

## **ISyE 4501 Energy, Efficiency and Sustainability**

### **Category Toward Degree:**

ISyE Concentration Breadth Elective

### **Credit:**

3-0-3

### **Prerequisites:**

ISyE 3025 Eng Economy, ISyE 3133 Engineering Optimization (with concurrence), Physics 2211, Chem 1301 or Chem 1211 K.

### **Catalog Description:**

Analysis and modeling of energy production and use, material and energy efficiency, sustainability, and cost for systems, products, and services.

### **Text and readings:**

Lecture notes will be posted, supplemented by articles.

### **Outcomes:**

At the end of the course, students will be able to:

- Evaluate lifecycle environmental impacts of a product or service (by exams)
- Use knowledge of industrial systems to scope and develop environmental assessments (by project)
- Evaluate monetary and environmental costs and benefits of technology choices (by exams)

### **Methods:**

- Environmental lifecycle assessment (LCA) – Green supply chains. Lifecycle environmental impact including production, distribution, use, and recycling or disposal.
- Economic approaches to environmental management - Cost-benefit analysis. Taxes and subsidies. Supply curves. Environmental externalities, tradable permits, markets.
- Material flow accounting and industrial ecology – Efficiency assessment.
- Resource constraints and availability – Calculations with population, technology, consumption and emissions.

### **Topics: (At least 4 topics below)**

- Energy - Energy calculations for mass, fuel energy value, energy efficiency, and applying energy knowledge to calculate energy resources and constraints.
- Water - Water mass balances, water needed for electricity generation; combined energy/water analysis for industrial systems.
- Greenhouse gas emissions - Greenhouse gas accounting, global warming potential calculations, and greenhouse gas emission inventories.
- Transportation energy - Energy use by transport mode. Supply chain energy use and environmental impacts.
- Electricity – Generation, transmissions, distribution.
- Air Pollution – Human health impacts, monetization.

**Grading:**

- Homework – 10%.
- Midterm 1 – 20%.
- Midterm 2 – 20%.
- Projects – 25%.
- Final Exam – 25%

**Sample Schedule**

<b>Week</b>	<b>Topic</b>
Week 1	Efficiency
Week 2	Energy
Week 3	Life Cycle Assessment
Week 4	Cost-Benefit Analysis
Week 5	Material analysis; Midterm 1
Week 6	Greenhouse Gas Accounting
Week 7	Economic Input Output Life Cycle Assessment
Week 8	Energy, Efficiency and Sustainability in Freight Transport
Week 9	Electricity; Water
Week 10	Levelized Costs, Midterm 2
Week 11	Metrics of Impact; Impact Assessment
Week 12	Box Models
Week 13	Air Pollution; Monetization of Impacts
Week 14	Sustainability in Product Supply Chains
Week 15	Project Presentations
Week 16	Integrated Assessment Models

**Attendance**

The only acceptable excuses are the Institute Approved Absences

<http://www.registrar.gatech.edu/students/formlanding/iaabsences.phpor>, or from Dean's Office.

**Rules**

- Honor Code: <http://www.policylibrary.gatech.edu/student-affairs/academic-honor-code>
- Student-Faculty Expectations: <http://www.catalog.gatech.edu/rules/22/>

If you have GT approved official excuse\_

<http://www.registrar.gatech.edu/students/formlanding/iaabsences.phpor> or excuse from Dean's office for assignments, tests or presentations, you must arrange for the resolutions with the instructor before the test

<b>Course outcome \ Program Outcomes</b>	<b>Evaluate monetary and environmental costs and benefits of technology choices (by exam)</b>	<b>Use knowledge of industrial and systems engineering to cope and develop environmental assessment (by evaluation project)</b>	<b>Evaluate Lifecycle environmental impacts of a product or service (by exam questions)</b>
<b>Identify, formulate solve engg prob by engg, sci &amp; Math</b>	High	High	
<b>Produce solutions consider public health, safety, welfare, global, cultural, social, environ &amp; economic</b>		High	High
<b>Communicate with a range of audience</b>		High	
<b>Recognize ethical &amp; professional responsibilities, make informed judgement consider resolutions in global, economic, environ and societal context.</b>		High	High
<b>Effective on a team provide leadership, collaborative and inclusive envirn, plan tasks &amp; meet objectives</b>			
<b>Develop and conduct experiment, analyze and interpret data &amp; use engineering judgement to draw conclusions.</b>			
<b>Acquire and apply new knowledge using appropriate learning strategies</b>		High	