR	This seminar will provide an introduction to modern U.S. energy policy. Our goal will be to understand, from a practical perspective, how economics, , technology, politics, public opinion, national security, and environmental / climate considerations all influence the development and implementation of policy. Questions that we will address include: How has U.S. energy policy changed over the years and what lessons have we learned from past initiatives? How much influence does government really have? How have new technologies changed the energy landscape? What priority do national leaders give to energy policy? And how does energy policy impact our relationships with other countries? The class will begin with an overview of the energy sector and the related government structure. After covering some historical context, we will discuss Presidential initiatives and legislative activity, with a particular focus on more recent activities. We will then consider some case studies, such as the Keystone Pipeline, EPA's Clean Power Plan, and the development of the Marcellus Shale, that demonstrate conflicting viewpoints about appropriate energy policy. The class will also explore international energy issues like exports of liquefied natural gas and crude oil exports, as well as the Paris Climate Agreement. This course is a seminar class; I will provide a framework and then guide a discussion among the students. Depending on the particular class session, we will have individual or group presentations. Your preparation and participation is essential. Each session will begin with a short review and discussion of current events in the energy sector. We will also hear from guest speakers, including a number of current and former senior government officials.

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Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90817	EDUC FIN AND PLCY	GR	The purpose of this Heinz course is to introduce professional master's students to the special problems of financing regional governments in a decentralized federal system with a special focus on public education. The course i] reviews theories of federalism from economic and constitutional perspectives, ii] reviews the evolution of the United States from a confederation to a federation, iii] examines financial and political problems associated with jointure, iv] reviews alternative rationales for public financing and provision of education (k-16), v] analyzes distressed school systems and municipal governments, vi] reviews the international evidence on estimated economic returns and distributional effects of k-16 public education and the use of cost-effectiveness and educational production functions, vii] school budgeting issues, viii] the school property tax, ix] intergovernmental relations and the design of school aid formulas, and x] the measurement and implications of student achievement. These issues are examined from positive and normative perspectives, and through the lens of economics and political economy. .Read More
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90822	CRIT ANA POL RES	GR	This course prepares students to understand, interpret, and critique existing policy research. The course focuses on the development of three essential skills for policy analysts: 1) Read and interpret empirical results in published research. 2) Understand the assumptions needed to infer causal relationships and assess their plausibility. 3) Recognize common problems in policy research, including reverse causality, omitted variables, measurement error, etc., and use graphical methods to determine the direction of the resulting statistical bias. Using these three skills, students will practice understanding and critiquing policy research. Moreover, by identifying and understanding potential problems, students can make valid conclusions even from seriously flawed research. At the end of the class, students demonstrate these skills by independently evaluating an existing piece of research of their choice, presenting their findings in a written report and in-class presentation.

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Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90831	ADV FIN MGT HLTH CRE	GR	This mini-course builds upon the students learning basis from Financial Statements & Analysis of Companies (course 90-723). Advanced Financial Management of Health Care is designed to provide students with a general understanding of health systems financial management - including a conceptual framework, financial tools, and management techniques. The subjects covered will provide the background and analytic skills for students to evaluate select financial matters encountered in the overall management of health systems. The course includes lectures, substantial reading assignments and real world examples and discussions. Initial lectures include a historical perspective on health systems financial management issues, including the evolution of third party payors and various payment/reimbursement systems. This will also include issues impacting payments received from Medicare and commercial managed care insurers. Lectures will focus on federal and state health care policy decisions and the increasing impact on health systems finances. This background section will also include a theoretical and practical review of standard health systems financial management reports and effective techniques for using them. The course includes a section on integrated delivery systems and the currently evolving accountable care organizations arrangements between hospitals, physician organizations, long term care providers and managed care insurers. It will also address a number of initiatives the Center for Medicare and Medicaid Services (CMS) has in process or has proposed.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90832	HEALTH LAW	GR	This course introduces students to the laws that impact the provision of health care services. With the increasing intersection between health care and the law, executives and others involved in the administration and delivery of health care services are likely to encounter a wide range of legal and regulatory issues, particularly as the fate of the Affordable Care Act is debated. This course is designed to provide students with the practical knowledge needed to identify legal issues inherent in health care and to understand the legal ramifications of administrative and management decisions. Specific course topics include: sources of law, the US court system and legal procedures, professional and institutional liability, governmental regulatory methods, antitrust law, fraud laws, corporate compliance programs, issues concerning informed consent, credentialing of medical professionals, termination of care, and health care reform. Upon completion of this course the student should be able to: 1. Explain the US legal system and sources of law in the United States. 2. Recognize and apply laws, regulations, and policies that govern the administration and delivery of health care services. 3. Identify potential legal ramifications of health care management and administrative decisions. 4. Identify issues that warrant seeking the assistance of legal counsel.

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Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90833	POPULATION HEALTH	GR	It is a societal imperative that we improve the quality of health for all Americans while reducing the cost. In so doing, we must move from a reactionary, disease driven, hospital-dominated model to one that creates the appropriate level of incentives and health delivery infrastructure so that patients embrace strategies to prevent disease and promote healthy living and behavior. What is Population Health and what role do individuals, executive branch agencies, and non-profits play in the protection and promotion of positive health outcomes? How are health outcomes assessed? In this introductory course, we will examine the way health care delivery systems, public health agencies, community-based organizations, and many other entities work together to develop interventions to improve the health outcomes in the local, national, and global communities they serve. We will first learn to examine health issues from a population health perspective.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90834	HEALTH CARE GIS	GR	A geographic information system (GIS) provides an effective way to visualize, organize and manage a wide variety of information including administrative and medical record data, social services, and other location data. Public health departments, hospitals, and medical research agencies are using GIS to map health-related events, identify disease clusters, investigate environmental health problems, and understand the spread of disease. This course uses a unique approach for teaching GIS in health care. It imbeds learning how to use GIS software in the context of carrying out projects for visualizing and analyzing health-related data. Each week includes lectures and computer labs that focus on a health, technical, or policy issue which use Esri's ArcGIS Pro and Platform technologies to analyze data or solve a problem. Students learn to create Story Maps to convey their maps and associated text to the public and decision makers. Through assignments and projects students will not only learn how to use the software but will also learn the many distinctive advantages of using GIS for health care policy making and planning. By the end of the course, students will have sufficient background so that they can become expert users of GIS in health care organizations - building, managing, and using GIS maps and health data. Prerequisites: 90-728 Introduction to Database Management, 91-802 Information Systems for Managers or permission of instructor.

Department	College	Course #	Course Title	Grad/UG	Description
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90836	HEALTH POL & MGT SYS	GR	Health Systems is a foundation course intended to introduce students to many of the broad subjects that will be detailed in more advanced course work. This introduction provides a framework to aid students in navigating from public policy through to healthcare delivery. Public policy is the study of the written and unwritten principles on which law is based. Laws and regulations translate policy into action. Public policy and laws form the basis of health policy. Health policy is supported by: - Public health initiatives focused on preventing disease, prolonging life and promoting health for the entire population. (i.e. diabetes awareness) - Population health is interested in the outcomes of individual groups and the distribution of outcomes among the groups. (i.e. income equality and infant mortality) - Healthcare delivery is focused on access, quality and cost. At this time in our history, Healthcare Reform best embodies the intent of this aspect of health policy. Through the use of group assignments, students will create a model which links external environment into healthcare delivery profitability. Modeling is a form of combining individual technical components with the greater knowledge and conceptualization of the entire process. Its promise is to promote better decision making by envisioning how micro decisions interconnect to mission, goals and outcomes. Utilizing the two textbook books, students will gain an understanding of the topics of health policy, public health, population health and healthcare
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90842	PUBLIC POL IMPLEMENT	GR	Presidents governors legislators elected officials and judges have issued orders passed laws approved policies and set goals for hundreds of years. But approving or legislating the most enlightened public policy or program does not guarantee that it will be implemented in an effective way -- or even in the way intended by the policy maker. Rarely are the people who make public policy decisions the ones who implement those decisions. In a democratic government saying it is does not make it so! This course is designed to study review and analyze policy implementation in the public sector. This is a look at government bureaucracy! In a democratic society how does one effectively get from the declaration of a policy to its implementation particularly when implementation has been such a low priority for our elected officials? Implementation involves the complex interactions of many elements: translating ideas into workable programs; making decisions for both program design and operation; communicating with both constituencies and affected decision-makers; overcoming the resistance of bureaucrats; and assessing and evaluating the results. Examples of programs and policies will be used throughout the course. Each student as a member of a team will develop an implementation plan for a selected policy or program. The course will also involve lots of reading that highlight implementation issues. ...Read More

Department	College	Course #	Course Title	Grad/UG	Description
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90843	UN DEV TOOL SUS DEV	GR	Economic development is driven largely by funding and financing opportunities. Nearly every redevelopment, business expansion, community facility and infrastructure project hinges on the availability of affordable, patient and flexible capital. When addressing sustainability in economic development, funding and finance are even more critical. The lack of funding and finance can result in the ability for projects and programs to move forward in an effective manner. From the bedrock tools like bonds and targeted tool like tax increment to tax credit investment and access to capital lending programs, the development finance toolbox provides financing options that cover the entire development continuum. Unlocking the Development Finance Toolbox to Support Sustainable Economic Development will explore the intersection of development, sustainability and finance with an in depth review of the financing tools that catalyze and drive job growth and economic expansion. This course will not only explore the tools behind effective development but also examine success projects and programs that are driving communities towards a sustainable future. COURSE MEETS March 3 and 4.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90850	SOCIETAL CONSEQNCES	GR	Note: Course will meet on: February 17 & 18, 2018 This "micro class" is a two-day dive into the future of K-12 education, a $600 billion industry in the U.S. affecting the lives of over 55 million children every year. The class focuses on the intersection of education and technology, and its implications for the future of how we teach, learn, and live. Students will learn about the promise of "personalization", a big idea with the potential to change the management model that has organized schooling for more than a century. They'll be exposed to research and reform efforts, including some happening here at CMU, to apply technology and cognitive learning to improve how we teach and learn, and to anticipate ways technology could facilitate new ways of organizing the experience of school. Then they'll unpack these ideas to identify future scenarios, their implications, and anticipate how the benefits and costs would likely be distributed. Participants will identify actions that could be taken to improve the potential effect on the human condition, mitigating the risks and maximizing the benefits across many stakeholders, including those who have been historically marginalized and disadvantaged. As part of the experience, students will be challenged to apply the skills they are learning in their courses, and will experience facilitation techniques they are likely to find useful in their own careers, whatever field they ultimately pursue. The course will meet for two fun and intense days - February 18 and 19, 2018. The grade will be based on participation (including peer feedback and self-reflection) and assignments completed during the two days as well as pre-work leading up to the experience and afterwards to complete the group project and bring closure to the learning.

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Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90852	HIGH RELIABIL HTHCRE	GR	Health care in the United States is largely delivered in systems of care that are complex, inefficient, error prone, and costly. There currently exists a high degree of variability in the delivery of care between providers and settings of care. Other industries outside of health care have been successful at reducing inefficiencies and eliminating waste through the standardization of processes. High reliability in Healthcare is a 6-unit mini course that will provide students with insight into the unique aspects of the health care environment and the necessary skills to successfully facilitate change in health care organizations. The course will explore elements of highly reliable organizations, culture of safety in the healthcare environment, the evolving science of quality improvement, and the use of clinical pathways to drive high-value health care.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90854	SOCIETAL CONSEQUENCE	GR	*This course will meet the weekend of February 3 and 4.* This "micro class" is a deep-dive into the impact of rapidly developing autonomous vehicle technology and the consequences for the way cities look and work. Students will be exposed to the research, development and deployment of vehicle technology happening right here at CMU. They'll apply that understanding to developing scenarios of what the impact on the City of Pittsburgh may be, with particular emphasis on the major employment center of the region, i.e. the City's Central Business District (i.e. downtown.) In addition to gaining an appreciation of the technology in developing future scenarios, students will have to explore the way urban space is used (e.g. parking) and may be reused; how work changes with new technology; and how transportation modal mix and residential location may change. Students will be expected to explore interventions that could change the direction of potential impacts of their various scenarios. As part of the experience, students will be challenged to apply the skills they are learning in their courses, and will experience facilitation techniques they are likely to find useful in their own careers whatever field they ultimately pursue. The majority of the grade for the based on participation (including peer feedback and self-reflection) and assignments completed during the two days. There will be some pre-work leading up to the two-day and then ten days afterwards to bring closure to the experience.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90860	POLICY GLOBAL ECONMY	GR	As global economic integration reaches historically unprecedented levels international trade exerts an ever greater influence on national economies. In this environment international trade affects the challenges faced by nearly all policy makers and managers including those addressing poverty growth development labor inequality and the environment. This course provides policy makers and managers with the knowledge and analytical tools necessary to understand international trading relationships and their effects. These issues will be studied using the analytical tools and concepts of international economics. Case studies will be used to implement these concepts in practice....Read More

Department	College	Course #	Course Title	Grad/UG	Description
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90880	BEHAVIORAL ECONOMICS	GR	This course introduces students to behavioral economics, an emerging subfield of economics that incorporates insights from psychology and other social sciences into economics. We will examine evidence on how human behavior systematically departs from the standard assumptions of economics, and then investigate attempts by behavioral economists to improve economic analyses.
Public Policy & Mgt:Sch of Pub Pol & Mgt	HC	90882	BEHVL ECONM PUBL PLY	GR	"Economics has up to now been the social science that has been most broadly and deeply involved in public policy. With its rational choice perspective, the economic perspective has tended to favor certain types of policies, namely those that enhance the efficiency of market mechanisms and lower the cost of information. In this course we will spend the first several classes reviewing the assumptions, implications for public policy, and limitations of the rational choice perspective. The remainder of the course will then be devoted to examining different public policy issues, including saving, health care, crime and drug abuse, through the competing lenses of traditional and behavioral economics."
					SCS Interdisciplinary 1
SCS Interdisciplinary	SCS	7128	FRSHMN IMGRATN COURS	UG	The Freshman Immigration Course is taken by first-semester Computer Science majors on the Pittsburgh campus. The course is designed to acquaint incoming majors with computer science at CMU. Talks range from historical perspectives in the field to descriptions of the cutting edge research being conducted in the School of Computer Science. Enrollment is limited to SCS Freshmen ONLY.
					SCS: Computational Biology 9
SCS: Computational Biology	SCS	2319	GENOMICS & EPIGEN BRAIN	UG	This course will provide an introduction to genomics, epigenetics, and their application to problems in neuroscience. The rapid advances in genomic technology are in the process of revolutionizing how we conduct molecular biology research. These new techniques have given us an appreciation for the role that epigenetics modifications of the genome play in gene regulation, development, and inheritance. In this course, we will cover the biological basis of genomics and epigenetics, the basic computational tools to analyze genomic data, and the application of those tools to neuroscience. Through programming assignments and reading primary literature, the material will also serve to demonstrate important concepts in neuroscience, including the diversity of neural cell types, neural plasticity, the role that epigenetics plays in behavior, and how the brain is influenced by neurological and psychiatric disorders. Although the cours

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Computational Biology	SCS	2510	COMPUTATNL GENOMICS	UG	Dramatic advances in experimental technology and computational analysis are fundamentally transforming the basic nature and goal of biological research. The emergence of new frontiers in biology, such as evolutionary genomics and systems biology is demanding new methodologies that can confront quantitative issues of substantial computational and mathematical sophistication. In this course we will discuss classical approaches and latest methodological advances in the context of the following biological problems: 1) sequence analysis, focusing on gene finding and motifs detection, 2) analysis of high throughput molecular data, such as gene expression data, including normalization, clustering, pattern recognition and classification, 3) molecular and regulatory evolution, focusing on phylogenetic inference and regulatory network evolution, 4) population genetics, focusing on how genomes within a population evolve through recombination, mutation, and selection to create various structures in modern genomes and 5) systems biology, concerning how to combine diverse data types to make mechanistic inferences about biological processes. From the computational side this course focuses on modern machine learning methodologies for computational problems in molecular biology and genetics, including probabilistic modeling, inference and learning algorithms, data integration, time series analysis, active learning, etc. This course may be taken for 12 units, which requires completion of a course project, or for 9 units, which does not.
SCS: Computational Biology	SCS	2518	COMP MEDICINE	UG	Modern medical research increasingly relies on the analysis of large patient datasets to enhance our understanding of human diseases. This course will focus on the computational problems that arise from studies of human diseases and the translation of research to the bedside to improve human health. The topics to be covered include computational strategies for advancing personalized medicine, pharmacogenomics for predicting individual drug responses, metagenomics for learning the role of the microbiome in human health, mining electronic medical records to identify disease phenotypes, and case studies in complex human diseases such as cancer and asthma. We will discuss how machine learning methodologies such as regression, classification, clustering, semi-supervised learning, probabilistic modeling, and time-series modeling are being used to analyze a variety of datasets collected by clinicians. Class sessions will consist of lectures, discussions of papers from the literature, and guest presentations by clinicians and other domain experts. Grading will be based on homework assignments and a project. 02-250 is a suggested pre-requisite.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Computational Biology	SCS	2601	PRGRMMING SCIENTISTS	GR	Provides a practical introduction to programming for students with little or no prior programming experience who are interested in science. Fundamental scientific algorithms will be introduced, and extensive programming assignments will be based on analytical tasks that might be faced by scientists, such as parsing, simulation, and optimization. Principles of good software engineering will also be stressed, *and students will have the opportunity to design their own programming project on a scientific topic of their course*. The course will introduce students to the Go programming language, an industry-supported, modern programming language, the syntax of which will be covered in depth. Other assignments will be given in other programming languages such as Python and Java to highlight the commonalities and differences between languages. No prior programming experience is assumed, and no biology background is needed. Analytical skills and mathematical maturity are required. Course not open to CS majors.02-250 is a suggested pre-requisite.
SCS: Computational Biology	SCS	2602	PROF ISSUES COMP BIO	GR	This course gives MS in Computational Biology students an opportunity to develop professional skills necessary for a successful career in computational biology. This course will include assistance with resume writing, interview preparation, presentation skills, and job search techniques. This course will also include opportunities to network with computational biology professionals and academic researchers. This course will meet once a week. This course is pass/fail only. Grading scheme will be discussed on first day of class.
SCS: Computational Biology	SCS	2718	COM MEDICINE	GR	Modern medical research increasingly relies on the analysis of large patient datasets to enhance our understanding of human diseases. This course will focus on the computational problems that arise from studies of human diseases and the translation of research to the bedside to improve human health. The topics to be covered include computational strategies for advancing personalized medicine, pharmacogenomics for predicting individual drug responses, metagenomics for learning the role of the microbiome in human health, mining electronic medical records to identify disease phenotypes, and case studies in complex human diseases such as cancer and asthma. We will discuss how machine learning methodologies such as regression, classification, clustering, semi-supervised learning, probabilistic modeling, and time-series modeling are being used to analyze a variety of datasets collected by clinicians. Class sessions will consist of lectures, discussions of papers from the literature, and guest presentations by clinicians and other domain experts. Grading will be based on homework assignments and a project. 02-250 is a suggested pre-requisite.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Computational Biology	SCS	2719	GENOMICS AND EPIGENE	GR	This course will provide an introduction to genomics, epigenetics, and their application to problems in neuroscience. The rapid advances in genomic technology are in the process of revolutionizing how we conduct molecular biology research. These new techniques have given us an appreciation for the role that epigenetics modifications of the genome play in gene regulation, development, and inheritance. In this course, we will cover the biological basis of genomics and epigenetics, the basic computational tools to analyze genomic data, and the application of those tools to neuroscience. Through programming assignments and reading primary literature, the material will also serve to demonstrate important concepts in neuroscience, including the diversity of neural cell types, neural plasticity, the role that epigenetics plays in behavior, and how the brain is influenced by neurological and psychiatric disorders. Although the course focuses on neuroscience, the material is accessible and applicable to a wide range of topics in biology.
SCS: Computational Biology	SCS	2730	CELL SYSTMS MODELING	GR	This course will introduce students to the theory and practice of modeling biological systems from the molecular to the organism level with an emphasis on intracellular processes. Topics covered include kinetic and equilibrium descriptions of biological processes, systematic approaches to model building and parameter estimation, analysis of biochemical circuits modeled as differential equations, modeling the effects of noise using stochastic methods, modeling spatial effects, and modeling at higher levels of abstraction or scale using logical or agent-based approaches. A range of biological models and applications will be considered including gene regulatory networks, cell signaling, and cell cycle regulation. Weekly lab sessions will provide students hands-on experience with methods and models presented in class. Course requirements include regular class participation, bi-weekly homework assignments, a take-home exam, and a final project. Prerequisites: The course is designed for graduate and upper-level undergraduate students with a wide variety of backgrounds. The course is intended to be self-contained but students may need to do some additional work to gain fluency in core concepts. Students should have a basic knowledge of calculus, differential equations, and chemistry as well as some previous exposure to molecular biology and biochemistry. Experience with programming and numerical computation is useful but not mandatory. Laboratory exercises will use MATLAB as the primary modeling and computational tool augmented by additional software as needed. *THIS COURSE WILL BE AT PITT

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Computational Biology	SCS	2760	LAB METHODS COMP BIO	GR	Computational biologists frequently focus on analyzing and modeling large amounts of biological data, often from high-throughput assays or diverse sources. It is therefore critical that students training in computational biology be familiar with the paradigms and methods of experimentation and measurement that lead to the production of these data. This one-semester laboratory course gives students a deeper appreciation of the principles and challenges of biological experimentation. Students learn a range of topics, including experimental design, structural biology, next generation sequencing, genomics, proteomics, bioimaging, and high-content screening. Class sessions are primarily devoted to designing and performing experiments in the lab using the above techniques. Students are required to keep a detailed laboratory notebook of their experiments and summarize their resulting data in written abstracts and oral presentations given in class-hosted lab meetings. With an emphasis on the basics of experimentation and broad views of multiple cutting-edge and high-throughput techniques, this course is appropriate for students who have never taken a traditional undergraduate biology lab course, as well as those who have and are looking for introductory training in more advanced approaches. Grading: Letter grade based on class participation, laboratory notebooks, experimental design assignments, and written and oral presentations. 02-250 is a suggested pre-requisite.
					SCS: Computer Science 6
SCS: Computer Science	SCS	15294	ST: RAPID PROTYP TEC	UG	This mini-course introduces students to rapid prototyping technologies with a focus on laser cutting and 3D printing. The course has three components: 1) A survey of rapid prototyping and additive manufacturing technologies, the maker and open source movements, and societal impacts of these technologies; 2) An introduction to the computer science behind these technologies: CAD tools, file formats, slicing algorithms; 3) Hands-on experience with SolidWorks, laser cutting, and 3D printing, culminating in student projects (e.g. artistic creations, functional objects, replicas of famous calculating machines, etc.). Please note that there will be a usage/materials fee for this course.
SCS: Computer Science	SCS	15316	SFTWR FNDTN SEC PRIV	UG	Security and privacy issues in computer systems continue to be a pervasive issue in technology and society. Understanding the security and privacy needs of software, and being able to rigorously demonstrate that those needs are met, is key to eliminating vulnerabilities that cause these issues. Students who take this course will learn the principles needed to make these assurances about software, and some of the key strategies used to make sure that they are correctly implemented in practice. Topics include: policy models and mechanisms for confidentiality, integrity, and availability, language-based techniques for detecting and preventing security threats, mechanisms for enforcing privacy guarantees, and the interaction between software and underlying systems that can give rise to practical security threats. Students will also gain experience applying many of these techniques to write code that is secure by construction.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Computer Science	SCS	15388	PRACTICAL DATA SCI	UG	Data science is the study and practice of how we can extract insight and knowledge from large amounts of data. This course provides a practical introduction to the "full stack" of data science analysis, including data collection and processing, data visualization and presentation, statistical model building using machine learning, and big data techniques for scaling these methods. Topics covered include: collecting and processing data using relational methods, time series approaches, graph and network models, free text analysis, and spatial geographic methods; analyzing the data using a variety of statistical and machine learning methods include linear and non-linear regression and classification, unsupervised learning and anomaly detection, plus advanced machine learning methods like kernel approaches, boosting, or deep learning; visualizing and presenting data, particularly focusing the case of high-dimensional data; and applying these methods to big data settings, where multiple machines and distributed computation are needed to fully leverage the data.Students will complete weekly programming homework that emphasize practical understanding of the methods described in the course. In addition, students will develop a tutorial on an advanced topic, and will complete a group project that applies these data science techniques to a practical application chosen by the team; these two longer assignments will be done in lieu of a midterm or final.
SCS: Computer Science	SCS	15483	ST:TRTH, JST, ALGRTH	UG	Truth, Justice, and Algorithms is an interdisciplinary course that covers selected theoretical topics at the interface of computer science and economics, focusing on the algorithmic side of incentives and fairness. The course's topics include: computational social choice, e.g., voting rules as maximum likelihood estimators, the axiomatic approach to ranking systems and crowdsourcing, manipulation of elections and ways to circumvent it; cooperative games, focusing on solution concepts such as the core and the Shapley value, and their computation; fair division algorithms for allocating divisible and indivisible goods, and approximate notions of fairness; online matching algorithms (competitive analysis, not dating) and kidney exchange; noncooperative games, including Nash equilibrium and correlated equilibrium, their computation, connections to learning theory, Stackelberg security games, and the price of anarchy in congestion and routing games; and topics in social networks such as the diffusion of technologies and influence maximization. NOTE: This course is cross-listed with 15-896. Undergraduates may enroll into 15-896 but be aware of work load difference. The two courses are identical in terms of lectures, content, and homework assignments. The only difference is in the final project requirement. In 483, students will prepare a summary of several papers -- this will require 10-20 hours of work. In 896, students will carry out a research project with the goal of obtaining novel results, and present their results in class -- a good project will require 50-60 hours of work. Also note that 483 is 9 units, and 896 is 12 units.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Computer Science	SCS	15604	IMMIGRATION COURSE	GR	This is a discussion course with enrollment limited to MS in CS students during their first semester in the program. Students explore the scope of graduate education in computer science, the tools and techniques for success, and the resources available to MS in CS students. Students also explore life after graduation, including careers in academia, industry, and other organizations, and plan an academic program that supports their individual goals.
SCS: Computer Science	SCS	15896	TRUTH, JUSTICE & ALG	GR	Truth, Justice, and Algorithms is an interdisciplinary course that covers selected theoretical topics at the interface of computer science and economics. The course's topics include: computational social choice, e.g., voting rules as maximum likelihood estimators, the axiomatic approach to ranking systems and crowdsourcing, manipulation of elections and ways to circumvent it; cooperative games, focusing on solution concepts such as the core and the Shapley value, and their computation; fair division algorithms for allocating divisible and indivisible goods, and approximate notions of fairness; online matching algorithms (competitive analysis, not dating) and kidney exchange; noncooperative games, including Nash equilibrium and correlated equilibrium, their computation, connections to learning theory, Stackelberg security games, and the price of anarchy in congestion and routing games; and topics in social networks such as the diffusion of technologies and influence maximization. Please refer to https://www.cs.cmu.edu/~csd-grad/courseschedules16.html this link for the most recent schedule updates. Description:
				SCS: Human-Computer Interaction	22
SCS: Human-Computer Interaction	SCS	5291	LRNG MEDIA DESIGN	UG	[IDeATe collaborative course] Learning is a complex human phenomenon with cognitive, social and personal dimensions that need to be accounted for in the design of technology enhanced learning experiences. In this studio course students will apply learning science concepts to critique existing forms of learning media, establish a set of design precedents to guide project work and produce a series of design concepts that support learning interactions in a real-world context. Collaborating in small interdisciplinary teams, students will partner with a local informal learning organization (e.g. museum, after school program provider, maker space) to conduct learning design research studies, synthesize findings, establish learning goals and iteratively prototype and assess design concepts. As final deliverables, students will present their design research findings, design concepts, and prototypes to stakeholders, and draft a media-rich proposal for their learning media concept to pitch to a local funder. Please note that there may be usage/materials fees associated with this course. Please note that there may be usage/materials fees associated with this course.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Human-Computer Interaction	SCS	5292	LEARNING MEDIA MTHDS	UG	Learning Media Methods brings together students from across the disciplines to consider the design of mediated learning experiences though a project-based inquiry course. Students will be introduced to a range of design research methods and associated frameworks that explore the cognitive, social and affective dimensions of learning in everyday contexts through readings, invited lectures, in-class activities and assignments. Students will conduct a series of short design research studies to define learning goals and develop supporting design concepts that improve learning outcomes for diverse participants in informal learning settings (e.g. museums, after school programs, maker spaces or online). In concept development, we will look at how to position technology and question its role in the setting to engage and foster positive learning interactions. This course will work in tandem with 80-292 Learning Science Principles and will culminate in a media-rich presentation of design concepts to a stakeholder audience, and include an evaluation plan describing how learning outcomes for the project would be assessed.
SCS: Human-Computer Interaction	SCS	5391	DES HUMN CENTRD SFTW	UG	Why are things so hard to use these days? Why doesn't this thing I just bought work? Why is this web site so hard to use? These are frustrations that we have all faced from systems not designed with people in mind. The question this course will focus on is: how can we design human-centered systems that people find useful and usable? This course is an introduction to designing, prototyping, and evaluating user interfaces. If you take only one course in Human-Computer Interaction, this is the course for you. This class is a core course for undergrads in the HCI Minor but open to all undergrads and grad students, with either technical or non-technical backgrounds. We will cover theory as well as practical application of ideas from Human-Computer Interaction. Course work includes lectures, class discussion, homework, class presentations, and group project. Students will need a prerequisite of a fundamental computer programming course.
SCS: Human-Computer Interaction	SCS	5392	INTERACTN DESGN OVRV	UG	This studio course offers a broad overview of communication and interaction design. Students will learn design methodologies such as brainstorming, sketching, storyboarding, wire framing, and prototyping. Students learn to take a human-centered design approach to their work. Assignments include short in-class exercises as well as individual and team-based projects. Students take part in studio critiques, engaging in critical discussions about the strengths and weaknesses of their own work and the work of others. No coding is required.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Human-Computer Interaction	SCS	5395	APPLCTNS COG SCIENCE	UG	The goal of this course is to examine cases where basic research on cognitive science, including cognitive neuroscience, has made its way into application, in order to understand how science gets applied more generally. The course focuses on applications that are sufficiently advanced as to have made an impact outside of the research field per se; for example, as a product, a change in practice, or a legal statute. Examples are virtual reality (in vision, hearing, and touch), cognitive tutors, phonologically based reading programs, latent semantic analysis applications to writing assessment, and measures of consumers' implicit attitudes. The course will use a case-study approach that considers a set of applications in detail, while building a general understanding of what it means to move research into the applied setting. The questions to be considered include: What makes a body of theoretically based research applicable? What is the pathway from laboratory to practice? What are the barriers - economic, legal, entrenched belief or practice? The format will emphasize analysis and discussion by students. They should bring to the course an interest in application; extensive prior experience in cognitive science is not necessary. The course will include tutorials on basic topics in cognitive science such as perception, memory, and spatial cognition. These should provide sufficient grounding to discuss the applications.
SCS: Human-Computer Interaction	SCS	5410	USER-CN RSRCH EVALN	UG	This course provides and overview and introduction to the field of human-computer interaction (HCI). It introduces students to tools, techniques, and sources of information about HCI and provides a systematic approach to design. The course increases awareness of good and bad design through observation of existing technology, and teaches the basic skills of task analysis, and analytic and empirical evaluation methods. This is a companion course to courses in visual design (51-422) and software implementation (05-430, 05-431). When registering for this course, undergraduate students are automatically placed the wait list. Students will be then moved into the class, based on if they are in the BHCI second major and year in school e.g. seniors, juniors, etc This course is NOT open to students outside the HCI major. When registering for this course, undergraduate students are automatically placed the wait list. Students will be then moved into the class, based on if they are in the BHCI second major and year in school. This course is a core requirement for students in the HCI additional major.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Human-Computer Interaction	SCS	5413	HUMAN FACTORS	UG	This course uses theory and research from human factors, cognitive science, and social science to understand and design the interactions of humans with the built world, tools, and technology. The course emphasizes current work in applied domains such as automotive design, house construction, medical human factors, and design of information devices. The course also will emphasize not only individual human factors (e.g., visual response, anthropometry) but also the organizational arrangements that can amplify or correct human factors problems. Through reading, discussion, and projects, you will learn about human perceptual, cognitive, and physical processes that affect how people interact with, and use, technology and tools. You will learn why we have so many automobile accidents, voting irregularities, and injuries from prescription medication. You will learn some tried and true solutions for human factors problems, and some of the many problems in human factors that remain. You will also have gained experience in research in this field.
SCS: Human-Computer Interaction	SCS	5418	DESIGN EDUCTNL GAMES	UG	The potential of digital games to improve education is enormous. However, it is a significant challenge to create a game that is both fun and educational. In this course, students will learn to meet this challenge by combining processes and principles from game design and instructional design. Students will also learn to evaluate their games for fun, learning, and the integration of the two. They will be guided by the EDGE framework for the analysis and design educational games. The course will involve a significant hands-on portion, in which students learn a design process to create educational games ? digital or non-digital. They will also read about existing educational games and discuss game design, instructional design, learning and transfer, and the educational effectiveness of digital games. They will analyze an educational game and present their analysis to the class.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Human-Computer Interaction	SCS	5432	PERSONL ONLN LEARNG	UG	Online learning has become widespread (e.g., MOOCs, online and blended courses, and Khan Academy) and many claim it will revolutionize higher education and K-12. How can we make sure online learning is maximally effective? Learners differ along many dimensions and they change over time. Therefore, advanced learning technologies must adapt to learners to provide individualized learning experiences. This course covers a number of proven personalization techniques used in advanced learning technologies. One of the techniques is the use of cognitive modeling to personalize practice of complex cognitive skills in intelligent tutoring systems. This approach, developed at CMU, may well be the most significant application of cognitive science in education and is commercially successful. We will also survey newer techniques, such as personalizing based on student meta-cognition, affect, and motivation. Finally, we will look at personalization approaches that are widely believed to be effective but have not proven to be so. The course involves readings and discussion of different ways of personalizing instruction, with an emphasis on cognitive modeling approaches. Students will learn to use the Cognitive Tutor Authoring Tools (CTAT, http://ctat.pact.cs.cmu.edu) to implement tutor prototypes that rely on computer-executable models of human problem solving to personalize instruction. The course is meant for graduate or advanced undergraduate students in Human-Computer Interaction, Psychology, Computer Science, Design, or related fields, who are interested in educational applications. Students should either have some programming skills or experience in the cognitive psychology of human problem solving, or experience with instructional design.
SCS: Human-Computer Interaction	SCS	5436	USUABLE PRV SECURITY	UG	There is growing recognition that technology alone will not provide all of the solutions to security and privacy problems. Human factors play an important role in these areas, and it is important for security and privacy experts to have an understanding of how people will interact with the systems they develop. This course is designed to introduce students to a variety of usability and user interface problems related to privacy and security and to give them experience in designing studies aimed at helping to evaluate usability issues in security and privacy systems. The course is suitable both for students interested in privacy and security who would like to learn more about usability, as well as for students interested in usability who would like to learn more about security and privacy. Much of the course will be taught in a graduate seminar style in which all students will be expected to do a weekly reading assignment and each week different students will prepare a presentation for the class. Students will also work on a group project throughout the semester. The course is open to all graduate students who have technical backgrounds. The 12-unit course numbers (08-734 and 5-836) are for PhD students and masters students. Students enrolled in these course numbers will be expected to play a leadership role in a group project that produces a paper suitable for publication. The 9-unit 500-level course numbers (08-534 and 05-436) are for juniors, seniors, and masters students. Students enrolled in these course numbers will have less demanding project and presentation requirements.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Human-Computer Interaction	SCS	5452	SERVICE DESIGN	UG	In this course, we will collectively define and study services and product service systems, and learn the basics of designing them. We will do this through lectures, studio projects, and verbal and written exposition. Classwork will be done individually and in teams.
SCS: Human-Computer Interaction	SCS	5610	USER-CN RSRCH EVALN	GR	This course provides and overview and introduction to the field of human-computer interaction (HCI). It introduces students to tools, techniques, and sources of information about HCI and provides a systematic approach to design. The course increases awareness of good and bad design through observation of existing technology, and teaches the basic skills of task analysis, and analytic and empirical evaluation methods. This is a companion course to courses in visual design (05-650) and software implementation (05-630, 05-631). This course is NOT open to students outside of the MHCI program.
SCS: Human-Computer Interaction	SCS	5630	PRGMG USABLE INTFCE	GR	This course is combines lecture, and an intensive programming lab and design studio. It is for those who want to express their interactive ideas in working prototypes. It will cover the importance of human-computer interaction/interface design, iterative design, input/output techniques, how to design and evaluate interfaces, and research topics that will impact user interfaces in the future. In lab, you will learn how to design and program effective graphical user interfaces, and how to perform user tests. We will cover a number of prototyping tools and require prototypes to be constructed in each, ranging from animated mock-ups to fully functional programs. Assignments will require implementing UIs, testing that interface with users, and then modifying the interface based on findings. Some class sessions will feature design reviews of student work. This course is for HCII Masters students and HCI dual majors with a minimal programming background. Students will often not be professional programmers, but will need to interact with programmers. RECITATION SELECTION: Students taking this course can sign up for either Prototyping Lab recitation. PREREQUISITES: Proficiency in a programming language, program structure, algorithm analysis, and data abstraction. Normally met through an introductory programming course using C, C++, Pascal or Java, such as 15100, 15112, 15127 or equivalent. Students entering this course should be able to independently write a 300-line program in 48 hours.
SCS: Human-Computer Interaction	SCS	5652	SERVICE DESIGN	GR	In this course, we will collectively define and study services and product service systems, and learn the basics of designing them. We will do this through lectures, studio projects, and verbal and written exposition. Classwork will be done individually and in teams.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Human-Computer Interaction	SCS	5691	LRNG MEDIA DESIGN	GR	Learning is a complex human phenomenon with cognitive, social and personal dimensions that need to be accounted for in the design of technology enhanced learning experiences. In this studio course students will apply learning science concepts to critique existing forms of learning media, establish a set of design precedents to guide project work and produce a series of design concepts that support learning interactions in a real-world context. Collaborating in small interdisciplinary teams, students will partner with a local informal learning organization (e.g. museum, after school program provider, maker space) to conduct learning design research studies, synthesize findings, establish learning goals and iteratively prototype and assess design concepts. As final deliverables, students will present their design research findings, design concepts, and prototypes to stakeholders, and draft a media-rich proposal for their learning media concept to pitch to a local funder. Please note that there may be usage/materials fees associated with this course. Please note that there may be usage/materials fees associated with this course.
SCS: Human-Computer Interaction	SCS	5775	COG PERSPECTIVES HCI	GR	One of a series of four, seminar style mini-courses, to expose our PhD students to the breadth of classic and cutting edge research in four distinct traditions in HCII--computer science, cognitive science, social science, and design. Although no project is required for this course, there will be significant reading and writing. The four courses are: Number Name When Instruct 05-773 Computer Science Perspectives in HCI Mini 3-Spring'07 05-772 Social Perspectives in HCI Mini 4-Spring'07 05-774 Cognitive Science Perspectives in HCI Mini 3-Spring'08 05-775 Design Perspectives in HCI Mini 4-Spring'08
SCS: Human-Computer Interaction	SCS	5813	HUMAN FACTORS	GR	This course uses theory and research from human factors, cognitive science, and social science to understand and design the interactions of humans with the built world, tools, and technology. The course emphasizes current work in applied domains such as automotive design, house construction, medical human factors, and design of information devices. The course also will emphasize not only individual human factors (e.g., visual response, anthropometry) but also the organizational arrangemenhts that can amplify or correct human factors problems. Through reading, discussion, and projects, you will learn about human perceptual, cognitive, and physical processes that affect how people interact with, and use, technology and tools. You will learn why we have so many automobile accidents, voting irregularities, and injuries from prescription medication. You will learn some tried and true solutions for human factors problems, and some of the many problems in human factors that remain. You will also have gained experience in research

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Human-Computer Interaction	SCS	5818	DESIGN EDUCTNL GAMES	GR	The potential of digital games to improve education is enormous. However, it is a significant challenge to create a game that is both fun and educational. In this course, students will learn to meet this challenge by combining processes and principles from game design and instructional design. Students will also learn to evaluate their games for fun, learning, and the integration of the two. They will be guided by the EDGE framework for the analysis and design educational games. The course will involve a significant hands-on portion in which students learn a design process to create educational games, digital or non-digital. They will also read about existing educational games and discuss game design, instructional design, learning and transfer, and the educational effectiveness of digital games. They will analyze an educational game and present their analysis to the class. The intended audience includes graduate and advanced undergraduate students in HCII, CS, ETC, Design, and students interested in education or psychology research. To be eligible to enroll, students must have successfully completed one course in human-computer interaction, game design, computer science, or cognitive/educational psychology, or they must have instructor permission. During most weeks, we will have a lecture and a course meeting devoted to student game presentations, discussion of homework assignments, and hands-on work. The lecture meetings will be devoted to discussions focused on the course readings. The hands-on part will be opportunities for students to work on assignments and projects, and to discuss progress and open issues with the course instructors.
SCS: Human-Computer Interaction	SCS	5823	E-LEARN DSGN PRNCPLS	GR	This course is about e-learning design principles, the evidence and theory behind them, and how to apply these principles to develop effective educational technologies. It is organized around the book "e-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning" by Clark & Mayer with further readings drawn from cognitive science, educational psychology, and human-computer interaction. You will learn design principles 1) for combining words, audio, and graphics in multimedia instruction, 2) for combining examples, explanations, practice and feedback in online support for learning by doing, and 3) for balancing learner versus system control and supporting student metacognition. You will read about the experiments that support these design principles, see examples of how to design such experiments, and practice applying the principles in educational technology development.
SCS: Human-Computer Interaction	SCS	5840	TOOLS ONLINE LRNG	GR	In this course, we will explore issues that pertain to interaction and interface design. The class will focus on elements of the larger interaction design process including basic design principles, information architecture and navigation, planning and brainstorming methods, and techniques for developing rapid sketches and prototypes. Course Requirements: This class will not focus on learning specific software tools. Students are expected to have prior experience using a variety of design and programming tools. Please speak with the instructor if you have questions regarding these prerequisites. This course was design for students in the METALS program.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Human-Computer Interaction	SCS	5891	DES HUMAN CENTR SFTW	GR	Why are things so hard to use these days? Why doesn't this thing I just bought work? Why is this web site so hard to use? These are frustrations that we have all faced from systems not designed with people in mind. The question this course will focus on is: how can we design human-centered systems that people find useful and usable? This course is an introduction to designing, prototyping, and evaluating user interfaces. If you take only one course in Human-Computer Interaction, this is the course for you. This class is a core course for undergrads in the HCI Minor but open to all undergrads and grad students, with either technical or non-technical backgrounds. We will cover theory as well as practical application of ideas from Human-Computer Interaction. Course work includes lectures, class discussion, homework, class presentations, and group project. Students will need a prerequisite of a fundamental computer programming course.
SCS: Human-Computer Interaction	SCS	5982	INDPNT TEACHING EXPR	GR	This course is appropriate for graduate students who have significant instructional responsibilities and are listed as instructors in roles such as co-instructor of a course or section instructor. The course will involve mentored independent teaching experience. Special permission is required.

SCS: Institute for Software Research	SCS	8200	ETHCS POLICY CMPTNG	UG	In this course, students will study the social impacts of computing technology and systems. The course will provide a brief introduction to ethics and to the new and difficult ethical questions modern computing technology presents us with. It will focus on a number of areas in which computers and information technology are having an impact on society including data privacy, social media, and autonomous technologies.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Institute for Software Research	SCS	8421	BLD USR SENS SYSTEMS	UG	These days we are surrounded by sensing and computation. Smart devices, such as smartphones, smartwatches, are packed with sensors. While they are already very useful devices, we have only started to scratch the surface here. The aim of this class will be to introduce the students to building and understanding smart sensing devices. The course will include discussion into contribution of various fields, including human-computer interaction, embedded computing, computer vision, distributed systems, machine learning, signal processing, security, and privacy. We will discuss how these various disciplines are coming together to form an end-to-end system that generates useful and user-actionable data. We will take a hands-on approach towards building and evaluating these systems. The students will gain practical experience in developing sensing systems in different application domains, such as activity recognition, health sensing, gestural interaction, etc. You will learn about embedded systems and understand the advantages and limitations of different platforms. You will learn about sensors and how to interface them with the real world to be able to get useful and actionable data. You will learn how to build a network of sensors that can communicate with each other. You will also learn about storing the sensor data for visualization, analysis and presentation both locally and to the cloud. The course will be a combination of lectures, tutorials, class discussions, and demonstrations. Students will be evaluated based on 5 mini-projects/assignments, class participation, weekly reading summaries, and a final project. All hardware resources will be provided to the students and they will be given an option to take their final prototypes with them for the cost of the hardware components. The only requirement for the class is that the students should have reasonable programming experience and an interest in tinkering.
SCS: Institute for Software Research	SCS	8537	AI METHODS SOC GOOD	UG	The rapid advance in artificial intelligence (AI) has opened up new possibilities of using AI to tackle the most challenging societal problems today. This course brings together a set of advanced AI methods that allow us to address societal challenges and promote social good: 1) Machine Learning: supervised learning, deep learning 2) Game Theory and Mechanism Design: security games, human behavior modeling, scheduling and pricing, citizen science 3) Sequential Decision Making: Markov Decision Processes (MDPs), partially observable MDPs 4) Planning and Optimization: influence maximization, online planning, combinatorial optimization In addition to providing a deep understanding of these methods, the course will introduce which societal challenges they can tackle and how, in the areas of (i)healthcare, (ii)social welfare, (iii)security and privacy, (iv)environmental sustainability. The course will also cover special topics such as AI and Ethics and Safety of AI. Example research projects and social good outcomes can be found at http://aiandsocialgood.org. The course content is designed to not have too much overlap with other AI courses offered at CMU. Although the course is listed within SCS, it should be of interest to students in several other departments, including ECE, EPP, and SDS. The students in this 9-unit course are expected to have taken at least two mathematics courses covering linear algebra and probability. The students will work in groups on a systematic literature review or a project exploring the possibility of applying existing AI tools to a societal problem, with a survey paper or technical report and presentation delivered at the end of the semester. Please see the instructor if you are unsure of whether your background is suitable for the course.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Institute for Software Research	SCS	8602	CURNT TPC PRVY SEMR	GR	In this seminar course students will discuss recent papers and current public policy issues related to privacy. Privacy professionals from industry, government, and non-profits will deliver several guest lectures each semester.
SCS: Institute for Software Research	SCS	8605	ENGN PRIV SOFTWARE	GR	Privacy harms that involve personal data can often be traced back to software design failures, which can be prevented through sound engineering practices. In this course, students will learn how to identify privacy threats due to surveillance activities that enhance modern information systems, including location tracking, behavioral profiling, recommender systems, and social networking. Students will learn to analyze systems to identify the core operating principles and technical means that introduce privacy threats, and they will learn to evaluate and mitigate privacy risks to individuals by investigating system design alternatives. Strategies to mitigating privacy risk will be based on emerging standards and reliable privacy preference data. Students will have the opportunity to study web-, mobile- and cyber-physical systems across a range of domains, including advertising, healthcare, law enforcement and social networking. In addition, students will know how, and when, to interface with relevant stakeholders, including legal, marketing and other developers in order to align software design with privacy policy and law.
SCS: Institute for Software Research	SCS	8630	ETHICS POLICY ISSUES	GR	Should autonomous robots make life and death decisions on their own? Should we allow them to select a target and launch weapons? To diagnose injuries and perform surgery when human doctors are not around? Who should be permitted to observe you, find out who your friends are, what you do and say with them, what you buy, and where you go? Do social media and personalized search restrict our intellectual horizons? Do we live in polarizing information bubbles, just hearing echoes of what we already know and believe? As computing technology becomes ever more pervasive and sophisticated, we are presented with an escalating barrage of decisions about who, how, when, and for what purposes technology should be used. This course will provide an intellectual framework for discussing these pressing issues of our time, as we shape the technologies that in turn shape us. We will seek insight through reading, discussion, guest lectures, and debates. Students will also undertake an analysis of a relevant issue of their choice, developing their own position, and acquiring the research skills needed to lend depth to their thinking. The course will enhance students' ability to think clearly about contentious technology choices, formulate smart positions, and support their views with winning arguments.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Institute for Software Research	SCS	8714	NEGOTIATION	GR	This course is part of the MSIT eBusiness Technologies course curriculum and is not open to students from other programs. Permission to take the course will not be given to students outside of the MSIT eBusiness Technology program. Please do not contact the instructor regarding taking this course.
SCS: Institute for Software Research	SCS	8734	USABLE PRVCY & SECUR	GR	There is growing recognition that technology alone will not provide all of the solutions to security and privacy problems. Human factors play an important role in these areas, and it is important for security and privacy experts to have an understanding of how people will interact with the systems they develop. This course is designed to introduce students to a variety of usability and user interface problems related to privacy and security and to give them experience in designing studies aimed at helping to evaluate usability issues in security and privacy systems. The course is suitable both for students interested in privacy and security who would like to learn more about usability, as well as for students interested in usability who would like to learn more about security and privacy. Much of the course will be taught in a graduate seminar style in which all students will be expected to do a weekly reading assignment and each week different students will prepare a presentation for the class. Students will also work on a group project throughout the semester. The course is open to all graduate students who have technical backgrounds. The 12-unit course numbers (08-734 and 5-836) are for PhD students and masters students. Students enrolled in these course numbers will be expected to play a leadership role in a group project that produces a paper suitable for publication. The 9-unit 500-level course numbers (08-534 and 05-436) are for juniors, seniors, and masters students. Students enrolled in these course numbers will have less demanding project and presentation requirements.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Institute for Software Research	SCS	8735	BLD USR SENS SYSTEMS	GR	These days we are surrounded by sensing and computation. Smart devices, such as smartphones, smartwatches, are packed with sensors. While they are already very useful devices, we have only started to scratch the surface here. The aim of this class will be to introduce the students to building and understanding smart sensing devices. The course will include discussion into contribution of various fields, including human-computer interaction, embedded computing, computer vision, distributed systems, machine learning, signal processing, security, and privacy. We will discuss how these various disciplines are coming together to form an end-to-end system that generates useful and user-actionable data. We will take a hands-on approach towards building and evaluating these systems. The students will gain practical experience in developing sensing systems in different application domains, such as activity recognition, health sensing, gestural interaction, etc. You will learn about embedded systems and understand the advantages and limitations of different platforms. You will learn about sensors and how to interface them with the real world to be able to get useful and actionable data. You will learn how to build a network of sensors that can communicate with each other. You will also learn about storing the sensor data for visualization, analysis and presentation both locally and to the cloud. The course will be a combination of lectures, tutorials, class discussions, and demonstrations. Students will be evaluated based on 5 mini-projects/assignments, class participation, weekly reading summaries, and a final project. All hardware resources will be provided to the students and they will be given an option to take their final prototypes with them for the cost of the hardware components. The only requirement for the class is that the students should have reasonable programming experience and an interest in tinkering.
SCS: Institute for Software Research	SCS	8737	AI METHODS SOC GOOD	GR	The rapid advance in artificial intelligence (AI) has opened up new possibilities of using AI to tackle the most challenging societal problems today. This course brings together a set of advanced AI methods that allow us to address societal challenges and promote social good: 1) Machine Learning: supervised learning, deep learning 2) Game Theory and Mechanism Design: security games, human behavior modeling, scheduling and pricing, citizen science 3) Sequential Decision Making: Markov Decision Processes (MDPs), partially observable MDPs 4) Planning and Optimization: influence maximization, online planning, combinatorial optimization In addition to providing a deep understanding of these methods, the course will introduce which societal challenges they can tackle and how, in the areas of (i)healthcare, (ii)social welfare, (iii)security and privacy, (iv)environmental sustainability. The course will also cover special topics such as AI and Ethics and Safety of AI. Example research projects and social good outcomes can be found at http://aiandsocialgood.org. The course content is designed to not have too much overlap with other AI courses offered at CMU. Although the course is listed within SCS, it should be of interest to students in several other departments, including ECE, EPP, and SDS. This 12 unit course is only open to graduate students (masters and PhD) with previous programming experience and background knowledge in artificial intelligence. The students will work in groups on a research project with a research-style paper and on oral presentation delivered at the en of the semester. Please see the instructor if you are unsure of whether your background is suitable for the course.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Institute for Software Research	SCS	8802	SOCTAL CMPTNG PTHSIS	GR	This course is provided by each Societal Computing advisor to coach the student in preparing, presenting, and passing a thesis proposal. The proposal will generally occur in the semester where this course is taken. If it is not, then, at the advisor's discretion, an incomplete may be granted. In that case, in accordance with university policy, the course must be completed (and the thesis passed) no later than the last day of the following semester, or the default grade will be awarded.
SCS: Institute for Software Research	SCS	17200	ETHICS POLICY CMPTNG	UG	In this course, students will study the social impacts of computing technology and systems. The course will provide a brief introduction to ethics and to the new and difficult ethical questions modern computing technology presents us with. It will focus on a number of areas in which computers and information technology are having an impact on society including data privacy, social media, and autonomous technologies.
SCS: Institute for Software Research	SCS	17331	INFR SEC PRIV & POL	UG	As layers upon layers of technology mediate increasingly rich business processes and social interactions, issues of information security and privacy are growing more complex too. This course takes a multi-disciplinary perspective of information security and privacy, looking at technologies as well as business, legal, policy and usability issues. The objective is to prepare students to identify and address critical security and privacy issues involved in the design, development and deployment of information systems. Examples used to introduce concepts covered in the class range from enterprise systems to mobile and pervasive computing as well as social networking. Format: Lectures, short student presentations on topics selected together with the instructor, and guest presentations. Target Audience: Primarily intended for motivated undergraduate and masters students with CS background. Also open to PhD students interested in a more practical, multi-disciplinary understanding of information security and privacy.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Institute for Software Research	SCS	17334	USABLE PRIV SECURITY	UG	There is growing recognition that technology alone will not provide all of the solutions to security and privacy problems. Human factors play an important role in these areas, and it is important for security and privacy experts to have an understanding of how people will interact with the systems they develop. This course is designed to introduce students to a variety of usability and user interface problems related to privacy and security and to give them experience in designing studies aimed at helping to evaluate usability issues in security and privacy systems. The course is suitable both for students interested in privacy and security who would like to learn more about usability, as well as for students interested in usability who would like to learn more about security and privacy. Much of the course will be taught in a graduate seminar style in which all students will be expected to do a weekly reading assignment and each week different students will prepare a presentation for the class. Students will also work on a group project throughout the semester. The course is open to all graduate students who have technical backgrounds
SCS: Institute for Software Research	SCS	17422	BLDG USER FCSD SENSE SYS	UG	These days we are surrounded by sensing and computation. Smart devices, such as smartphones, smartwatches, are packed with sensors. While they are already very useful devices, we have only started to scratch the surface here. The aim of this class will be to introduce the students to building and understanding smart sensing devices. The course will include discussion into contribution of various fields, including human-computer interaction, embedded computing, computer vision, distributed systems, machine learning, signal processing, security, and privacy. We will discuss how these various disciplines are coming together to form an end-to-end system that generates useful and user-actionable data. We will take a hands-on approach towards building and evaluating these systems. The students will gain practical experience in developing sensing systems in different application domains, such as activity recognition, health sensing, gestural interaction, etc. You will learn about embedded systems and understand the advantages and limitations of different platforms. You will learn about sensors and how to interface them with the real world to be able to get useful and actionable data. You will learn how to build a network of sensors that can communicate with each other. You will also learn about storing the sensor data for visualization, analysis and presentation both locally and to the cloud. The course will be a combination of lectures, tutorials, class discussions, and demonstrations. Students will be evaluated based on 5 mini-projects/assignments, class participation, weekly reading summaries, and a final project. All hardware resources will be provided to the students and they will be given an option to take their final prototypes with them for the cost of the hardware components.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Institute for Software Research	SCS	17562	LAW OF COMPUTER TECH	UG	A survey of how legislatures and courts cope with rapidly advancing computer technologies and how scientific information is presented to, and evaluated by, civil authorities. The course is also an introduction to the legal process generally and the interaction between the legal system and technology organizations. Topics include: patents, copyrights in a networked world, law of the Internet, free speech, data security, technology regulation, international law, and trans-border crime. Open to juniors, seniors and graduate students in any school. Open to sophomores by permission of the instructor.
SCS: Institute for Software Research	SCS	17606	PRVY DES PRJ WRKSHP	GR	Note: Previously offered as 08-606. This course is for students enrolled in the Privacy by Design Practicum or by permission of the instructor. Students will discuss privacy by design challenges and solutions.
SCS: Institute for Software Research	SCS	17607	PRVY DESIGN PRAC	GR	NOTE: Previously offered as 08-607. Students in this course will work in small teams on a large semester-long Privacy By Design project for a project sponsor. Students will be expected to deliver a final report and project presentation at the end of the semester. This course is for students in the MSIT-Privacy Engineering program or by permission of the instructor.
SCS: Institute for Software Research	SCS	17610	RSK MNGT SFTW IN PRJ	GR	It is estimated that nearly half of all software projects fail to meet initial requirements, cost, schedule and/or customer expectations due to problems that occur during the development life cycle. Some of these problems began as risks that, if properly identified, analyzed and mitigated, should not have escalated to the problem state. Despite its benefits, the practice of risk management in industry is ad-hoc, inconsistent, and often ineffective, leading decision makers to make poor choices based upon lack of, or mis-communicated, information. The goal of this course is to develop risk managers, individuals who are capable of identifying both the risks and the underlying factors influencing them in order make better project decisions. Students will become familiar with existing tools, techniques and strategies that serve to identify, analyze and assist in mitigating or avoiding risks. At the end of the course, students will have gained confidence in their ability to apply a range of risk management techniques to a software intensive project. Students need to be software engineering students. All others, please contact instructor (droot@cs.cmu.edu) for registration.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Institute for Software Research	SCS	17631	INFM SEC PRIV & POL	GR	As layers upon layers of technology mediate increasingly rich business processes and social interactions, issues of information security and privacy are growing more complex too. This course takes a multi-disciplinary perspective of information security and privacy, looking at technologies as well as business, legal, policy and usability issues. The objective is to prepare students to identify and address critical security and privacy issues involved in the design, development and deployment of information systems. Examples used to introduce concepts covered in the class range from enterprise systems to mobile and pervasive computing as well as social networking. Format: Lectures, short student presentations on topics selected together with the instructor, and guest presentations. Target Audience: Primarily intended for motivated undergraduate and masters students with CS background. Also open to PhD students interested in a more practical, multi-disciplinary understanding of information security and privacy.
SCS: Institute for Software Research	SCS	17658	MITS SEMINAR I	GR	The MITS seminar occurs in both the fall and the spring semesters. The Seminar brings together a cohort of students to explore topics of particular interest to the Navy, and includes special presentations by military and civilian leaders. In addition to these guest lectures, students are required to attend weekly seminars offered in various departments across the university, and to write and submit a summary paragraph on each seminar that they attend in support of their learning and attendance. MITS students are required to enroll in the Seminar in the first fall semester and the subsequent spring term. Each Seminar registration counts as 3 units of degree completion credit.
SCS: Institute for Software Research	SCS	17702	CURNT TPC PRVY SEMR	GR	In this seminar course students will discuss recent papers and current public policy issues related to privacy. Privacy professionals from industry, government, and non-profits will deliver several guest lectures each semester.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Institute for Software Research	SCS	17731	FOUNDATIONS OF PRIVC	GR	Privacy is a significant concern in modern society. Individuals share personal information with many different organizations - healthcare, financial and educational institutions, the census bureau, Web services providers and online social networks - often in electronic form. Privacy violations occur when such personal information is inappropriately collected, shared or used. We will study privacy in a few settings where rigorous definitions and enforcement mechanisms are being developed - statistical disclosure limitation (as may be used by the census bureau in releasing statistics), semantics and logical specification of privacy policies that constrain information flow and use (e.g., by privacy regulations such as the HIPAA Privacy Rule and the Gramm-Leach-Bliley Act), principled audit and accountability mechanisms for enforcing privacy policies, anonymous communication protocols - and other settings in which privacy concerns have prompted much research, such as in social networks, location privacy and Web privacy (in particular, online tracking & targeted advertising).
SCS: Institute for Software Research	SCS	17733	PRIVCY POL LAW TECH	GR	This course focuses on policy issues related to privacy from the perspectives of governments, organizations, and individuals. We will begin with a historical and philosophical study of privacy and then explore recent public policy issues. We will examine the privacy protections provided by laws and regulations, as well as the way technology can be used to protect privacy. We will emphasize technology-related privacy concerns and mitigation, for example: social networks, smartphones, behavioral advertising (and tools to prevent targeted advertising and tracking), anonymous communication systems, big data, and drones. This is part of a series of courses offered as part of the MSIT-Privacy Engineering masters program. These courses may be taken in any order or simultaneously. Foundations of Privacy (Fall semester) offers more in-depth coverage of technologies and algorithms used to reason about and protect privacy. Engineering Privacy in Software (Spring semester) focuses on the methods and tools needed to design systems for privacy. This course is intended primarily for graduate students and advanced undergraduate students with some technical background. Programming skills are not required. 8-733, 19-608, and 95-818 are 12-unit courses for PhD students. Students enrolled under these course numbers will have extra assignments and will be expected to do a project suitable for publication. 8-533 is a 9-unit course for undergraduate students. Masters students may register for any of the course numbers permitted by their program. This course will include a lot of reading, writing, and class discussion. Students will be able to tailor their assignments to their skills and interests. However, all students will be expected to do some writing and some technical work.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Language Technologies Institute	SCS	11291	APPLD COMP TECH LAB	UG	What would an "intelligent" picture on the wall do? What if it could see and hear you? What should it say if it could talk? What if your pantry, wardrobe or medicine cabinet could sense, think and act? What should they do and say? What should your cell phone be saying to you? These are not whimsical or theoretical questions...they inevitably arise as ordinary everyday objects around us acquire the ability to sense changes in their environment, think about their implications, and act in pursuit of their goals. These objects are connected to the web and become conduits for services, erasing the distinction between products and services. The ability to invent and build smart products/services is becoming a key skill in the new technology-driven services economy. The focus of the course will be on building "ordinary" objects that can sense, think and act in the real world and on exploring the implications of these capabilities. Students will select their own project and by the end of the semester will create a working prototype that will be exhibited in a public place.
SCS: Language Technologies Institute	SCS	11624	HUMAN LANG FOR. AI	GR	Description to be provided by the department
SCS: Language Technologies Institute	SCS	11724	HUMAN LANG FOR. AI	GR	Description to be provided by the department
SCS: Language Technologies Institute	SCS	11751	SPEECH RECOG & UNDRSTD	GR	The technology to allow humans to communicate by speech with machines or by which machines can understand when humans communicate with each other is rapidly maturing. This course provides an introduction to the theoretical tools as well as the experimental practice that has made the field what it is today. We will cover theoretical foundations, essential algorithms, major approaches, experimental strategies and current state-of-the-art systems and will introduce the participants to ongoing work in representation, algorithms and interface design. This course is suitable for graduate students with some background in computer science and electrical engineering, as well as for advanced undergraduates. Prerequisites: Sound mathematical background, knowledge of basic statistics, good computing skills. No prior experience with speech recognition is necessary.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Language Technologies Institute	SCS	11777	ADV MULTIMOD MACH LRNG	GR	Multimodal machine learning (MMML) is a vibrant multi-disciplinary research field which addresses some of the original goals of artificial intelligence by integrating and modeling multiple communicative modalities, including linguistic, acoustic and visual messages. With the initial research on audio-visual speech recognition and more recently with language & vision projects such as image and video captioning, this research field brings some unique challenges for multimodal researchers given the heterogeneity of the data and the contingency often found between modalities. This course will teach fundamental mathematical concepts related to MMML including multimodal alignment and fusion, heterogeneous representation learning and multi-stream temporal modeling. We will also review recent papers describing state-of-the-art probabilistic models and computational algorithms for MMML and discuss the current and upcoming challenges. The main technical topics are: (1) multimodal representation learning, including multimodal auto-encoder and deep learning, (2) multimodal component analysis and fusion, including deep canonical correlation analysis and multi-kernel learning, (3) multimodal alignment and multi-stream modeling, including multi-instance learning and multimodal recurrent neural networks, and (4) multi-sensory computational modeling, including nonparametric Bayesian networks and multimodal hierarchical Dirichlet processes. The course will also discuss many of the recent applications of MMML including multimodal affect recognition, image and video captioning and cross-modal multimedia retrieval.
					SCS: Machine Learning 4
SCS: Machine Learning	MCS	10830	ML IN POLICY	GR	Machine learning, a field derived primarily from computer science and statistics, has matured and gained wide adoption over past decades. Alongside exponential increases in data measurement and availability, the ability to develop appropriate and tailored analyses is in demand. As practitioners in the social sciences consider machine learning methods, however, we are identifying limitations and externalities of the applications of machine learning techniques, such as overconfidence in settings with concept drift, lack of generalizability due to selection bias, and magnification of inequities. Machine Learning and Policy seeks to (1) demonstrate motivations and successes of machine learning, to (2) contrast them with more classical methods, and to (3) investigate the promise and cautions of machine learning for public policy. The course will cover variety of topics, including: Basics of machine learning; probability/Bayes/likelihood/conjugacy, terminology, code/algorithm design, evaluation, mathematical formulations Popular and well-performing methods; random forests/trees/ensembles, neural networks/backpropagation/embeddings/generalized adversarial networks, generalized linear models/shrinkage/convexity/basis functions, support vector machines/kernels/optimization/Lagrangian Leveraging other data sources; natural language processing/topic modeling/relational (non-i.i.d.)/relational (Markov logic networks)/temporal data Additional topics: causality/confounding/propensity scoring/inverse weighting/causal directed acyclic graphs, fairness/ethics, interpretation/explanation/visualization, anomaly detection, semi-supervised and active learning, reinforcement learning

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Machine Learning	SCS	10601	MACHINE LEARNING	GR	Machine Learning (ML) develops computer programs that automatically improve their performance through experience. This includes learning many types of tasks based on many types of experience, e.g. spotting high-risk medical patients, recognizing speech, classifying text documents, detecting credit card fraud, or driving autonomous vehicles. 10601 covers all or most of: concept learning, decision trees, neural networks, linear learning, active learning, estimation & the bias-variance tradeoff, hypothesis testing, Bayesian learning, the MDL principle, the Gibbs classifier, Naive Bayes, Bayes Nets & Graphical Models, the EM algorithm, Hidden Markov Models, K-Nearest-Neighbors and nonparametric learning, reinforcement learning, bagging, boosting and discriminative training. Grading will be based on weekly or biweekly assignments (written and/or programming), a midterm, a final exam. 10601 is recommended for CS Seniors & Juniors, quantitative Masters students, & non-MLD PhD students. Prerequisites (strictly enforced): strong quantitative aptitude, college probability & statistics course, and programming proficiency. For learning to apply ML practically & effectively, without the above prerequisites, consider 11344/05834 instead. You can evaluate your ability to take the course via a self-assessment exam (http://bit.ly/2fkddDN). Also, be sure to read the ML course comparison (http://bit.ly/2eV3UaD).
SCS: Machine Learning	SCS	10701	MACHINE LEARNING	GR	Machine learning studies the question "How can we build computer programs that automatically improve their performance through experience?" This includes learning to perform many types of tasks based on many types of experience. For example, it includes robots learning to better navigate based on experience gained by roaming their environments, medical decision aids that learn to predict which therapies work best for which diseases based on data mining of historical health records, and speech recognition systems that learn to better understand your speech based on experience listening to you. This course is designed to give PhD students a thorough grounding in the methods, mathematics and algorithms needed to do research and applications in machine learning. Students entering the class with a pre-existing working knowledge of probability, statistics and algorithms will be at an advantage, but the class has been designed so that anyone with a strong numerate background can catch up and fully participate. You can evaluate your ability to take the course via a self-assessment exam that will be made available to you after you register. If you are interested in this topic, but are not a PhD student, or are a PhD student not specializing in machine learning, you might consider the master's level course on Machine Learning, 10-601." This class may be appropriate for MS and undergrad students who are interested in the theory and algorithms behind ML. If you are unsure whether you have sufficient mathematical background to do well in this course, you should consider taking the minis 10-606/10-607 Mathematical Background for Machine Learning. You can evaluate your ability to take the course via a self-assessment exam at: https://goo.gl/mmR2eL

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Machine Learning	SCS	10718	DATA ANALYSIS	GR	In this course students will gain exposure to practical aspects of machine learning and data analysis. Through a mix of lectures, student presentations, and assignments, the course will cover the various stages in modern data analysis pipelines, as well other relevant applied learning topics, including experimental design for properly evaluating statistical methods, modern societal problems related to FATE (fairness, accountability, transparency, ethics), and ML engineering best-practices.
				SCS: Robotics	8
SCS: Robotics	SCS	16161	ROB FRESHMAN SEMINAR	UG	In 1965 British mathematician I.J. Good wrote, An ultraintelligent machine could design even better machines; there would then unquestionably be an intelligence explosion, and the intelligence of man would be left far behind. As we enter an age where companies like Uber are testing driverless cars in Pittsburgh and innovative interfaces like IBMs Watson can play jeopardy and learn techniques for medical diagnoses, how are we to negotiate an intelligence explosion that for many individuals might threaten the very notions of what it means to be human? The future of human-to-machine relationships will likely define our historical epoch and yet, many young technologists and humanists underestimate the downstream impact of technological innovations on human society. Presently, we have little choice but to attend to this rapidly anxiety-ridden question. This seminar will attend to the challenge of present existential questions on what it means to be human (read not machine) in the context of a rapidly advancing technological age. We will consider human narratives throughout history that exam how governments and individual citizens defined humanity in the context of slavery and colonialism as a framework for exploring and projecting what it means to be human in the age of rapidly advancing intelligent machines. We will trace the technological advancements of the recent five decades and identify historical precedents and speculative narratives that help us to consider issues like labor, economic disparity, negotiations of power, human dignity and ethical responsibility within the context of human relations with advancing technological tools that are now coined, artificial intelligence.
SCS: Robotics	SCS	16264	HUMANOIDS	UG	This course surveys perception, cognition, and movement in humans, humanoid robots, and humanoid graphical characters. Application areas include more human-like robots, video game characters, and interactive movie characters.

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Robotics	SCS	16665	ROBOT MOBILITY	GR	Many robots are designed to move through their environments. Three prevalent environments on earth are land, air, and water. This course will explore the modeling, control, and navigation of ground-based (wheeled and legged), air-based (rotorcraft such as quadcopters), and water-based robots.
SCS: Robotics	SCS	16740	MANIPULATION	GR	Manipulation is the process of changing the state of objects through direct physical interactions. To perform manipulation tasks in unstructured environments, autonomous robots will need to learn about the objects in their surroundings as well as the skills required to manipulate and change the state of these objects. In this course, we explore the use of machine learning and data-driven algorithms for robot manipulation. The course introduces students to the wide variety of challenges posed by manipulation tasks, and how these challenges can be formulated as learning problems. Students are taught how these problems can be solved using machine learning techniques. The types of machine learning methods covered in this course include supervised, unsupervised, active, and reinforcement learning methods. The course includes both lectures and guided paper discussions.
SCS: Robotics	SCS	16748	UNDERACTUATED ROBOTS	GR	People and animals move through and interact with the world in a fundamentally dynamic way. In the vast majority of cases the same cannot be said for robots. In fact, many conventional approaches to motion planning and robot control attempt to explicitly cancel out the dynamics associated with different tasks. This class will consider underactuated robots, systems that do not have full control over their state and therefore cannot be planned for or controlled via conventional methods. Our goal will be to make novel locomoting robots act more "naturally." This class will highlight the relationship between conventional ideas from deterministic motion planning and control design (e.g., dynamic programming and linear-quadratic regulators) and their contemporary counterparts, many of which help form the analytical basis for the probabilisitic reasoning that underlies contemporary AI systems (e.g., POMDPs). Note that this course is inspired by and, for the most part, will follow the format of "Underactuated Robotics: Learning, Planning, and Control for Efficient and Agile Machines" created by Prof. Russ Tedrake at MIT. We will take several tangents, but the course materials provided by Prof. Tedrake through MIT Open Courseware are an incredible resource for this course (and really just in general).

Department	College	Course #	Course Title	Grad/UG	Description
SCS: Robotics	SCS	16782	PLANNING IN ROBOTICS	GR	Planning and Decision-making are critical components of autonomy in robotic systems. These components are responsible for making decisions that range from path planning and motion planning to coverage and task planning to taking actions that help robots understand the world around them better. This course studies underlying algorithmic techniques used for planning and decision-making in robotics and examines case studies in ground and aerial robots, humanoids, mobile manipulation platforms and multi-robot systems. The students will learn the algorithms and implement them in a series of programming-based projects.
SCS: Robotics	SCS	16831	STAT TECH IN ROBOTCS	GR	Probabilistic and learning techniques are now an essential part of building robots (or embedded systems) designed to operate in the real world. These systems must deal with uncertainty and adapt to changes in the environment by learning from experience. Uncertainty arises from many sources: the inherent limitations in our ability to model the world, noise and perceptual limitations in sensor measurements, and the approximate nature of algorithmic solutions. Building intelligent machines also requires that they adapt to their environment. Few things are more frustrating than machines that repeat the same mistake over and over again. We'll explore modern learning techniques that are effective at learning online: i.e. throughout the robots operation. We'll explore how the twin ideas of uncertainty and adaptation are closely tied in both theory and implementation.
SCS: Robotics	SCS	16867	HUMAN ROBOT INTRACTN	GR	This course focuses on the emerging field of human-robot interaction, bringing together research and application of methodology from robotics, human factors, human-computer interaction, interaction design, cognitive psychology, education and other fields to enable robots to have more natural and more rewarding interactions with humans throughout their spheres of functioning. This course is a combination of state-of-art reading and discussions, focused team exercises and problem-solving sessions in human-robot interaction, and a special team project resulting in the implementation of a human-robot interaction system. This new area of inquiry brings together diverse areas of expertise, and so this course includes some guest lectures by researchers in related fields.

Department	College	Course #	Course Title	Grad/UG	Description
SCS:Computational Biology	SCS	2710	COMPUTATIONAL GENOMICS	GR	Dramatic advances in experimental technology and computational analysis are fundamentally transforming the basic nature and goal of biological research. The emergence of new frontiers in biology, such as evolutionary genomics and systems biology is demanding new methodologies that can confront quantitative issues of substantial computational and mathematical sophistication. In this course we will discuss classical approaches and latest methodological advances in the context of the following biological problems: 1) sequence analysis, focusing on gene finding and motifs detection, 2) analysis of high throughput molecular data, such as gene expression data, including normalization, clustering, pattern recognition and classification, 3) molecular and regulatory evolution, focusing on phylogenetic inference and regulatory network evolution, 4) population genetics, focusing on how genomes within a population evolve through recombination, mutation, and selection to create various structures in modern genomes and 5) systems biology, concerning how to combine diverse data types to make mechanistic inferences about biological processes. From the computational side this course focuses on modern machine learning methodologies for computational problems in molecular biology and genetics, including probabilistic modeling, inference and learning algorithms, data integration, time series analysis, active learning, etc.
					SCS:Institute for Software Research 1
SCS:Institute for Software Research	SCS	17333	PRIVCY POLCY LAW TEC	UG	This course focuses on policy issues related to privacy from the perspectives of governments, organizations, and individuals. We will begin with a historical and philosophical study of privacy and then explore recent public policy issues. We will examine the privacy protections provided by laws and regulations, as well as the way technology can be used to protect privacy. We will emphasize technology-related privacy concerns and mitigation, for example: social networks, smartphones, behavioral advertising (and tools to prevent targeted advertising and tracking), anonymous communication systems, big data, and drones. This is part of a series of courses offered as part of the MSIT-Privacy Engineering masters program. These courses may be taken in any order or simultaneously. Foundations of Privacy (Fall semester) offers more in-depth coverage of technologies and algorithms used to reason about and protect privacy. Engineering Privacy in Software (Spring semester) focuses on the methods and tools needed to design systems for privacy. This course is intended primarily for graduate students and advanced undergraduate students with some technical background. Programming skills are not required. 8-733, 19-608, and 95-818 are 12-unit courses for PhD students. Students enrolled under these course numbers will have extra assignments and will be expected to do a project suitable for publication. 8-533 is a 9-unit course for undergraduate students. Masters students may register for any of the course numbers permitted by their program. This course will include a lot of reading, writing, and class discussion. Students will be able to tailor their assignments to their skills and interests. However, all students will be expected to do some writing and some technical work.
					Social & Decision Sciences 14

Department	College	Course #	Course Title	Grad/UG	Description
Social & Decision Sciences	DC	88120	REASN PASSN & COGNTN	UG	This course will introduce students to major concepts and theories in the social and decision sciences, focusing in particular on how cognition and emotion shape judgment and choice. We will address such questions as: In what ways do emotions influence judgments and choices? What are some common mistakes in judgment and decision making? Can information shape our choices even if we do not consciously recognize the information? Throughout the course, the emphasis will be on understanding: (1) basic theories and research findings of decision science and psychology, and (2) the relevance of research findings to everyday life.
Social & Decision Sciences	DC	88150	MANAGING DECISIONS	UG	This course will introduce the major concepts behind "good" decision making. Future employers will pay handsomely for decisions that are well thought out, defendable, and understandable. Being able to organize decision processes in a way that will achieve these goals is not trivial. Biases brought on by emotions and heuristic shortcuts often jeopardize the quality of a decision. Multiple levels of "good" decision making will be investigated ranging from life choices to national climate policies. Techniques that account for uncertainty and time preferences will be introduced.
Social & Decision Sciences	DC	88230	HUMAN INTELIG&STUPID	UG	By some standards, humans are an incredibly intelligent species. We have set foot on the moon, split the atom, and produced extraordinary works of art and literature (including the complete works of Shakespeare, which, despite theoretical accounts to the contrary, no amount of monkeys on typewriters has ever been able to duplicate). And yet. we are also the species that has brought about the Darwin Awards, spent $125 million sending a probe to Mars which was unable to function because engineers failed to convert inches to centimeters, and produced cringe-worthy works of art and literature (including the 1964 movie "Santa Claus Conquers the Martians" which no amount of monkeys on typewriters would ever want to duplicate.). What is intelligence and how does it vary across individuals and over our lifespans? What are we good at, and what are we bad at, and why? Are there things that that make us dumber? Are there things we can do to make ourselves smarter? How should what we know about the range of human intellectual abilities guide policy, education, law, medicine, and business; what implications does this have regarding the tasks/jobs that humans should be doing and the tasks/jobs that machines ought to do? Using cutting edge research from psychology and decision science, this course will explore the strange contradiction that defines the human experience: How are we simultaneously so smart and so dumb?

Department	College	Course #	Course Title	Grad/UG	Description
Social & Decision Sciences	DC	88255	STRATEGIC DECIS MAK	UG	When should a person cooperate and when should a person be selfish in an ongoing social interaction? How can a business establish strategic partnerships when it comes to creating a pie and at the same time battle with competitors when it comes to dividing up the pie? Strategic decision making requires a framework to think through the implications of cooperation and of competition. This course gives you a systematic approach to understanding how people, firms, or countries interact with one another to achieve their own goals. In this course students will learn to apply behavioral strategic principles to analyze strategic situations arising in business, politics, international relations, domestic policy, organizational management, and everyday life. Our focus will be on practical applicability rather than abstract theorizing. Readings will focus on real-life stories accompanied by a full analysis of the principles involved. The class will be organized as a seminar, centered around discussion, not lecture. Students will also be placed in the role of strategist in occasional simulations in class.
Social & Decision Sciences	DC	88281	TPCS LAW: 1ST AMEND	UG	In their firm desire to perfect the new Constitution, which defined and limited the powers and roles of their new government, the founding fathers insisted on explicit statements that would protect the rights of the new nation's citizens. Indeed, the protection of these essential rights in many ways drove and defined their successful rebellion from Britain. This impulse resulted in ten amendments to the Constitution, which we have come to know as the Bill of Rights. The very first (and arguably considered at the time as the most essential) of these was the First Amendment, which we sometimes call the "free speech" amendment to the Constitution. This amendment guarantees every U.S. citizen five freedoms: freedom of religion, speech, press, peaceable assembly, and the freedom to petition the government for redress of grievances. This course examines the historical and philosophical roots of this key constitutional amendment, how it has been fleshed out and defined over time through case law, and the bases of some more recent critics of this amendments and current interpretations.
Social & Decision Sciences	DC	88284	TPCS LAW:BILL OF RIG	UG	This course examines the history and place of the Bill of Rights in our nation's constitutional framework. It focuses on the historical origins of the U.S. Constitution, of each of the first ten amendments to the Constitution (that we refer to as the "Bill of Rights"), how the meanings and interpretations of these have evolved over time, and what they mean to us today. Each article of the Bill of Rights will be examined in terms of its original intentions, and then through cases that have challenged and been interpreted through the Bill's articles.

Department	College	Course #	Course Title	Grad/UG	Description
Social & Decision Sciences	DC	88302	BEHAV DECSN MAKING	UG	Behavioral decision making is the study of how people make decisions, in terms that can eventually help them to make better decisions. It draws together research from psychology, economics, political science, and management, among other fields. It has applications that range from managing potentially hazardous technologies, to involving patients more fully in the choice of medical procedures, to the design of computer-interactive systems. The course covers behavioral theories of probabilistic inference, intuitive prediction, preference, and decision making. Topics include heuristics and biases in inference and prediction, risk perceptions and attitudes, strategies for combining information from different sources and dealing with conflicting objectives, and the roles of group and emotional processes in decision making. The course emphasizes the mutually reinforcing relationship between theory and application.
Social & Decision Sciences	DC	88360	BEHAVIORAL ECONOMICS	UG	This course introduces students to behavioral economics, an emerging subfield of economics that incorporates insights from psychology and other social sciences into economics. We will examine evidence on how human behavior systematically departs from the standard assumptions of economics, and then investigate attempts by behavioral economists to improve economic analyses.
Social & Decision Sciences	DC	88365	BEHVL ECONMCS PUB PL	UG	Economics has up to now been the social science that has been most broadly and deeply involved in public policy. With its rational choice perspective, the economic perspective has tended to favor certain types of policies namely those that enhance the efficiency of market mechanisms and lower the cost of information. In this course we will spend the first several classes reviewing the assumptions, implications for public policy and limitations of the rational choice perspective. The remainder of the course will then be devoted to examining different public policy issues, including saving, health care, crime and drug abuse, through the competing lenses of traditional and behavioral economics.
Social & Decision Sciences	DC	88411	RISE OF ASIAN ECON	UG	For most of the past quarter century, no region of the world has been more economically dynamic than Asia. This course is designed to provide students with the essential knowledge necessary to evaluate opportunities and risks in Asia. The course will use analytical tools drawn from economics and finance, business cases, and guest lectures to focus on the key strengths that sustained economic growth in East Asia for decades, the weaknesses that undermined that growth in the late 1990s, and what lies ahead. The course will also examine Indian economic growth since the early 1980s, and compare India's experience with that of the East Asian economies. A special focus will be placed on recent developments in India and China and the prospects for continued growth in those countries over the next decade.

Department	College	Course #	Course Title	Grad/UG	Description
Social & Decision Sciences	DC	88418	DOMESTIC NEGOTIATION	UG	Negotiation is the art and science of securing an agreement between two or more interdependent parties. Decision-makers use negotiation to reach agreements with co-workers, bosses, clients, subordinates, firms, family and friends. Hence, the ability to negotiate effectively is a critical skill. In this course, students will develop a systematic and insightful approach to negotiation. Students will learn to analyze the features of the negotiation environment, develop an understanding of effective negotiation strategies and tactics, and identify the barriers and the psychological factors that may prevent decision-makers from reaching wise agreements. Considerable emphasis will be placed on negotiation exercises and role-playing. In-class discussions and lectures will supplement the exercises. This course will focus on negotiations in a wide variety of context: public policy negotiations, business negotiations, salary negotiations, and inter-personal negotiations.
Social & Decision Sciences	DC	88452	POLCY ANALY SNR PRJ	UG	Students in this course apply the research and analytical methods learned in their other courses to a real-world problem. Students decide how to structure the problem, divide into teams responsible for its different parts, identify and analyze relevant literature, collect data, synthesize their results, and present their conclusions in oral and written form to a review panel of individuals concerned with the problem. Faculty members help them along the way. Performance is based on students' contribution to the process and substance of the class, as observed by the faculty and by their fellow students. One or two such projects is offered every term. A complete list of previous topics is available from the department. Course is open only to seniors in SDS.
Social & Decision Sciences	DC	88702	BEHAVIORAL ECONOMICS	GR	No course description provided.

Department	College	Course #	Course Title	Grad/UG	Description
Social & Decision Sciences	DC	88718	LG-SCALE SOCIAL PHEN	GR	A special seminar devoted to new ideas and new methods in the study of human behavior on the very largest scales. Emphasis on data science approaches and the analysis of archives, historical and contemporary, as a new arena for the development of new theories and the testing of old ones. We'll consider both cognitive models of the individual, and the institutions and social organizations people have created in response¿from the parliaments of the 18th Century to 20th and 21st Century technologies such as branching bulletin board comment threads and the blockchain.A major goal of our seminar is for you to ask, and answer, a non-trivial research question with the view towards a peer-reviewed publication. We'll use class discussion to answer questions about the reading and to go beyond the assigned papers to speculate, together, on new ways to test their conjectures and claims.
				Statistics	7
Statistics	DC	36200	REASONING DATA	UG	This course is an introduction to learning how to make statistical decisions and "reason with data". The approach will emphasize thinking through an empirical problem from beginning to end and using statistical tools to look for evidence for/against an explicit argument/hypothesis. Types of data will include continuous and categorical variables, images, text, networks, and repeated measures over time. Applications will largely draw from interdisciplinary case studies spanning the humanities, social sciences, and related fields. Methodological topics will include basic exploratory data analysis, elementary probability, hypothesis tests, and empirical research methods. There is no calculus or programming requirement. There will be one weekly computer lab for additional hands-on practice using an interactive software platform that allows student-driven inquiry. This course is the credit-equivalent to 36-201 and will be honored appropriately as a pre-requisite for downstream Statistics courses. As such, this course is not currently open to students who have received credit for 36-201, 36/70-207, 36-220, 36-247, or any 300- or 400-level Statistics course.
Statistics	DC	36202	STAT & DS METHODS	UG	This course builds on the principles and methods of statistical reasoning developed in 36-200 (or its equivalents). The course covers simple and multiple regression, analysis of variance methods and logistic regression. Other topics may include non-parametric methods and probability models, as time permits. The objectives of this course is to develop the skills of applying the basic principles and methods that underlie statistical practice and empirical research. Learning the Data Analysis Pipeline is strongly emphasized through structured coding and data analysis projects. In addition to three lectures a week, students attend a computer lab twice a week for "hands-on" practice of the material covered in lecture; students will learn the basics of R Markdown and related analytics tools. Not open to students who have received credit for: 36-208/70-208, 36-309. Students who have completed or are enrolled in 36-401 prior to completing 36-202, are not able to take/receive credit for 36-202.

Department	College	Course #	Course Title	Grad/UG	Description
Statistics	DC	36207	PROB & STAT BUS APPL	UG	This is the first half of a year long sequence in basic statistical methods that are used in business and management. Topics include exploratory and descriptive techniques, probability theory, statistical inference in simple settings, basic categorical analysis, and statistical methods for quality control. Not open to students who have received credit for 36-201, 36-220, 36-625, or 36-247. Cross-listed as 70-207.
Statistics	DC	36208	REGRESSION ANALYSIS	UG	This is the second half of a year long sequence in basic statistical methods that are used in business and management. Topics include time series, regression and forecasting. In addition to two lectures a week, students will attend a computer lab once a week. Not open to students who have received credit for 36-202, 36-626. Cross-listed as 70-208. Students who have completed 36-401 prior to 36-208 will not receive credit for 36-208.
Statistics	DC	36375	DATA ETHICS & RCR	UG	Description not provided.
Statistics	DC	36467	DATA SPACE TIME	UG	This course is an introduction to the opportunities and challenges of analyzing data from processes unfolding over space and time. It will cover basic descriptive statistics for spatial and temporal patterns; linear methods for interpolating, extrapolating, and smoothing spatio-temporal data; basic nonlinear modeling; and statistical inference with dependent observations. Class work will combine practical exercises in R, a little mathematics on the underlying theory, and case studies analyzing real problems from various fields (economics, history, meteorology, ecology, etc.). Depending on available time and class interest, additional topics may include: statistics of Markov and hidden-Markov (state-space) models; statistics of point processes; simulation and simulation-based inference; agent-based modeling; dynamical systems theory.Co-requisite: For undergraduates taking the course as 36-467, 36-401. For graduate students taking the course as 36-667, consent of the professor.
Statistics	DC	36601	PERSPTV DATA SCI I	GR	This course covers the principles and practice of Data Science including data input and cleaning, exploratory data analysis, intermediate R programming, beginning SAS programming, beginning to intermediate python programming, and SQL. For Master's in Statistical Practice students only.

Department	College	Course #	Course Title	Grad/UG	Description
					Statistics and Data Science 2
Statistics and Data Science	DC	36309	EX DES BEHA SOC SCI	UG	Statistical aspects of the design and analysis of planned experiments are studied in this course. A clear statement of the experimental factors will be emphasized. The design aspect will concentrate on choice of models, sample size and order of experimentation. The analysis phase will cover data collection and computation, especially analysis of variance and will stress the interpretation of results. In addition to a weekly lecture, students will attend a computer lab once a week.
Statistics and Data Science	DC	36749	EXP DES BEH SOC SCI	GR	Statistical aspects of the design and analysis of planned experiments are studied in this course. A clear statement of the experimental factors will be emphasized. The design aspect will concentrate on choice of models, sample size and order of experimentation. The analysis phase will cover data collection and computation, especially analysis of variance, and will stress the interpretation of results. In addition to weekly lecture, students will attend a computer lab once a week. Prerequisite: 36-202, 36-220, or 36-247.
					Tepper School of Business 17
Tepper School of Business	TSB	45711	GLOBAL ECONOMICS	GR	This class is designed to give you some insight into the enormous differences in economic environments faced by businesses around the world: how the environment in the United States differs from that in (say) France, China, or Mexico. We will view the world through the lens of open economy macroeconomics, the field of economics concerned with the national performance, policies of countries and interactions among them. We will use it to study such issues as economic indicators and forecasting (Where are we headed?), economic growth (Why are some countries more productive than others?), business cycles (booms and recessions), employment and unemployment, inflation and deflation, monetary policy and interest rates, international trade and capital flows, foreign exchange rates, and impact of fiscal policy. By the end of the Mini, you will be able to: Better understand the behavior of the economy as a whole. Better understand the sources of the various controversies concerning macroeconomic policy. Explain how differences in ?local institutions" change the nature (and cost) of doing business. Describe the causes of good long-term performance: why per capita income is higher in the US and France than in India or Mexico valuate such economic indicators as bond yields, employment, inflation, exchange rates,and current account deficits.

Department	College	Course #	Course Title	Grad/UG	Description
Tepper School of Business	TSB	45745	ETHICS & LEADERSHIP	GR	This course introduces you to important ethical problems that you may face in contemporary business. ¿In particular, it is intended to bring up difficult ethical challenges and dilemmas, and to offer credible decision-making frameworks for coping with those challenges. Many of these challenges will involve justifying one's position to those in disagreement. To this end, the course emphasizes articulating reasoned arguments. It is neither intended to preach the esoteric wisdom of moral philosophers, nor convert sinners into moral saints. It is rather designed to assist you learn common patterns of success and failure. ¿It is intended to give you the opportunity to reflect on your own values as they apply to the job of the leader. Class sessions will primarily consist of games, collaborative case discussions, and explorations of theoretical frameworks for interpreting ethical challenges.
Tepper School of Business	TSB	45747	ACCELRT LDRSHP ASMNT	GR	Description to be provided by the department
Tepper School of Business	TSB	45748	ACCELRT LDSHP FDBK	GR	Description to be provided by the department
Tepper School of Business	TSB	45749	LDRSHP IMMERSN WRKSH	GR	Description to be provided by the department
Tepper School of Business	TSB	45791	INTRPERSNL COMMCNTN	GR	To execute business objectives effectively, managers communicate on an interpersonal level with an array of people that includes employees, co-workers, senior executives, directors, investors, clients, vendors, distributors, union leaders, government officials and others. This theory-into-practice course examines a range of interpersonal communications required of successful managers in the workplace. We explore critical channels of communication distinctly different from formal management presentations and written business documents. Topics and modules will vary depending upon student assessments; students will typically work on assignments that help them.
Tepper School of Business	TSB	45809	SCIENCE OF GROWTH	GR	Description to be provided by the department

Department	College	Course #	Course Title	Grad/UG	Description
Tepper School of Business	TSB	45840	NEGOTIATIONS	GR	In this course, students will examine the theory and practice of negotiation across a variety of settings. The course is designed to address a broad spectrum of negotiation problems that are faced by managers and professionals. It provides students with the opportunity to develop their negotiation skills experientially in a series of role-playing exercises that highlight various bargaining and negotiation processes. This course is designed to complement the technical and diagnostic skills learned in other courses at the Tepper School. A basic premise of this course is that while a manager needs analytical skills to develop optimal solutions to problems, a broad array of skills is needed for these solutions to be accepted and implemented. Thus the content is relevant to students interested in management, marketing, sales, real estate, consulting, entrepreneurship, mergers and acquisitions, and other fields that require expertise in bargaining, negotiation, and/or dispute resolution. The class will include negotiation exercises, debriefings, class discussions, and lectures.
Tepper School of Business	TSB	45875	GOVNMT & BUSINESS	GR	Government at all levels can significantly affect business through regulations, international relations, funding, or the myriad of political processes and people. The way your business interacts with government can make you a success or a failure. Competitive markets are efficient only under certain assumptions. Governments differ in how (and if) they try to create an environment that meets those assumptions. During this course, you will gain an understanding of the factors that drive both businesses and the public to ask for government action, and most importantly, why these actions can vary by country. The overlap between the roles of business and those of government change over time and differ from place to place. The course will examine the cycles of business and government interaction, and evaluate the inputs and outcomes. For example, why does a meeting with an agency head seldom change regulations? What really influences regulatory agencies? Examples will demonstrate how business and governments interact to positively structure complicated problems and become partners for the benefit of all participants. Some of the course modules will include: What government attributes are required for efficient markets? Regulation: why it occurs and disappears, and how to influence regulations and regulators Management of the commons, incorporation of externalities and congestion Government, business, and innovation How taxes and infrastructure investments change the rules of the game

Department	College	Course #	Course Title	Grad/UG	Description
Tepper School of Business	TSB	45890	CNSG & CNFLT RESLTN	GR	Consulting and Conflict Resolution offers you a systematic methodology for improving your interpersonal communications skills as well as your effectiveness as a consultant, mediator, and business leader. In the course students learn how employ the strategies that experts use to handle difficult people, to circumvent the dirty tricks that hard bargainers play, and to get their business recommendations and advice implemented. Students role-play consultants, clients, CEO's, investors, etc. in real business cases and receive extensive feedback on their performance. Students also have the opportunity to negotiate with a high-level labor negotiator and to consult with experienced management consultants playing the roles of some of their most difficult clients.
Tepper School of Business	TSB	45892	EXECTV COMMUNCTN SKL	GR	As you advance up the managerial ladder you?re likely to find yourself facing irate shareholders or analysts or legislators or consumers or?worst of all in the eyes of many executives?journalists and broadcasters who are covering your company?s relationships with one or more of these groups. Representing your company in external forums is a major executive responsibility but many executives do it poorly. When they speak to external audiences and sometimes to their own employees, executives frequently alienate their listeners. According to recent polls only one in four people believes that most business leaders are honest and business executives have joined car dealers and HMO managers as the people least trusted by a cross-section of Americans. In this course we?ll talk about why this happens and how to fix it. You will get intense practical training in communicating a concise message under tense or adversarial conditions. You will learn techniques for handling tough questions and for getting your own point-of-view across in any forum where you need to think fast on your feet. You will also learn to use your voice and body language to reinforce the message you put into words. We use the process of being interviewed by a reporter as the major vehicle for developing and strengthening your executive communication skills. In the process you will learn how to? · get across to an audience a message that you want to convey about an issue your organization is grappling with · increase your credibility with a skeptical or hostile audience · increase your confidence and poise during interactions with reporters shareholders investment analysts legislators public interest groups or worried employees. In addition to learning by doing, we'll critique video of real-life executives to see how they have represented their companies and issues. (2013 - emp)
Tepper School of Business	TSB	45894	COMMUNCATING CHANGE	GR	Organizations must change to remain competitive, yet employees are often resistant to change. In this course, students will develop strategies for anticipating, identifying, and clarifying sources of resistance and learn strategies of persuasion to overcome resistance. Responding to cases, students will deliver communication (written and oral) designed to overcome resistance. This course will be of value to those who plan to enter either managerial or consulting roles.

Department	College	Course #	Course Title	Grad/UG	Description
Tepper School of Business	TSB	45906	BUS HLTHCARE INNOV	GR	The course provides a broad overview of business trends in the manufacturing segment (the ?production side) of the healthcare industry, with emphasis on the strategic, competitive, and financial challenges in its major market segments: pharmaceuticals, biotechnology (Biopharma), medical devices, & medical IT. The industry will be discussed in the context of its placement in the value chain of the HealthCare industry which in the United States accounts for more than ~$2Trillion of expense or about 17.5% of US GDP (and growing). However, the industry is global. Students will be expected to develop an understanding of the industry structure, issues, challenges, and strategies for competitiveness and innovation (sustained, disruptive and open). Topics to be included are: overviews of each industry segment including emerging trends and opportunities driven by SET factors (societal, economic, technology); business models for monetizing IP (dynamic rent seeking) thru implementation of open innovation; financing innovation via partnering, alliances, mergers and acquisitions; and, convergences across industry sectors. We also include the legal, regulatory and reimbursement that healthcare innovators must navigate as non-market factors.
Tepper School of Business	TSB	45928	ENERGY FINANCE	GR	Financial markets and financial institutions have become an integral part of the energy industry. This course covers the critical aspects of this relationship. It begins with some history and institutional description. When did the "financialization" of the energy industry begin? Why? What exactly does this mean? Has it been an unambiguously good thing, or has it led to some unanticipated side effects (e.g., bubbles) that prompt introspection? The course goes on to explore what makes "energy finance" distinct from other areas of corporate finance. Examples include distinctive financing structures such as project finance and tax-based equity vehicles, the ubiquitous role played by government regulation and tax policy, forms of business organization known as Master Limited Partnerships (MLPs), "energy accounting and valuation," and a variety of financial modeling issues that are often referred to as real option models. The course will not be overly technical. It will be more of a broad overview than an in-depth technical analysis of a particular topic. It places more emphasis on corporate finance that on capital markets. The course is relevant for careers in the energy industry and the energy-related finance industry, as well as careers in supporting industries such as consulting. (CT, 11/2014) http://bertha.tepper.cmu.edu/telmerc/45928energy/
Tepper School of Business	TSB	45995	ENERGY BUS PROJ	GR	No course description provided.

Department	College	Course #	Course Title	Grad/UG	Description
Tepper School of Business	TSB	47894	RSRCH MTHDS BEH SCI	GR	This course provides an introduction to research methodology applicable to organizational behavior with an emphasis on experimentation. The course will survey the major research methodologies used in organizational behavior and social psychology, and will focus on both theoretical and practical considerations of research methods. This is not a statistics course (though an introduction to basic principles is part of the course). The purpose of the course is to give you the background to choose the methods that are most appropriate for your area of study, help you anticipate the shortcomings and problems you will encounter executing your chosen methodologies, and to defend your methodological choices against criticism in your interactions with investigators from allied and not-so-allied disciplines.
Tepper School of Business	TSB	47911	NEGO & CONFL MGMT	GR	This graduate seminar will survey major theories and research on negotiation and conflict management. The readings will be centered on the organizational behavior and social/personality psychology literature on negotiation, conflict, cooperation, and related topics. Through this course you will gain an intellectual understanding of central concepts and ideas in the negotiations and conflict management literature, and you will have an opportunity to explore new research ideas and improve your scholarly writing skills. We will meet once a week and the class will have a discussion format.

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