

# ENERGY SYSTEMS ENGINEERING (ESE)

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## **ESE 500 Sustainable Energy Systems 3 Credit Hours**

The course provides an overview of energy technology from a broad perspective that encompasses technical and environmental aspects. It covers a wide range of traditional and alternative energy sources and presents assessments of their availability, sustainability, and environmental impacts as well as evaluation of their potential role in solving the global energy problem. Course work includes project.

### **Restriction(s):**

Can enroll if Class is Graduate

Can enroll if Level is Rackham or Graduate

Can enroll if College is Engineering and Computer Science

## **ESE 501 Energy Conversion 3 Credit Hours**

This course covers fundamental engineering principles for converting available energy sources, renewable and nonrenewable, into other energy forms of direct utility. It may include such topics as steam and gas based power plants as well as devices for solar, wind, and hydraulic energy conversion.

### **Restriction(s):**

Can enroll if Class is Graduate

Can enroll if Level is Rackham or Graduate

Can enroll if College is Engineering and Computer Science

## **ESE 502 Energy Storage Systems 3 Credit Hours**

This course introduces the basics of energy storage systems for EDV. It will cover battery basics, ultracapacitors, flywheels, and hybrid energy storage concepts. Battery management, battery charging, and battery safety will be covered. Finally, the requirements of EDV and renewable energy application examples will be explained. Lead acid, nickel metal hydride, and lithium ion batteries will be covered. Other energy storage systems such as super conducting magnetic, hydraulic, compressed air, and integrated (hybrid) energy storage systems, will be discussed as well.

### **Restriction(s):**

Can enroll if Class is Graduate

Can enroll if Level is Doctorate or Rackham or Graduate or

Can enroll if College is Engineering and Computer Science

Can enroll if Major is Computer & Information Science, Computer Engineering, Electrical Engineering, Energy Systems Engineering, , Industrial & Systems Engin, Mechanical Engineering, Software Engineering, Automotive Systems Engineering

## **ESE 503 Energy Policy, Econ & Environ 3 Credit Hours**

This course will give an overview of the current energy and environment policies, their origin and implementation, and the process of developing such policies. It will consider the public policy issues related to alternative and renewable energy systems at both national and international levels. The roles of government, industry and consumers in making these policies will be discussed. The economics of various alternative energies will be considered and trade-offs between them will be discussed from the viewpoint of availability, safety, environmental impact and related issues.

### **Restriction(s):**

Can enroll if Class is Graduate

Can enroll if College is Engineering and Computer Science

## **ESE 504 Energy Eval/Risk&Optimization 3 Credit Hours**

Formulation of economically efficient strategies and development plans for energy systems requires a sound understanding of energy supply, demand and allocation options as well as the interrelationships between the energy sector, environment, and the economy. Analysis of these energy policy decisions requires evaluation of investment decisions on potential energy projects (and programs) in terms of selected project viability indicators and comparison against a set of decision criteria. This course will provide students the knowledge and skills to identify, analyze, assess, and manage the risks inherent in selecting various energy sources, projects and portfolios of projects. The tools and techniques explored in this class will be applied to energy, environment and resource management policy and investment decisions which are multi-criteria including societal cost and environmental impacts.

### **Restriction(s):**

Can enroll if Class is Graduate

Can enroll if College is Engineering and Computer Science

## **ESE 505 Ecosystem Engineering and Management 3 Credit Hours**

The course is designed to provide principles of ecological engineering and design of ecosystems that integrate human society with its natural environment for the benefit of both. Particular emphasis is placed on 1) Understand and describe important physical, chemical, and biological processes that affect ecosystem integrity; 2) Explain, use, and illustrate mass balances, water balances, energy balances, and chemical balances as tools to help understand and describe ecosystem functions; 3) Familiarity with approaches to ecological restoration of streams and rivers, wetlands and riparian areas, lakes and reservoirs, and coastal ecosystems; 4) Understand and apply concepts involved in designing and achieving sustainable uses of ecosystems (e.g., treatment wetlands and land treatment systems), and application of ecological engineering techniques in stormwater management; 5) Analyze and illustrate the impact that designing ecosystems to solve engineering problems has in the context of societal and global issues; and 6) Identify and describe the contemporary issues and emerging fields in which ecological engineers will be called upon to use their expertise. (F).

### **Restriction(s):**

Can enroll if Level is Rackham or Graduate or Doctorate or

## **ESE 510 Sustainability Science and Engineering 3 Credit Hours**

This course incorporates ethical and social issues into the design of products, processes and practices that will benefit the society as a whole. Specific emphasis will be given to engineering principles that will help engineers design products and services to meet societal needs with minimal impact on the global ecosystem. Using specific examples and illustrations, the course will demonstrate opportunities for sustainable engineering practices, providing students with valuable insight to applying these principles. (W).

### **Restriction(s):**

Can enroll if Level is Rackham or Graduate or Doctorate or

**ESE 578 Advanced Vehicle Energy Systems 3 Credit Hours**

Sustainability is an increasingly important topic for the automotive industry. This course discusses sustainable vehicle technology with focus on energy-related aspects, such as resources, consumption, environmental impacts, and regulations. It reviews sustainable technologies employed in automotive systems to reduce emissions in an energy-efficient manner and discusses their impacts on the industry. The course covers the fundamentals, characteristics, and design considerations of the vehicle energy systems. Students have a hands-on practice using numerical simulation tools. Specific technical topics include advanced internal combustion engines, alternative fuels with the focus on biofuels, hybrid, electric, and fuel cell vehicles, waste energy recovery systems, and smart grid system. (OC).

**Restriction(s):**

Can enroll if Level is Rackham or Graduate or Doctorate or  
Can enroll if Major is , Energy Systems Engineering

**ESE 591 Guided Stud in Energy Systems 1 to 3 Credit Hours**

Individual or group study of an energy systems engineering topic of contemporary interest.

**Restriction(s):**

Can enroll if Class is Graduate  
Can enroll if College is Engineering and Computer Science

**ESE 699 Master's Thesis 3 to 6 Credit Hours**

Research for master's thesis under the direction of a faculty adviser.

**Restriction(s):**

Can enroll if Class is Graduate  
Can enroll if College is Engineering and Computer Science

\*An asterisk denotes that a course may be taken concurrently.

Frequency of Offering

The following abbreviations are used to denote the frequency of offering:  
(F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally