IGERT

University of Texas at Austin

Sustainable Grid Integration of Distributed and Renewable Resources

IGERT Curriculum					
Course #	**Title**	**Description**	**Instructor**	**Frequency**	**Reference***
ARE 381E/ CE381E	Design of Energy Efficient and Healthy Buildings	Design of buildings for low energy use and optimal indoor air quality. Includes ventilation, energy efficiency, moisture problems, and prevention by design	**Siegel**	Every other Spring (2012)	**Steve Bourne**
ARE 383/ CE 397	Energy Simulation in Building Design	Fundamentals of building energy simulations including basic analytical models for heat and mass transfer in building elements and general numerical methods for solving system of equations. Use of energy simulation tools for building design analyses.	**Novoselac**	Fall	**Steve Bourne, Josh Rhodes**
CE 389H	HVAC Design	Design of heating, ventilation, and air-conditioning systems	**Novoselac**	Spring	**Wesley Cole**
CE 397	Renewable Energy/Environmental Sustainability	The prerequisites for undergrads are Applied Thermodynamics (ME 320) and Building Environmental Systems (ARE 346N). Course objectives are to understand causes and consequences of global climate change, estimate ecological footprints, solve environmental sustainability problems using mass and energy balances, apply input-output technique in environmental life-cycle assessment, and assess potential for use of different forms of renewable energy	**Xu**	Spring	
CH 390L	Electrochemical Methods	Fundamentals of electrochemistry and the application of electrochemical methods to chemical problems. Special emphasis on the study of electrode reaction mechanisms and the interpretation of electrochemical results (e.g., cyclic voltammetry) for organic and inorganic systems. A rigorous consideration of voltammetric and coulometric methods and several topics of interest in electrochemistry (for example: modified electrodes, photoelectrochemistry, scanning electrochemical microscopy). Students are assumed to have some background in the physical chemistry of solutions, potentiometry, polarography and electroanalytical chemistry at the general level of undergraduate courses and CH 381M.	**Bard**	Fall Every other year (2011)	
CH 390L	Advanced Analytical Chemistry: Electrochemistry	Covers the theory and practice of a broad spectrum of advanced electrochemical analytical methods including: scanning electrochemical microscopy. rotating disk electrodes, and impedance spectroscopy, as well as hybrid techniques for in situ and ex situ study of interfaces: FTIR, Raman, XAFS, XPS, LEED, MS, SPM, and EQCM. Phenomena studied include interaction of light and electrochemistry in photoelectrochemical processes at semiconductor electrodes and electrogenerated chemiluminescence, inner sphere reactions, adsorption, surface reactions, electrocatalysis, and modified electrodes. Analytical techniques for studies of electrochemical devices such as batteries, fuel cells, supercapacitors, and sensors. Some modeling (computer simulation) with Multi-physics.	**Bard**	Every other Fall (2012)	

ChE 384	Energy Policy & Technology	Survey of energy technologies and policy issues covers U.S energy supplies/origin and occurrence; oil exploration and production, CO2 sequestration, coal extraction, combustion, gasification, liquefaction; recovery of oil shale/tar sands; climate change and energy utilization, energy policy; energy and transportation; fuel cells, hydrogen economy, solar energy, wind power, geothermal; nuclear power; biomass production and conversion; and energy conservation.	**Edgar**	Fall	**Hunter Estes, Wesley Cole, Dave Tuttle**
EE 369	Power Systems Engineering	Topics include complex power, phasors, balanced three phase, transformers and per-unit system, transmission line parameters, steady state operation of transmission lines, the power flow problem, symmetrical faults, power system controls, economic operation of power systems, optimal power flow, and deregulation and restructuring. Pre-requisite: Electrical Engineering 438 (or 338) or 331 or 331K.	**Baldick**	Fall	**Dave Tuttle, Hunter Estes**
EE 394-9	Power Quality	The study of electrical transient and harmonic phenomena in utility distribution and industrial power systems. Topics include roles of current and impedance, characteristics and definitions, voltage sags and swells, overcurrent protections, electrical transients and switching surges, harmonics, effects of distributed generation, solutions and mitigations, standards on power quality and harmonics.	**Santoso**	Fall/ Spring	**Hunter Estes**
EE 394V	Distributed Generation Technologies	Covers distributed generation technologies. Topics include distributed generation and microgrids elements; microsources; energy storage; power electronics interfaces; dc and ac architectures; economics, operation, stabilization, and control; reliability aspects; and grid interconnection, "smart" grids.	**Kwasinski**	Fall	**Hunter Estes, Greg Dahlberg, Amir Toliyat, Dave Tuttle, Hunter Estes**
EE 394V	Advanced Power Electronics	- Modeling and analysis of dc-dc converters. Analysis of switched systems. - Linear and nonlinear control methods in power electronics. - Effects of real components in power electronics circuits, including semiconductor switches, capacitors, inductors, loads, and sources. - Design issues in highly-efficient energy conversion systems. - Practical issues such as thermal management and transient overshoots control - Inverter controls and application to variable speed drives for induction machines. - Elements of reliability in power electronics circuits.	**Kwasinski**	Fall Every other year	**Dave Tuttle**
EE 394J-2	Power Systems Engineering II	Physical features, operational characteristics, and analytical models for major electric power systems and components	**Grady**	Spring	**Greg Dahlberg, Dave Tuttle, Hunter Estes**
EE 396K	Organic and Polymer Semiconductor Devices	Theory of electron, magnetic, and electro-optic devices.	**Dodabalapur**	?	

EE 379K	Renewable Energy	Introduction to renewable energy sources and their integration into power systems. Includes wind energy: resources, turbines, blades, rotor power characteristics, generators, active and reactive power, variability, and voltage regulation; solar energy: resources, solar radiation measurements, photovoltaic materials and properties, photovoltaic electrical characteristics, and system integration; and demonstration with commercial- grade solar panels and laboratory-scale wind turbines.	**Grady**	Fall	**Greg Dahlberg, Dave Tuttle**
EE 380N	Optimization of Engineering Systems	Formulation and solution of continuous optimization problems in engineering design.	**Baldick**	Fall	
EE 394L	Power System Apparatus & Lab	Fundamentals of power systems emphasized through laboratory experiments. Includes complex power, three-phase circuits, per-unit system, transformers, synchronous machines, transmission line models, steady-state analysis, induction machines, capacitor banks, protective relaying, surge arrestors, and instrumentation.	**Santoso**	Spring	**Dave Tuttle**
EE 394V	Modeling and Simulation of Wind Power Plants	Time-domain simulations of dynamic models of wind turbines and power plants; aerodynamic models of three-bladed turbines, multi-mass models of drive trains, reference frame theory, Park and Clarke transforms, dynamic models of induction machines, vector controls, modeling of fixed-speed direct-connect, wide-slip, doubly-fed, full-power converter turbines.	**Santoso**	Spring	**Dave Tuttle**
EE 394V	Restructured Electricity Markets: Locational Marginal Pricing	This course focuses on the "locational marginal pricing" model of day-ahead and real-time electricity markets, which is in place in the Eastern United States, in the Midwest United States, California, and most recently in Texas from December 2010. We will formulate the market dispatch problem as an optimization problem, consider transmission and unit commitment issues, and discuss pricing rules and incentives in markets, particularly in the context of transmission limitations. Other topics include energy and transmission price risk hedging, network models, and revenue adequacy of financial transmission rights. Also covered are mixed-integer programming approach to unit commitment, the representation of voltage constraints into market models, and the design of electricity markets to mitigate market power.	**Baldick**	Spring	**Dave Tuttle**
EE 394-14	Electrical Transients in Power Systems	Analysis and modeling of electrical transient phenomena in power systems, traveling wave, insulation coordination, overvoltage protection.	**Grady**	Last offered Spring '08	
EE 394-7	Power Electronic Devices and Systems	Steady-state and transient analysis; symmetrical components, stability, protection, relaying. A study of power electronic components and circuits; hvdc converters; electronic drives for machines; ac/dc converters.	**Grady/ Kwasinski**	Fall/ Spring	**Greg Dahlberg, Dave Tuttle, Hunter Estes**
Law 397S	Energy Development & Policy	This interdisciplinary course will introduce students to the legal, business, and engineering facets of energy development and entrepreneurship. The course is structured around two central case studies—one based on a wind development project and the other on a high-efficiency natural gas combined-cycle plant. The key stages of project development will be covered, including site selection, due diligence, permitting, contracting, and financing. The case studies are designed (1) to provide real-world conditions for understanding project development, (2) to allow students to engage in practical problem solving, and (3) to enable government policies to be evaluated in context. Course work will be complemented by regular discussions with leading experts in the utility and renewable-energy sectors.	**Adelman/ Humble**	Spring 2013	

ME 379	Introduction to Renewable Energy and Sustainability	Covers several renewable energy production methods, such as solar energy, wind, fuel cell, biomass, biofuels, OTEC, geothermal, wave energy, nuclear, hydropower, and tidal. The course focuses on the modeling of each technology, while highlighting the most relevant parameters that affect the system performance, and determining idealized efficiencies. A general discussion on the technical and environmental impact of each technology is also carried out.	**da Silva**	Every other Fall	**Charlie Upshaw**
ME 384	Energy Policy and Technology	Covers energy uses, basics, and fundamentals; fossil fuels, renewable power, electricity sector, advanced transportation; energy and the environment; climate change; energy and water; energy and the economy; energy policy basics; energy geography, security and foreign policy; energy and food; peak oil: Is it real? Do we care?; Texas as a world energy leader (and laggard); critical energy technologies of the future.	**Webber**	Spring	
ME 388C	Nuclear Power Engineering	Fundamental principles of the design and analysis of nuclear systems; introduction to the physics of nuclear reactions, chain reactions, and nuclear energy generation; heat generation and conduction within nuclear systems; heat transfer and fluid flow in nuclear systems; the thermodynamics of nuclear power; the nuclear fuel cycle; and the issues related to the materials aspect of reactor engineering.	**Biegalski/ Landsberger**	Fall/ Spring	**Amir Toliyat**
ME 386Q-14	Electrochemical Energy Materials	Electrochemical cells; principles of electrochemical power sources; materials for batteries, fuel cells, electrochemical capacitors, electrochromatic devices, and electrochemical sensors.	**Manthiram**	Spring	**Matt Charlton, Dave Tuttle**
ME 386Q	Electro-Chemical Energy Systems	Overview of electrochemical energy system design. Fundamentals of electro chemical systems include how the presence of charged species and charge-transfer across an interface affect both thermodynamic and kinetic processes. Practical details of electrochemical energy system design are covered, specifically examining the major engineering and materials challenges associated with developing rechargeable batteries and fuel cells.	**Meyers**	Spring	**Dave Tuttle Robert Fares, Hunter Estes**

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