

## SUSTAINABLE AND RENEWABLE ENERGY COURSE DESCRIPTIONS

**MEPM 511 Project Management Fundamentals (3:3:0)**  
**Pre-requisite(s): None; Co-requisite: MEPM 532**

The fundamentals of project management including: overview and concepts of project management (principles, body of knowledge, strategies); planning successful projects (defining, specifying, delivery options, scheduling, budgeting); implementing (organizing the team, work assignments, team building, effective leadership); executing (performance measurement, maintaining the schedule, adjustments/mid-course corrections, record keeping, status reporting, communications, managing conflict, time management); and closeout (performance measurement, maintaining the schedule, adjustments/mid-course corrections, record keeping, status reporting, communications, managing conflict, time management).

**MSRE 511 Energy Conversion (3:3:0)**  
**Pre-requisite(s): None; Co-requisite: None**

Forms of energy. Energy needs and available sources of energy. Conversion of thermal energy into mechanical energy, including power, and heat engine cycles, internal and external combustion systems and turbines. Basic technical and economic criteria for the design of efficient energy conversion systems, including traditional as well as alternative power systems.

**MSRE 512 Energy Systems Modeling and Optimization (3:3:0)**  
**Pre-requisite(s): None; Co-requisite: None**

Review of renewable energy resources; solar energy and photovoltaic, wind energy, wave energy, biomass energy conversion, fuel cells and batteries. Hydroelectric power and geothermal energy. Modeling methodology including system conceptualization. Model construction and validation (computational accuracy). Model evaluation and calibration. Simulation of energy and environmental systems. Optimization techniques; Classical direct search-for-optimum methods, Golden Mean, Conjugate Gradients, Modified Newton Method. Methods for constrained optimization such as Lagrange Multipliers, Search methods, Linear and Dynamic Programming. Use of software packages.

**MSRE 513 Energy Economics (3:3:0)**  
**Pre-requisite(s): None; Co-requisite: None**

Comprehensive understanding of energy markets. Technological, cost, and environmental fundamentals of energy sources and environmental systems. Economic principles underlying the supply and demand for energy in a modern economy, through considerations of topics such as energy demand at the individual and economy-wide level, the supply of renewable and non-renewable energy resources, the rationale for energy policy and energy policy instruments. Advanced tools to analyze how energy and environmental policies affect the demand and supply of different types of energy.

**MSRE 514 Direct Research (3:3:0)**  
**Pre-requisite(s): Department Approval; Co-requisite: None**

Under the guidance of an engineering faculty member, the Directed Research Project provides the student with a meaningful research experience. It requires that the student conduct a research topic or issue of significance to the field of renewable and sustainable energy.

**MSRE 515 Energy Efficiency and Management**

**(3:3:0)**

**Pre-requisite(s): None; Co-requisite: None**

Techniques and approaches adapted to improve the efficiency of energy generation, utilization, conversion, transport, storage and management. Energy audits. Energy conservation opportunities for efficiency improvements in different sectors: industrial, commercial, transportation and domestic. Economic evaluation of energy conservation opportunities using engineering economic formulas, simple pay-back analysis, and life-cycle cost models. Short- and long-term planning. Restructuring and Privatization. Models of electricity industry, contract issues, markets and transmission pricing. De-regulation of the energy market around the world. Electrical demand control and power factor correction. Load forecast and generation side management.

**MSRE 521 Photovoltaics**

**(3:3:0)**

**Pre-requisite(s): None; Co-requisite: None**

Introduction to solar radiation and some important related concepts like blackbody, solar spectrum, irradiance, irradiation, air mass and peak sun hour. Semiconductor and P-N junctions. PV cells properties, design, interconnection and module fabrication. Modules and arrays, stand-alone PV schemes with battery energy storage and grid-connected PV schemes.

**MSRE 522 Wind Energy Systems**

**(3:3:0)**

**Pre-requisite(s): None; Co-requisite: None**

Basic characteristics of wind, site characterization, statistical methods of wind analysis, wind resources assessment, fundamental principles of wind energy utilization, aerodynamics, mechanical and electrical design aspects. Wind machine technologies and wind turbines performance analysis. Wind farm planning and design. Wind power integration into the power systems, and the environmental impact of wind power utilization.

**MSRE 523 Biofuels**

**(3:3:0)**

**Pre-requisite(s): None; Co-requisite: None**

Fundamentals and applications of biofuels and bioenergy produced from biomass including processes of production, availability and attribution of biofuel/bioenergy production. Types of biomass raw material and methods of selection. First, second and third generation of biofuels. Methods of biomass conversion to fuel including thermochemical conversion, biochemical conversion and catalytic conversion. Production of hydrogen, biodiesel and microbial fuel cells. Environmental impacts of biofuel production. Economics and life-cycle analysis of biofuel. Value-added processing of biofuel residues.

**MSRE 524 Sustainable Desalination**

**(3:3:0)**

**Pre-requisite(s): None; Co-requisite: None**

Basic science and technology of water desalination to ensure sustainable water supply. Water production via desalination within the water-energy-cost nexus, evaluation of renewable energy-

powered desalination processes, power-desalination cogeneration analysis, evaluation and applications of novel desalination systems, such as thermal desalination, membrane distillation and forward osmosis. Recent technological improvements for enhanced desalination processes, and fouling issues in current technologies. Assessing economic feasibility and the environmental impact of new desalination processes.

**MSRE 525 Concentrated Solar Power**

**(3:3:0)**

**Pre-requisite(s): None; Co-requisite: None**

Introduction to solar energy, solar radiation; review of the basics of thermodynamics and heat transfer, power plant technologies; types of CSP systems including CSP parabolic trough systems, CSP dish technology, CSP Fresnel technology and solar tower; heat storage systems; hybridization; secondary use of CSP systems; operation and maintenance of CSP systems; power quality control and grid integration; CSP plant project planning: economic, social and environmental considerations and site assessment.

**MSRE 526 Green Buildings**

**(3:3:0)**

**Pre-requisite(s): None; Co-requisite: None**

Green building initiatives, their origin, characteristics of a green building, certification of green buildings rating systems, criteria for rating. Policies and drivers that are leading to the more widespread uptake of green building technologies; green building codes, policies and planning from the past, present and future from around the globe. Integrated design: urban micro-climate design, passive and active architectural interventions.

**MSRE 590 Thesis**

**(9:0:27)**

**Pre-requisite(s): Department Approval; Co-requisite: None**

A research-based thesis course that offers students the opportunity to work on a comprehensive, individual project. Topic to be agreed in consultation with a supervisor. The project will be of suitable complexity for results to be published for an expert audience.