

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ESD.00 Introduction to Engineering Systems (2-3-4)

Spring 2012

Lectures: Mondays 3pm to 5 pm in Room 4-253

Recitation: TBD

Lecturers: Professor Joseph Sussman Phone: X3 – 4430
Office: 1 - 163 Email: sussman@mit.edu
Office Hours: TBD

Dr. Stan Finkelstein Phone: X3 - 8014
Office: E40-251 Email: snf@mit.edu
Office Hours: TBD

Dr. Afreen Siddiqi Phone: X3 - 2522
Office: E40-231 Email: siddiqi@mit.edu
Office Hours: TBD

Teaching Assistant: Christina Karapataki Email: ck333@mit.edu

Web Site: <https://stellar.mit.edu/S/course/ESD/sp12/ESD.00/>

Description: Students work on projects to address large, complex and seemingly intractable real-world problems, such as energy supply, environmental issues, health care delivery, and critical infrastructure (e.g., telecommunications, water supply, and transportation). Introduces interdisciplinary approaches - rooted in engineering, management, and the social sciences - for considering these critical contemporary issues. Small, faculty-led teams select an engineering systems term project to illustrate several of these approaches.

Prerequisites: None

Readings: Teaching notes and articles

Note: This course will have active in-class discussions and application of some of the introduced concepts to critical, contemporary real-world issues. The reading and texts are intended as a supplement (not a substitute) to the lectures and discussions.

Class Schedule

LECTURES			ASSIGNMENTS	
Date	#	Topics	Assigned	Due
02/13	L1	<u>Introduction to Critical Contemporary Issues (CCIs) and Complex Systems</u> - \$ Trillion problems, Examples from CCIs, ESD focus Areas (energy, healthcare, critical infrastructure etc), Definitions of System, Complexity, system boundary, scale, interfaces, agents, architecture, what is 'design' of CSS, Project Introductions	#1	
TBD	R1	Project Recitations		
02/21 (Tue w/Mon schedule)	L2	<u>System Dynamics (1)- Introduction</u> Modeling complex systems, feedback, causal diagrams	#2	#1
TBD	R2	Project Recitations		
02/27	L3	<u>System Dynamics (2) – System Structure and Behavior</u> Stocks and flows, linear and non-linear first order systems		
TBD	R3	Project Recitations		
03/05	L4	<u>System Dynamics (3) – Simulation</u> Vensim Models	#3	#2
TBD	R4	Project Recitations		
03/12	L5	<u>Uncertainty/ Networks (1) - Introduction</u> Random variables, probability, examples from various domains including transportation, energy, health care		
TBD	R5	Project Recitations		
03/19	L6	<u>Uncertainty/ Networks (2) - Applications</u> MATLAB tools for probabilistic analysis	#4	#3
TBD	R6	Project Recitations		
03/26		Spring Break: No Class		
04/02	L7	<u>Uncertainty/ Networks (3) – Structure and Behavior</u> Examples of transportation, communication, social networks operating in an uncertain environment etc.		
TBD	R7	Project Recitations		
04/09	8	Mid-Term Project Presentations		#4
TBD	R8	Project Recitations		
04/16		Patriots Day Vacation: No Class		
TBD	R9	Project Recitations		

04/23	L9	Considering stakeholders with different values in decision making		
TBD	R10	Project Recitations		
04/30	L10	TBD		
TBD	R11	Project Recitations		
05/07	L11	TBD		
TBD	R12	Project Recitations		
05/14	12	Final Project Oral Presentations		

Assignments:

There will be four individual assignments associated with the lecture material, largely in the first half of the term. The assignments will cover topics discussed in lecture and will anchor the theoretical material with real-world issues and systems.

Assignment #1: Complex systems definitions and concepts

Assignment #2: Creating systems dynamics models

Assignment #3: Simulating and interpreting system behavior

Assignment #4: Uncertainty and networks

Projects:

There are six projects being offered for Spring 2012:

1. Multi-Criteria Decision Models and Influenza (Flu) Vaccination – Judith Maro
2. Design of a Municipal Organic (Food) Waste Management System for Cambridge – Jonathan Krones
3. Electric Power: Combining Renewables, Capacity Expansion and Demand Response – Fernando De Sisternes and Daniel Livengood
4. Finding a Nuclear Waste Repository Site in the United States – Lara Pierpoint
5. Developing Risk Models for Cyber Attacks – Josephine Wolff
6. Post-traumatic Stress Disorder (PTSD) Care Modeling – Wiljeana Glover



50% of this course deals with group projects. The students will work in teams, and recitation instructors will supervise the projects. The project work will be done during the recitation hours. There will be “milestone” project assignments along the way that are intended to ultimately be integrated into the final project reports. The teams will give oral presentations of their term project on May 14. A final written report will be due May 17 (last day of classes).

Grades:

Homework:	40%
Project:	50%
Final written report (40%)	
Final oral presentation (10%)	
Class-Participation:	10%