

Illinois Institute of Technology  
Sustainability Course Offerings  
Academic Year 2017-2018

## Undergraduate Sustainability Focused Courses

### Architecture

#### Basics of Building Simulation in the Built Environment I - ARCH 421

The application of energy conservation methods and renewable energy sources, such as wind power and passive solar systems, will be examined in the development of building energy budgets for a variety of building types.

#### Energy Conscious Design II - ARCH 422

The application of energy conservation methods and renewable energy sources, such as wind power and passive solar systems, will be examined in the development of building energy budgets for a variety of building types.

### Chemistry

#### Environmental Chemistry - CHEM 472

This course provides an introduction to environmental chemistry and is focused on application of chemical principles and theories to the study of environmental phenomena and issues and covers matters related to environment and earth. Potential topics include aquatic chemistry, water pollution and purification, atmospheric chemistry, air pollution, hydrology and geochemistry, soil chemistry and pollution, natural resource and cycle, energy and sustainability, climate change, chemical bonding and reactions, thermodynamics and kinetics, acid-base chemistry, redox chemistry, bio-inorganic chemistry on earth and living systems, organic and inorganic toxicants and pollutants, hazardous heavy metals, nuclear wastes, waste and recycling, green chemistry, environmental toxicology, and chemical and environmental health and safety.

#### Environmental Analytical Chemistry - CHEM 473

This course provides an overview of applications of analytical chemistry to environment and environmental problems. Students will learn spectrometric, chromatographic, electrochemical measurement methods and concepts for analysis of environmental samples and tracing and monitoring of environmental problems. Potential topics include: quality assurance (QA) and quality control (QC) in environmental sampling and analysis; determination of trace elements, toxicants, organics, pollutants, heavy metals, and radionuclides in environmental samples and drinking water; analytical tools for tracing and monitoring of pollution and contamination; instrumental analysis of environmental samples using ICP-MS (inductively coupled plasma-mass spectrometry), ICP-AAS (atomic absorption spectroscopy), ICP-AES (atomic emission spectrometry), ion chromatography, and gas chromatography (GC), GC-MS, high performance liquid chromatography (HPLC); chemometrics; electrochemical methods; GC/LC separation methods, liquid-liquid and solid phase extraction; statistical data analysis.

#### Science of Climate Change - CHEM 410

This course will focus on the science underlying global warming/climate change. How can we continue to lead the good life while living in harmony with nature? Although obviously important, commercial/political aspects are not considered here. However, any serious debate about climate change issues eventually has to rest on the underlying scientific facts so we need to be informed. Ultimately the sun is our primary source of power. How do we responsibly access that power in the short, intermediate and long terms? Bio-fuels, carbon dioxide, polar ice caps, and solar power are some of the topics to be discussed.

## Environmental Chemistry

### Introduction to Environmental Engineering - ENVE 310

This course provides an overview of how environmental engineers integrate biological, chemical, and physical sciences with engineering to develop solutions to environmental problems. Topics include air pollution, water pollution, solid waste, fate and transport of contaminants, and pollution prevention.

### Introduction to Water Resources Engineering - ENVE 401

The theory and practice involved in planning and design of urban water systems are introduced in this course. Topics include storm water management, water supply distribution, and waste water collection and transport systems.

### Water and Wastewater Engineering - ENVE 404

Water quality and water supply issues make up this course including the physical, chemical, and biological processes involved in water treatment. Process design, operations, and management are also considered.

### Introduction to Air Pollution Control - ENVE 463

Air pollution sources and characteristics of source emissions, atmospheric reactions, effects of pollutants, and techniques of emission control are presented in this course. Legal and administrative aspects of air pollution control are also described.

### Engineering Control of Industrial Hazards - ENVE 476

Design of control systems to enhance occupational safety and health; how to recognize and control existing or potential safety and health hazards.

### Industrial Ecology - ENVE 485

This course provides an overview of industrial ecology, the study of the science and engineering relationships between cultural and ecological systems, and how those relationships can be managed to achieve a more sustainable economy. Because it is an interdisciplinary field, topics include technology (science and engineering), public policy and regulatory issues, and business administration.

## Industrial Technology and Management

### Sustainable Facilities Operations - INTM 423

Maintaining and managing buildings and facilities is a challenging, multifaceted occupation. Facilities are becoming smarter and greener as the goals of energy conservation and occupant comfort have shifted to include environmental responsibility. This course examines facility operations and management (O&M) related to sustainability and green technology, with an emphasis on the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) requirements, rating system, and the process for properties to apply for certification as a resource-efficient operation.

### Issues in Industrial Sustainability - INTM 459

Examines the concept of sustainability and its application in the industrial environment. Identifies underlying stresses on natural and human environments and the resultant problems for business and society including legal, ethical, and political issues related to sustainability. Global warming, peak oil, and commodity pricing are considered as indicators of the need for improvements in sustainability. Industrial ecology will be discussed as well as strategies for developing sustainable practices in manufacturing, power generation, construction, architecture, logistics, and environmental quality. Coverage includes case studies on businesses that have developed successful sustainability programs.

#### Sustainability of Critical Materials - INTM 460

This course explores the limitations in supply and the need for sustainable use of carbon and non-carbon-based materials such as oil, minerals, food, water, and other natural resources used by industry. Limitations in the global availability of such resources pose challenges to industry which will require careful consideration and planning to ensure continued prosperity for current and future generations. Course will cover strategies and options to mitigate anticipated shortages and optimize the use of non-renewable natural resources, review of fuel and raw material pricing, and cost/benefit analysis of sustainable development proposals. Technical analyses will be presented during class discussions, but a technical background is not required.

#### Energy Options for Industry - INTM 461

Carbon-based fuels are a limited resource and within decades will be in very short supply. Associated energy costs will increase and industry will be required to incorporate alternate fuels and/or power sources, such as uranium (for nuclear power), hydroelectric, geothermal, wind, wave, solar, etc. This course presents such energy options and explores the anticipated impact on industry.

#### Special Topics in Sustainability - INTM 462

This course allows the student to research and report on an industrial sustainability issue of interest and relevance to their career objectives. Topics may touch on industrial ecology, ethics, regulations, environment, resource use, alternative manufacturing methods, facilities, logistics, etc. This is the fourth course in a specialization in Industrial Sustainability.

## Political Science

#### Environmental Politics and Policy - PS 329

Students look at the complexities of making and implementing environmental policy at the local, national, regional, and/or global levels. Emphasis will be placed the ways that conflict and cooperation among multiple economic, social, and political interests contribute to the successes and failures of environmental policy. Topics for in depth study may include global warming, air and water pollution, depletion of natural resources, biodiversity conservation, environmental communication, and the roles played by international organizations, local and national governments, businesses, and non-governmental organizations.

#### Energy and Environmental Policy - PS 338

This course traces our dependence on fossil fuels and government-based attempts to promote energy conservation and develop alternate energy sources. Assessed are the economic and political effects of the supply and demand for energy; the implications of different energy production and consumption methods; and efforts to minimize the environmental consequences through increased energy efficiency and/or regulation. The course explores such problems as fossil fuel dependence, greenhouse gas emissions reductions, nuclear waste, rapid industrialization, and national and international attempts to provide economic, political, and technological solutions.

## Social Sciences

#### Humans, Ecology, and the Environment - SSCI 359

Examines the relationship between humans and nature, including reasons for some well-known ecological catastrophes in human history. The course traces changing attitudes to the environment and explores various measures that have been offered to solve problems, for instance, the Green Revolution, sustainable development, renewable energy, "clean" technologies, and the potential social and ecological consequences of these solutions.

## Undergraduate Sustainability Related Courses

### Architecture and Urbanism

#### Contemporary Urbanism - AURB 465

This class explores urban form and metropolitan systems and introduces a synthetic overview of the interdependent factors that influence the design of 21st century metropolitan cities. The course covers several cities spanning the globe as case studies to expose students to a range of city-making protocols. Both the urban condition as a whole and less formal, incremental (sometimes spontaneous) urbanisms are presented in detail. The course addresses current day urban challenges, projecting back into the (modernist) past to frame our understanding of the present. Vital issues are spotlighted affecting contemporary architecture and urban design: globalization, technology, social engineering, the environment, and cultural politics. The course enables students to establish a broader definition of "urban" by investigating both common and distinct design strategies of divergent cities.

### Architecture

#### Contemporary Architecture - ARCH 321

This course investigates the state of contemporary architecture as represented by significant practices, buildings, theories, and criticisms. Themes to be considered include globalization, the role of digital design media, the ethics and aesthetics of sustainability, contemporary urbanism, new approaches to materials and structure, and recent interests in ornament and pattern-making. Current conditions will be related historically to postwar reactions to modernism and contextually to the social and technological shifts of recent decades.

#### Planning Law and Land Policy - ARCH 462

Since the introduction of basic zoning laws to the numbers and complexity of ordinances attached to any land parcel have proliferated to include those addressing land use, development, density, environmental concerns both on and off site, aesthetic mandates, energy use, quality of life concerns, and infrastructure development, the growing understanding that comprehensive and integrated systems must be managed across property lines to effect sustainable planning and communities will accelerate the number of prescriptive and policy ordinances enforced at the development of a parcel. Many agencies have further created extra-legal linkages between approvals for land development and the provision of social and ideological benefits to the community. The impact on the profession of architecture of the panoply of planning options and governmental goals is the result that the navigation of the system of mandated design determinates is one of the initial and potentially most creative acts in the process of project delivery. Project designers must understand the ramifications and trade-offs inherent in the system, especially in any attempt to achieve the best use of any parcel of land and position the most appropriate built environment.

### Biology

#### Introduction to Biology - BIO 105

This course, designed for non-majors, considers basic concepts and selected topics in biology beginning at the molecular level and ending with the biosphere. Topics include the following: the chemistry and structure of cells in plants and animals; how cells obtain and use energy; basic genetics and the role of biotechnology in agriculture and medicine; evolution, natural selection, and species formation; the origin and diversity of microbial, plant, and animal life; ecology, organisms, and their environments; and the impact of human population growth and human activity on the systems and resources of our planet.

## Industrial Technology and Management

### Chemical Manufacturing Processes in Industry - INTM 433

This course provides an overview of current and emerging chemical processes employed in the energy, food, drug, and plastics sectors. Current and future impacts of various manufacturing processes on society, environment, and sustainability are covered as are issues related to OSHA, EPA, FDA, USDA, and other regulatory systems. The various implications of recovery and reuse are explored as well as new non-polluting, zero-emissions processes and technologies. Students will gain an appreciable understanding of "how it's made" and the range of chemical processes and related technical challenges involved in manufacturing. A background in chemistry is not required.

## Mechanical, Material, and Aerospace Engineering

### Design for Innovation - MMAE 232

Design and development of mechanical systems. The design process, isometric sketching, engineering drawings, CAD, sustainable design, whole-system design and lifecycle thinking, design for product lifetime, lightweighting, technical writing, bio-inspired design process, bio-inspired design for locomotion, mechanism and linkage design, actuators, triggers, engineering and ethics, and engineering and law. Team-based design and build projects focusing on sustainable design techniques, bio-inspired locomotion, and mechatronics.

## Graduate Sustainability Focused Courses

### Architecture

#### Urban Ecology - ARCH 505

Students will develop a sensitivity to the environment in which architecture is created. Emphasis will be placed on an in-depth exposure to the integration of natural features of site, sustainable components of both natural and man-made systems, and the synergy of ecological design.

#### Design of Energy Efficient Buildings I - ARCH 551

Design criteria for achieving human performance goals in energy-efficient buildings, criteria for the exterior/interior environment, and criteria for architectural, mechanical, electrical and building system components. Building upon the fall course, various energy-conserving strategies shall be evaluated for achieving cost effective, energy-efficient design of a specific building type.

#### Design of Energy Efficient Buildings II - ARCH 552

Design criteria for achieving human performance goals in energy-efficient buildings, criteria for the exterior/interior environment, and criteria for architectural, mechanical, electrical and building system components. Building upon the fall course, various energy-conserving strategies shall be evaluated for achieving cost effective, energy-efficient design of a specific building type.

#### Talking TALL I - ARCH 570

Talking TALL I will fully examine the physical, environmental, and social sustainability implications of tall buildings at human, architectural, and urban scales in order to offer students extensive and in-depth knowledge and resources to investigate tall buildings and future cities. The aspects of TALL buildings covered in this course include their design principles, technologies, appropriateness to context, energy consumption, life-cycle considerations, natural ventilation, vertical greenery, facades, new typologies, and more. The aspects of TALL cities covered include an analysis of vertical urbanism vs. suburban sprawl, transportation and infrastructure implications, quality of life for residents in tall urban environments, etc., -- all ultimately with a view to a discourse on what should constitute a holistic vision of "sustainable vertical urbanism."

## Talking TALL II - ARCH 571

Talking TALL II will fully examine the physical, environmental, and social sustainability implications of tall buildings at human, architectural, and urban scales in order to offer students extensive and in-depth knowledge and resources to investigate tall buildings and future cities. The aspects of TALL buildings covered in this course include their design principles, technologies, appropriateness to context, energy consumption, life-cycle considerations, natural ventilation, vertical greenery, facades, new typologies, and more. The aspects of TALL cities covered include an analysis of vertical urbanism vs. suburban sprawl, transportation and infrastructure implications, quality of life for residents in tall urban environments, etc., -- all ultimately with a view to a discourse on what should constitute a holistic vision of "sustainable vertical urbanism." While Talking TALL I focuses mostly at the urban scale, Talking TALL II focuses more on the detailed building/technological scale.

## Chemical Engineering

### Renewable Energy Technologies - CHE 541

The course will cover three topics related to renewable Energy Technologies. 1. Review of renewable energy sources; solar, wind, biomass, etc. 2. Energy storage and conversion with emphasis on batteries and fuel cells 3. Hydrogen as an energy carrier and the Hydrogen Economy.

## Chemistry

### Energy, Environment, and Economics - CHEM 543

The linkage of energy, environmental and economic issues. The impact of energy supply and end use on human well-being and the ecosystem. A comprehensive approach to the resolution of resource, technical, economic, strategic, environmental, socio- and geopolitical problems of the energy industries. Pathways to a sustainable global energy system.

## Civil and Architectural Engineering

### Energy Conservation Design in Buildings - CAE 526

Identification of the optimal energy performance achievable with various types of buildings and service systems. Reduction of infiltration. Control systems and strategies to achieve optimal energy performance. Effective utilization of daylight, heat pumps, passive and active solar heaters, heat storage and heat pipes in new and old buildings.

### Applied Building Energy Modeling - CAE 550

This course introduces students to building energy modeling software and techniques that are widely used in industry applications. The course is practice-oriented and builds upon building energy modeling methods as they are practiced in engineering offices (using IES software). The course centers on the two most common types of energy models in practice: (1) models for LEED and code compliance, and (2) parametric models for evaluating energy conservation measures. During the first half of the course, students will learn modeling methods and assumptions to create an energy model of an actual building project for the LEED Energy and Atmosphere credit with all supporting documents required for LEED submission. In the second half of the course, students will learn to analyze energy conservation measures using parametric energy models. The course will also focus on advanced energy modeling topics, such as modeling HVAC systems and controls, passive techniques, composite fenestration, thermal bridges, thermal mass, and others. At the end of the course, students will have two complete energy models that they can use in their portfolio.

#### Net Zero Energy Home Design Competition I - CAE 556

This is a project-based course in which students will compete in the Department of Energy's annual Race to Zero home design competition. The goal is for an interdisciplinary team of students to design and provide full documentation for a home that meets the Department of Energy's Zero Energy Ready Home Requirements. Teams are expected to effectively and affordably integrate principles of building science, construction engineering and management, economic analysis, and architectural design in an integrated design process. Teams will be required to submit full sets of plans, drawings, renderings, construction details, and analyses for energy efficiency, costs, and affordability. The competition is designed to provide the next generation of architects, engineers, construction managers, and entrepreneurs with skills and experience to start careers in clean energy and generate creative solutions to real-world problems. Part 1 of a 2 part course.

#### Net Zero Energy Home Design Competition II - CAE 557

This is a project-based course in which students will compete in the Department of Energy's annual Race to Zero home design competition. The goal is for an interdisciplinary team of students to design and provide full documentation for a home that meets the Department of Energy's Zero Energy Ready Home Requirements. Teams are expected to effectively and affordably integrate principles of building science, construction engineering and management, economic analysis, and architectural design in an integrated design process. Teams will be required to submit full sets of plans, drawings, renderings, construction details, and analyses for energy efficiency, costs, and affordability. The competition is designed to provide the next generation of architects, engineers, construction managers, and entrepreneurs with skills and experience to start careers in clean energy and generate creative solutions to real-world problems. Part 2 of a 2 part course.

#### Electrical and Computer Engineering Department

##### Elements of Sustainable Energy - ECE 580

This course covers cross-disciplinary subjects on sustainable energy that relate to energy generation, transmission, distribution, and delivery as well as theories, technologies, design, policies, and integration of sustainable energy. Topics include wind energy, solar energy, biomass, hydro, nuclear energy, and ocean energy. Focus will be on the integration of sustainable energy into the electric power grid, the impact of sustainable energy on electricity market operation, and the environmental impact of sustainable energy.

#### Environmental Engineering Department

##### Environmental Chemistry - ENVE 501

Chemical processes in environmental systems with an emphasis on equilibrium conditions in aquatic systems. Processes examined include acid-base, dissolution precipitation, air-water exchange, and oxidation-reduction reactions. Methods presented for describing chemical speciation include analytical and graphical techniques as well as computer models.

##### Chemodynamics - ENVE 506

Processes that determine the fate and transport of contaminants in the environment. Upon successful completion of this course, students should be able to formulate creative, comprehensive solutions to transport problems, critically evaluate proposed solutions to transport problems, and acquire and integrate new information to build on these fundamentals.

### Biotechnological Processes in Environmental Engineering - ENVE 513

Fundamentals and applications of biological mixed culture processes for air, water, wastewater, and hazardous waste treatment. Topics include biochemical reactions, stoichiometry, enzyme and microbial kinetics, detoxification of toxic chemicals, and suspended growth and attached growth treatment processes. The processes discussed include activated sludge process and its modifications, biofilm processes including trickling filters and biofilters, nitrogen and phosphorus removal processes, sludge treatment processes including mesophilic and thermophilic systems, and natural systems including wetlands and lagoons.

### Modeling of Environmental Systems - ENVE 528

To introduce students to mathematical modeling as a basic tool for problem solving in engineering and research. Environmental problems will be used as examples to illustrate the procedures of model development, solution techniques, and computer programming. These models will then be used to demonstrate the application of the models including simulation, parameter estimation, and experimental design. The goal is to show that mathematical modeling is not only a useful tool but also an integral part of process engineering.

### Physiochemical Processes in Environmental Engineering - ENVE 542

Fundamentals and applications of physicochemical processes used in air, water, wastewater, and hazardous waste treatment systems. Topics include reaction kinetics and reactors, particle characterization, coagulation and flocculation, sedimentation, filtration, membrane separation, adsorption, and absorption.

### Industrial Waste Treatment - ENVE 551

Industrial waste sources and characteristics, significance of industrial waste as environmental pollutants; applications of standard and special treatment processes including physical, chemical, and biological systems.

### Design of Environmental Engineering Processes - ENVE 561

Design of water and wastewater treatment systems. System economics and optimal design principles.

### Air Pollution Meteorology - ENVE 570

Physical processes associated with the dispersion of windborne materials from industrial and other sources. Atmospheric motion including turbulence and diffusion, mathematical models, and environmental impact assessment.

### Indoor Air Pollution - ENVE 576

Indoor air pollution sources, indoor pollutant levels, monitoring instruments and designs, and indoor pollution control strategies; source control, control equipment and ventilation; energy conservation and indoor air pollution; exposure studies and population time budgets; effects of indoor air pollution; risk analysis; models for predicting source emission rates and their impact on indoor air environments.

### Design of Air Pollution Control Devices - ENVE 577

Indoor air pollution sources, indoor pollutant levels, monitoring instruments and designs, and indoor pollution control strategies; source control, control equipment and ventilation; energy conservation and indoor air pollution; exposure studies and population time budgets; effects of indoor air pollution; risk analysis; models for predicting source emission rates and their impact on indoor air environments.

### Physical and Chemical Processes for Industrial Gas Cleaning - ENVE 578

Application of physical and chemical processes in the design of air treatment systems; fundamentals of standard and special treatment processes.

#### Hazardous Waste Engineering - ENVE 580

Sources and characteristics of hazardous wastes, legal aspects of hazardous waste management, significance of hazardous wastes as air, water, and soil pollutants. Principles and applications of conventional and specialized hazardous waste control technologies.

#### Environmental Engineering Seminar - ENVE 590

Current topics in environmental engineering featuring presentations by practitioners from a range of institutions such as academia, industry, consulting, research laboratories, or government.

## Industrial Technology and Management

#### Sustainable Facilities Operations - INTM 523

Maintaining and managing buildings and facilities is a challenging, multifaceted occupation. Facilities are becoming smarter and greener as the goals of energy conservation and occupant comfort have shifted to include environmental responsibility. This course examines facility operations and management (O&M) related to sustainability and green technology, with an emphasis on the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) requirements, rating system, and the process for properties to apply for certification as a resource-efficient operation.

#### Issues in Industrial Sustainability - INTM 559

Examines the concept of sustainability and its application in the industrial environment. Identifies underlying stresses on natural and human environments and the resultant problems for business and society including legal, ethical, and political issues related to sustainability. Global warming, peak oil, and commodity pricing are considered as indicators of the need for improvements in sustainability. Industrial ecology will be discussed as well as strategies for developing sustainable practices in manufacturing, power generation, construction, architecture, logistics, and environmental quality. Coverage includes case studies on businesses that have developed successful sustainability programs.

#### Sustainability of Critical Materials - INTM 560

This course explores the limitations in supply and the need for sustainable use of carbon and non-carbon-based materials such as oil, minerals, food, water, and other natural resources used by industry. Limitations in the global availability of such resources pose challenges to industry which will require careful consideration and planning to ensure continued prosperity for current and future generations. Course will cover strategies and options to mitigate anticipated shortages and optimize the use of non-renewable natural resources, review of fuel and raw material pricing, and cost/benefit analysis of sustainable development proposals. Technical analyses will be presented during class discussions, but a technical background is not required.

#### Energy Options for Industry - INTM 561

Carbon-based fuels are a limited resource and within decades will be in very short supply. Associated energy costs will increase and industry will be required to incorporate alternate fuels and/or power sources, such as uranium (for nuclear power), hydroelectric, geothermal, wind, wave, solar, etc. This course presents such energy options and explores the anticipated impact on industry.

#### Special Topics in Sustainability - INTM 562

This course allows the student to research and report on an industrial sustainability issue of interest and relevance to their career objectives. Topics may touch on industrial ecology, ethics, regulations, environment, resource use, alternative manufacturing methods, facilities, logistics, etc. This is the fourth course in a specialization in industrial sustainability.

## Institute of Design

### Sustainable Solutions Workshop - IDN 573

In this course students will learn how to apply design methods and strategic thinking through open innovation practices for leveraging the interconnectivity of markets, technology, finance, and social networks in order to envision sustainable solutions with impact in the local lives and well-being of communities.

### Sustainable Systems Seminar - IDN 575

In this course students will learn key principles and concepts on complex adaptive systems in relation to human-centered design for understanding how product and service innovation can shape sustainable value webs and marketplaces

## Marketing Analytics

### Managing Sustainable Brands - MAX 513

This is a traditional brand management course applied to green or sustainable brands which are becoming more and more important in the global economy. The most valuable assets that a company has are the brands that it has developed and invested over time. Students will explore the components of a brand, its equity, and emotional benefits and gain an understanding of how to develop a meaningful brand relationship with the customer or prospect to optimize the brand or brand portfolio. The class will also explore the various aspects required to champion a new product or service from development to launch by optimizing the execution through all the marketing efforts of the firm. Students will address positioning, channel strategies, trade promotion, budgeting as a part of the planning process, new product development, packaging and merchandising, and the management of agency relationships. Like people, brands have unique personalities that differentiate them and drive their ability to grow or limit their ability to expand.

## MBA Business

### Sustainable Supply Chain Management - MBA 526

We will present models and practices that minimize supply-demand mismatch and therefore maximize companies' own profitability as well as models and practices of collaboration with other companies in a supply chain that minimize risk and environmental costs and therefore maximize the supply chain's sustainability. This course will have an emphasis on the integration of business and technology aspects. We will first introduce an integrated view of the production and logistics functions in organizations such as capacity analysis, inventory management, and logistics management. The course then discusses topics involved in the interaction of a firm with others players in a supply chain such as value of information, supply contracts, and risk sharing. Finally, the course will introduce models/tools enabling sustainability actions plans, for example, reducing waste in the supply chain, both upstream and downstream.

## Public Administration

### Energy and Environmental Policy - PA 558

This course requires successful completion of at least one other course marked with a satisfaction of IIT's Basic Writing Proficiency Requirement. This course places energy and environmental policy in domestic and global contexts. It also traces the economic and political implications of dependence on fossil fuels and the attempt to develop alternate energy sources and promote conservation. It assesses the environmental effects of resource consumption and the effort to control these effects by increased efficiency and regulation of pollution, and explores

such problems such as nuclear waste, acid rain, global warming, and deforestation. Finally, it examines national and international attempts at economic, political, and technological solutions.

## Sustainability Management

### Fundamentals of Environmental Science - SMGT 500

This is an introductory course designed to teach students without any background in environmental science the fundamentals of environmental science which is the prerequisite knowledge needed for the Sustainability Management program core courses. It covers basics of environmental science, calculus, chemistry, and other relevant topics that represent a needed foundation for the other courses in the program. Students with prior education in environmental science or related subjects could be waived out of this course with approval from the program director.

### Environmental Policy in a Competitive World - SMGT 501

This is an introductory course designed to teach students without any background in environmental science the fundamentals of environmental science which is the prerequisite knowledge needed for the Sustainability Management program core courses. It covers basics of environmental science, calculus, chemistry, and other relevant topics that represent a needed foundation for the other courses in the program. Students with prior education in environmental science or related subjects could be waived out of this course with approval from the program director.

### Contemporary and Emerging Laws Governing the Environment - SMGT 502

This course introduces students to major federal laws that govern the environmental performance of regulated facilities, sites, and activities. The course describes why these laws were enacted, how they are implemented by regulatory agencies, and the practical measures regulated entities must employ to achieve compliance. These laws include the National Environmental Policy Act, the Clean Water Act, the Clean Air Act, the Endangered Species Act, the Resource Conservation and Recovery Act, and the Comprehensive Environmental Response, Compensation, and Recovery Act. The review of these major federal laws will be informed by international and state initiatives that also affect decision making on environmental matters. The course will include a series of case studies and skill development sessions to introduce students to the practical realities of environmental management in a complex regulatory context.

### Environmental Pollution Prevention and Control Strategies - SMGT 503

Greening organizations benefit both firms and society as a whole by eliminating/reducing pollution, inventing new processes, and reducing risks. This course focuses on the design and development of environmental management strategies specific to industrial operations and economic development activities in order to make them more competitive and sustainable. Specifically discussed in this course are the techniques and tools for mapping and characterizing industrial operation and economic development activities, identifying sources and types of environmental pollution, and defining steps involved with designing pollution prevention/control strategies and their alternatives (i.e., changing inputs, increasing efficiency, promoting innovation, or adopting new technologies to either prevent emissions or treat residuals). The economics of the pollution prevention/control including cost valuation and cost-benefit analysis are covered in addition to discussing the limitations and risks.

### Industrial Ecology and Systems Thinking - SMGT 504

This course introduces the students to the philosophy of industrial ecology and how this systems-based approach can move society toward a more sustainable future. Industrial ecology is an interdisciplinary field involving technology (science and engineering), public policy and regulatory issues, and business administration. The major goal of this course is to promote creative and comprehensive problem solving as it might be applied to product, business, and systems models. The course introduces tools such as industrial metabolism, input-output analysis, life cycle

assessment, and design for the environment. Individual and team projects are a significant part of the learning experience in this course.

#### Environmental Finance - SMGT 505

The emerging field of environmental finance provides businesses an opportunity to approach environmental challenges in a financially sustainable and often profitable manner. The course will introduce students to fundamental concepts of microeconomics, macroeconomics, and accounting in order to prepare them for studying finance and other SMGT courses. It will explore implications of environmental finance on the financial sector ranging from banking, insurance, investments, financial services, sustainable investing, and social enterprise. The role of hedging devices for pollution and energy and the role of corporate advocacy in environmental policy and standards will be addressed from a corporate competitive business strategy perspective. The interrelationship between financial and environmental performance will be discussed with a focus on corporate risk management and impact on stock and bond ratings. Format will comprise of introduction of basic concepts, discussion of select current publications from corporate and academic thought leaders, and cases or examples that provide hands-on experience.

#### Solid and Hazardous Waste Management and Remediation - SMGT 511

The aim of this course is to teach the modern multi-faceted approach of the management of solid waste focusing on the generation and prevention (emphasis is on understanding what waste is, where it comes from, how/why it is generated, and how generation of waste can be reduced), re-use and recycling (once waste is generated, what can be done to make use of those waste components that are of economic interest), treatment (discuss the three most important treatment/disposal methods presently in use both in the less and the more developed world, landfills, incineration, and mechanical/biological treatment), and disposal of waste (examples include analysis and environmental impact assessment of land filling and incineration). RCRA technical and regulatory points of views are covered, and discussed are evolution of RCRA legislation, components of RCRA, and its interrelationship to other environmental statutes CERCLA, SARA, and DNR hazardous waste permitting. Also discussed are the fundamentals of remedial actions, Brownfield's redevelopment, and renewable energy. The emphasis would be on the economic, social, and environmental costs of waste generation, recycling, treatment, and storage.

#### Environmental Risk Assessment and Management - SMGT 512

The course provides an overview of the tools and techniques used to (1) assess environmental (human health), ecological, and occupational risks associated with exposure to environmental pollutants resulting from natural phenomena, economic development, and industrial growth, (2) examine current risk management and mitigation methods and strategies, and (3) design visionary risk management strategies grounded on a framework of operations in line with the principles of sustainable development.

#### Environmental Economics and Climate Change - SMGT 513

An overview of the modeling market process is provided focusing on externalities, environmental problems, and environmental quality. Economic solutions to environmental problems are discussed using a market approach which includes modeling emission charges, modeling a product charge, modeling per unit subsidy on pollution reduction, and modeling pollution permit trading systems and practice. The course examines institutional economic solutions to address environmental problems such as climate change, global warming, and water scarcity.

#### Ethics and Corporate Responsibility - SMGT 518

The corporate scandals and implosions of the past decade, climaxing in the recent global financial crisis and environmental disasters, have highlighted how critical ethical, environmental, and socially responsible decision making and leadership are to the long-term survival and success of both individual businesses and society. Concomitantly, the role of business is transforming from meeting a social contract to realizing tangible economic gains by creating shared value. In today's global environment, societal needs are defining markets, and key issues include poverty, hunger, water, sustainability, climate change, and MNC roles in developing economies. Ethical issues include bribery, fraud, and green washing all the way to a culture of corruption. Corporations and leaders have

to manage corporate social responsibility not just as a moral obligation or risk/reputation management exercise but as an integration into their global strategy. This course will endeavor to teach students how these issues get integrated in business through strategy and structure and how to build new competencies in managing transparency, accountability, stakeholder engagement, ethics culture, and social innovation that are critical for business success in the next economy.

#### Environmental Performance Analytics - SMGT 525

With increasing focus on sustainability factors from marketplace (regulators, investors, financiers, and consumers), corporate sustainability reporting is shifting from voluntary to vital. Advances in enterprise systems are making it feasible for corporations to track, trend, and transform sustainability performance. Materiality of these seemingly non-economic impacts is the critical link between sustainability and business strategy. This course provides insight into how to determine which environmental metrics are material to them and relevant to their business through application of environmental performance analytics. Format will comprise of introduction of basic concepts, discussion of select current publications from corporate and academic thought leaders, and short cases or examples that provide hands-on experience. Students completing this course will develop a better understanding of the materiality of interrelationships between business and sustainability. In particular, they will equip themselves with the ability to apply data collection, analytics, and quantitative justification to promote select sustainability improvements that are consistent with corporate strategy. This will help them to be better prepared to take on greater responsibilities in a consulting or advisory role to the corporate sector.

#### Sustainable Supply Chain Management - SMGT 526

Students will be presented with models and practices that minimize supply-demand mismatch and therefore maximize companies' own profitability as well as models and practices of collaboration with other companies in a supply chain that minimize risk and environmental costs and therefore maximize the supply chain's sustainability. This course will have an emphasis on the integration of business and technology aspects. We will first introduce an integrated view of the production and logistics functions in organizations such as capacity analysis, inventory management, and logistics management. The course then discusses topics involved in the interaction of a firm with others players in a supply chain such as value of information, supply contracts, and risk sharing. Finally, the course will introduce models/tools enabling sustainability actions plans, for example, reducing waste in the supply chain, both upstream and downstream.

#### Environmental Advocacy - SMGT 531

This course explores how individuals, firms, nonprofits, and others advocate in order to achieve environmental goals using a broad range of advocacy tools in the legislative, regulatory, administrative, political, judicial, and educational arenas. The course examines when, where, and how advocacy can be effective, strategies for framing policies, how to evaluate legal and ethical factors, and how to use traditional as well as grassroots, social networking, and other evolving new media methods to support an advocacy campaign.

#### Environmental and Energy Law Clinic - SMGT 532

This course provides students with the opportunity to experience the practical realities of being an environmental professional by working on actual cases under the supervision of a faculty member who is an experienced environmental attorney with a Chicago-based practice. The course includes weekly classroom sessions to build the skills environmental professionals must possess. Students apply these skills to cases in the Chicago area in which the faculty supervisor represents non-governmental organizations. The Clinic includes opportunities to participate in site visits, client interactions, a variety of professional meetings, and regulatory and enforcement proceedings. Students will engage in fact gathering, compliance analysis, client communication and case preparation activities, working alongside their faculty supervisor.

#### Managing Energy Technologies - SMGT 541

A significant focus of this course will be on what environmental managers and business managers need to know regarding the technical aspects of energy management -- energy efficiency and fossil and renewable energy technologies. The thrust of the course will be in understanding current and emerging technologies in this rapidly growing area of business and industry. However, students will not need to have technical or engineering background to do well in this course.

#### Economics of Energy Systems - SMGT 542

Students will see the big picture economics of energy management -- cost of production/distribution, financing renewable investments, climate change, etc. Students will understand the economic, strategic, and management issues surrounding energy management and have an opportunity to learn new tools and techniques.

#### Special Topics in Sustainability Management - SMGT 595

This course covers contemporary or cutting edge topics in the sustainability management field.

## **Graduate Sustainability Related Courses**

### **Architecture**

#### Topics in Advanced Technology - ARCH 509

This research seminar examines advances in the technologies that affect the practice of architecture. The course examines leading technologies, processes, and applications, and their role in building design and production. The course will navigate the broad and varied materials related to advanced technologies in architecture by focusing on specific applications for specific projects. Students may select between varying and diverse topics offered by the faculty that may include building envelopes, architectural materials, building and environmental systems, advanced structural design, energy and sustainability, architectural acoustics and lighting, fabrication, and computer-aided design technologies.

#### Master's Project Preparation: Research Analysis and Planning - ARCH 523

Identification and development of the proposal for the master's project. Development of the project will include a comprehensive listing of all necessary program elements, research, analysis and selection of site, a statement of design parameters, project objectives, or similar project characteristics. Projects will be selected from eight areas of focus: sustainable cities, building delivery practices, community-based planning, research/history/theory, research/advanced technologies, housing and urban design, high-rise typology, and cultural institutions.

### **Civil and Architectural Engineering**

#### Building Enclosure Design - CAE 524

Design of building exteriors, including the control of heat flow, air and moisture penetration, building movements, and deterioration. Study of the principle of rain screen walls and of energy conserving designs. Analytical techniques and building codes are discussed through case studies and design projects.

#### Control of Building Environmental Systems - CAE 527

Introduction to automatic control systems. Control issues related to energy conservation, indoor air quality and thermal comfort in buildings. Classification of HVAC control systems. Control systems hardware: selection & sizing of

sensors, actuators & controllers. Practical HVAC control systems; elementary local loop and complete control systems. Case studies. Computer applications.

#### Transportation Systems Evaluation - CAE 550

Concepts and principles of transportation economic analysis, transportation costs and benefits, user and nonuser consequences, needs studies, finance and taxation, methods for evaluation of plans and projects, cost-efficiency, cost-effectiveness, environmental impact assessment, and economic development assessment.

## Electrical and Computer Engineering

#### Elements of Smart Grid - ECE 581

This course covers cross-disciplinary subjects on sustainable energy that relate to energy generation, transmission, distribution, and delivery as well as theories, technologies, design, policies, and integration of sustainable energy. Topics include wind energy, solar energy, biomass, hydro, nuclear energy, and ocean energy. Focus will be on the integration of sustainable energy into the electric power grid, the impact of sustainable energy on electricity market operation, and the environmental impact of sustainable energy.

## MBA Business

#### Social Entrepreneurship - MBA 529, SMGT 529, PA 550

This course gives students a practical introduction to the exciting and rapidly growing field of social entrepreneurship. The course will begin by introducing students to contemporary understandings of poverty, its causes, and traditional poverty alleviation strategies. It will then turn to key concepts regarding social ventures including entrepreneurship, organizational structures (for-profit, non-profit, and hybrid), financing, marketing, and performance assessment (social and environmental impact). We will also examine the challenges that are faced in creating and operating social enterprises in different parts of the world. The course includes guest lectures by other Stuart School of Business faculty and social entrepreneurs working in different areas (such as health, education and environment). Students will gain hands-on experience by either developing a business plan for a social enterprise to address a specific real world problem or assisting an existing social venture in developing a business plan geared towards an expansion of its services. It is expected that the plans can be entered into a variety of social venture competitions.

#### Building an Innovative and Sustainable Business - MBA 510

This is an introductory course on the fundamentals of doing business in an increasingly interconnected and hypercompetitive world where rapid information flows, environmental degradation, and societal challenges (e.g., poverty and ethics) can be viewed as both threats and opportunities facing for-profit enterprises. Students will learn that sustainable businesses are also innovative businesses and that sustainability often drives innovation. Students will not only be exposed to the basics of starting, growing, and running a profitable business but also learn how to do so in an environmentally and socially sustainable fashion. They will learn how companies create and capture value and how to analyze the business environment, industry, competitors, and customers. They will be introduced to corporate, business, and functional strategy and learn about different business functions (accounting, finance, operations, marketing, and information management). Students will be introduced to critical challenges of global sustainability and will explore through case studies how leading companies are implementing triple bottom line accounting, sustainable growth, and stakeholder value creation strategies. Finally, they will develop an innovative business idea to start a brand new company that has sustainable growth in its mission statement.

## Mechanical, Material, and Aerospace Engineering

#### Nuclear, Fossil Fuel, and Sustainable Energy Systems - MMAE 522

Principles, technology, and hardware used for conversion of nuclear, fossil-fuel, and sustainable energy into electric power will be discussed. Thermodynamic analysis -- Rankine cycle. Design and key components of fossil-fuel power plants. Nuclear fuel, reactions, materials. Pressurized water reactors (PWR). Boiling water reactors (BWR). Canadian heavy water (CANDU) power plants. Heat transfer from the nuclear fuel elements. Introduction to two phase flow: flow regimes; models. Critical heat flux. Environmental effects of coal and nuclear power. Design of solar collectors. Direct conversion of solar energy into electricity. Wind power. Geothermal energy. Energy conservation and sustainable buildings. Enrichment of nuclear fuel. Nuclear weapons and effects of the explosions.

#### Fundamentals of Power Generation - MMAE 523

Thermodynamic, combustion, and heat transfer analyses relating to steam-turbine and gas-turbine power generation. Environmental impacts of combustion power cycles. Consideration of alternative and sustainable power generation processes such as wind and tidal, geothermal, hydroelectric, solar, fuel cells, nuclear power, and microbial.

Prerequisite: An undergraduate course in applied thermodynamics.