

3.57, Materials Selection, Design and Economics

Professors Joel Clark and Lallit Anand, Drs. Frank R. Field & Randy Kirchain

Web site: http://web.mit.edu/sma/Programs/adv_mat.html

(Note that you must be registered to access the course materials/WWW page, which is
<http://rolls.mit.edu/3.57/home.nsf>)

Organization of Syllabus

The syllabus for the course consists of 4 Blocks of material. These lead the participants through the natural evolution of systems analysis and design. These are:

- **Modeling of Efficient Systems Designs**, which leads to the result of optimization for systems, that is the definition of technically efficient designs and of the associated technical cost models;
- **Materials Selection and Performance**, involving the engineering relationships among geometry, processing and properties;
- **Decision Analysis/Utility Analysis**, focusing on the techniques of analysis of choices under risk, and the real value that decision-makers, either managers and designers on the one hand, or customers on the other, place on products and outcomes;
- **Integration** of the above into a flexible development plan that properly chooses the best level and types of options to build into the design. This block involves an independent project that integrates the above block into a coherent whole.

Instructors

The instructors are:

- Prof. Joel Clark, Department of Materials Science & Engineering (jplark@mit.edu)
- Prof. Lallit Anand, Department of Mechanical Engineering (anand@mit.edu)
- Dr. Frank R. Field, Research Director of the International Motor Vehicle Program (furd@mit.edu)
- Dr. Randy Kirchain, Associate Director of the MIT Materials Systems Laboratory (kirchain@mit.edu)

Appointments with Instructors

The instructors will be available after class for discussions or making individual appointments.

Text Materials

The reading material consists of three parts:

- *Applied Systems Analysis* (R. de Neufville, McGraw-Hill, 1990) is the basic text,
- Overheads for the course, can be viewed at the course web site;
- Handouts that will be distributed free during the semester as they are developed.

Computer Environment

Web Site: http://web.mit.edu/sma/Programs/adv_mat.html
(then follow the Subjects link to 3.57)

This web site is the primary means of distributing basic information about the course:

- Syllabus and Schedules of classes and the readings and assignments;
- Copies of Overheads used in the lectures which can be downloaded as Postscript files and printed two to a page;
- Course software;
- Email addresses of participants in the course.

The web site will also be the communications center for the course. It features:

- Course announcements (featured in a "Current Message" box); and
- A Threaded Discussion Group, in which participants can ask questions about the course, and receive replies from the instructors and other participants, organized by topic.

Note Well: Participants will not be able to access this WWW site until they have been given a userid and password, which will be assigned once they have registered for the course. A registry of e-mail addresses will be constructed from this list, which will be the primary roster of participants used for grading, etc.

Participants are expected to use email regularly to keep up with messages about the course from instructors. Messages sent by email will be considered to have been available to everyone.

Email related to the course will normally proceed through the web site for the course. Participants may find the Discussion Group to be a useful way to communicate rapidly with fellow students and the instructors.

Web Site: http://msl1.mit.edu/rdn/tree_98.htm
<<may be consolidated into above site>>

The final project represents an important part of the educational experience. In order to minimize the time spent on programming, students will be able to download from this server a generic set of spreadsheets designed to accommodate most of students' projects. However, building partly on the existing piece of work, students should feel free to design their own analysis tools in order to address the specific needs of their project. They should however be aware of the extra work this possibility may represent.

Course Software: The course project and many of the homework assignments rely heavily on the use of spread-sheet tools

The instructors are most familiar with Microsoft Excel and Lotus 123, and will provide support for running exercises with this software. However, students can use any package that can run the models, with the understanding that support will be limited if the product is unfamiliar to the instructors.

Treeplan, a decision analysis macro for use with Microsoft Excel (V 4.0 or higher required) will be made available. This shareware will be useful for both the homework assignments and the final project, but its use is not required. The instructors can suggest alternative decision analysis packages that students might wish to buy. One other tool that will be undergoing evaluation for course use this year is TreeAge, which we may be providing upon our assessment of its appropriateness and utility for the course.

All software for the course will be provided in DOS/WIntel format, but students can process assignments on any computer system. Note that the Excel materials are readable across platforms. All assignments will be turned in as hard-copy reports.

Grading, etc.

Grades will be based about equally on the following elements:

- A mid-semester quiz;
- A final individual written presentation of the Dynamic Strategic Planning project, demonstrating how the student has assimilated the entire course; and
- Homework assignments.

The final grade will be modulated by an appreciation of the participant's progress throughout the semester, giving extra weight to those that finish strongly and demonstrate that they have, at the end, mastered the material.

Absences: Students are expected to complete all assignments on time. Unexcused late assignments will be marked down. Reasonable excuses (sickness, unavoidable professional absences, family emergencies, etc.) will of course be accepted when presented near the event.

Work in Teams: Students may work in teams for the final project. Indeed, we encourage this collaboration because it can lead to more interesting results. We require each student to turn in individually written presentations and interpretations of the common analysis.

Academic Honesty: To avoid any potential confusion that might result from different expectations in other courses or establishments, please note the standards that apply in this subject:

- Anyone found cheating during the in-class exam will receive a zero for the exercise.
- Assignments turned in for grading are to be done individually, although it is expected that students will discuss the issues involved in problem sets and often learn best collectively. In practice this means that students may lead each other to the proper understanding of the material, and collaborate on setting up computer runs, but should ultimately prepare reports for each assignment individually, in their own format and words. Demonstrated evidence of copying (exactly the same presentations, same wording of sentences, etc.) will result in zeros for each paper with this evidence.

DRAFT Syllabus - 3.57, Materials Selection, Design and Economics
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Block I: Modeling of Efficient Systems Design			
Date	Topic	Readings	Assignments Due
Sept 9	Introduction To Subject		
Sept 14	Production Functions: Theory and Applications	Chapter 2	
Sept 16	Constrained Optimization & Cost Functions	Chapters 3 & 4	
Sept 21	Linear Programming (LP)	Chapter 5	2.3, 2.4; 3.1,4.3, 4.14
Sept 23	LP Sensitivity Analysis	Chapter 6	
Sept 28	LP In Practice		5.5, 5.8; 6.6, 6.10
Sept 30	Technical Cost Modeling (TCM): Theory	Handout	
Oct 5	TCM Applications		TBA
Oct 7	TCM Workshop		

Block II: Materials Selection and Performance			
Date	Topic	Readings	Assignments Due
Oct 12	Introduction to Properties and Design		
Oct 14	Materials Properties Charts I		
Oct 19	Materials Properties Charts II		
Oct 21	Materials Performance Indices		
Oct 26	MID TERM QUIZ		

Block III: Decision Analysis/Utility			
Date	Topic	Readings	Assignments Due
Oct 28	Value Analysis/Introduction to Term Project	Handout; Chapter 18	
Nov 2	Single Attribute Utility	Chapter 19	Cost Model Sensitivity Exercise
Nov 4	Decision Analysis/Trees	Chapter 16	
Nov 9	Value of Information	Chapter 17	19.7, 19.22, 16.1, 16.8
Nov 11	VETERAN'S DAY HOLIDAY		
Nov 16	Multiattribute Utility Analysis-MAUA	Chapter 20	16.6, 17.11, 17.13
Nov 18	MAUA Applications	Handout	
Nov 23	Choice of Discount Rate	Chapter 11	

Block IV: Integration			
Date	Topic	Readings	Assignments Due
Nov 28	THANKSGIVING DAY HOLIDAY		
Nov 30	Capital Asset Pricing Model	Chapter 12	20.5, 20.6, 20.8
Dec 2	Integration of Cost Models/Utility		
Dec 7	Case Study Workshop		
Dec 9	Final Presentations		