

## 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)

**Content:**

**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

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

## Student Outcome Assessment Plan

<p style="text-align: center;"><b>Course outcome \ Program Outcomes</b></p>	<p><b>1. identify, formulate solve engg prob by engg, sci &amp; Math</b></p>	<p><b>2. produce solutions consider public health, safety, welfare, global, cultural, social, environ &amp; economic</b></p>	<p><b>3 communicate with a range of audience</b></p>	<p><b>4 recognize ethical &amp; professional responsibilities, make informed judgement consider resolutions in global, economic, environ and societal context.</b></p>	<p><b>5. effective on a team provide leadership, collaborative and inclusive envirn, plan tasks &amp; meet objectives</b></p>	<p><b>6. develop and conduct experiment, analyze and interpret data &amp; use engineering judgement to draw conclusions.</b></p>	<p><b>7. acquire and apply new knowledge using appropriate learning strategies</b></p>
<p>Evaluate Lifecycle environmental impacts of a product or service (by exam questions)</p>		H		H			
<p>Use knowledge of industrial and systems engineering to cope and develop environmental assessment (by evaluation project)</p>	H	H	H	H			H
<p>Evaluate monetary and environmental costs and benefits of technology choices (by exam)</p>	H						