**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**

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| 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.

See the catalog for the Institute Absence Policy: http://www.catalog.gatech.edu/rules/4/

**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.

**Other**

Georgia Tech values diversity and inclusion; we are committed to a climate of mutual respect and full participation. Our goal is to create learning environments that are usable, equitable, inclusive and welcoming. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please notify the instructor as soon as possible. Students with disabilities should contact the Office of Disability Services to discuss options of removing barriers in this course, including accommodations. ODS can be reached at 404.894.2563, [dsinfo@gatech.edu](mailto:dsinfo@gatech.edu), or disabilityservices.gatech.edu

**Student Outcome Assessment Plan**

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