Sustainable Energy Systems Eng (ESEN)

ESEN 6102 Seminar in ESEN **1 SCH (1-0)**
Exposure to multidisciplinary options on current and future issues on Sustainable Energy Systems from industrial, scientific, academic, governmental and engineering experts, in an environment that fosters productive exchange of ideas. Credit/Noncredit. Prerequisite: Graduate Standing.

ESEN 6303 Adv T: Sustainable Energy Syst **3 SCH (3-0)**
One or more advanced topics. May be repeated when topic changes.

ESEN 6306 Proposal/Dissertation **1-9 SCH (0-0-1-9)**
Proposal. The abstract and signature page of the proposal should be filed with the Office of Graduate Studies upon successful defense by the student and approval of the document by the dissertation committee. Dissertation Defense. Student must successfully defend a dissertation. A quorum of the members of the dissertation committee is required for the defense. The Graduate Council Representative must be in attendance for the defense. Dissertation. A candidate must complete a dissertation which is acceptable to the student's advisory committee and the Dean of the Graduate Studies. To be acceptable, the dissertation must give evidence that the candidate has pursued a program of research, the result of which reveals superior academic competence and a significant contribution to knowledge.

ESEN 6310 Sust Energy Sys & Policy **3 SCH (3-0)**
An overview of existing and upcoming renewable energy technologies. Fundamentals of energy generation in each approach ae presented in detail. Assessment of technologies is attained based on comparative sustainability. Evaluation of energy generation technologies is established via life cycle assessment of climate change impact. Trends and probable future energy scenarios are discussed.

ESEN 6311 Fund Pow Gen & Energy Storage **3 SCH (3)**
Updated power generation and storage technologies. Design and evaluation of various types of power generation, storage systems, and its components using fundamentals of interdisciplinary engineering principles and a software. Prerequisites: MEEN 5321 and MEEN 5347.

ESEN 6312 Energy Sys Integ & Design **3 SCH (3-0)**
A unique system-of-systems concept to energy systems integration. The relationships among electricity, thermal, and fuel systems and data and information networks to ensure optimal integration and interoperability across the entire energy system spectrum. Prerequisites: Gradute Standing.

ESEN 6321 Smart Grids **3 SCH (3-0)**
Fundamentals of smart power grids, technology advances in transmission and distribution systems, policy drivers, assets and demand management, and smart grid security. Prerequisites: graduate standing and approval from instructor.

ESEN 6325 Solar Power **3 SCH (3-0)**
Traditional solar cell architectures, 1st and 2nd generation solar cells, nanotubes and nanowires based solar cells, thin-film organic conjugates solar cells, CIGS solar cells, plasmonic effects and light trapping. Prerequisite: graduate standing.

ESEN 6326 Characterization of Materials **3 SCH (3-0)**
This course on materials characterization techniques is designed to help engineers and scientists who have little background in materials analysis to realize the abundance of analytical methods available to provide information about their components. Characterization describes those features of composition and structure of materials that are significant for a particular preparation, study of properties or use, and suffice for reproduction of the material. The topics covered are vacuum theory, imaging techniques, vibration spectroscopy, electron emission spectroscopy, X-ray diffraction, techniques for characterization of thermal, mechanical and electrical properties. Prerequisite: Undergraduate degree in engineering or physical sciences.

ESEN 6328 Nanofab & Nanoscale Dev **3 SCH (3-0)**
This course is designed to give students experience in nanofabrication methods such as thin film disposition, ethcing and lithography to manipulate a wide variety of materials including dielectrics, semiconductors, organics, polymers, metallic materials and molecular films. In addition, this course will introduce MEMS/NEMS and CMOS devices. Prerequisite: Undergraduate degree in engineering or physical sciences.

ESEN 6329 Adv T: Multiphysics Modelling **3 SCH (3-0)**
Review of the macroscopic and microscopic transport laws and conservation principles that occur in the analysis of sustainable engineering systems involving multiscale and multiphysics phenomena. Methods for constructing models that involve coupling between electrical, mechanical, fluid flow, energy transport and species transport are presented through various examples and case studies. The efficient utilization of modern software tools to generate solutions, such as MATLAB and COMSOL Multiphysics, will extensively be taught along with the underlying mathematical and computational science. Graduate standing in engineering or permission of the instructor is required.

ESEN 6331 Thermal Systems Engineering **3 SCH (3-0)**
Understanding of the general theory of designing thermal systems. The dynamics and factors affecting the design of thermal systems. Prerequisites: MEEN 3347 and MEEN 3392.

ESEN 6333 Advanced Wind Farm Design **3 SCH (3-0)**
Advanced knowledge of wind farm design, development, and operation, including wind power estimation, wake flow effect, wind turbine selection, location selection, and layout optimization.

ESEN 6334 Energy Resource Mngmnt & Optim **3 SCH (3-0)**
Advanced knowledge related to energy resource management and optimization. Different types of energy resources, including petroleum and natural gas, electricity, and renewable energy. Comprehensive real world examples to describe various optimization problems, risk and logistics management, and regulations. The latest policy initiatives and recent trends in energy resource management. Prerequisites: graduate standing and approval from instructor.

ESEN 6335 Wind Power **3 SCH (3-0)**
Basics of Wind Energy and Power, Kinetic Energy of Wind, Properties of Wind, Statistical Distribution of Wind Speed, Wind Measurement and Sensors, Deploying Wind Turbines in Grid, Environmental Impact of Wind Turbines, Wind Classes, Shear, Operation and Control. Prerequisite: graduate standing.

ESEN 6341 Advanced Chemical Kinetics **3 SCH (3-0)**
Theory and applications of the principles of reaction kinetics to reactions involving substances in the gaseous, liquid, or solid state with an emphasis on those that occur in the energy sciences and sustainable reacting systems. Reactions catalyzed by organo-metallic complexes or solid heterogeneous catalysts and the analysis of transport-kinetic interactions for multiphase fluid-fluid and fluid-solid systems. Experimental techniques for measurement of reaction rates for both single phase and multiphase reaction environments. Prerequisites: Graduate standing and permission of instructor.