

**COMMONWEALTH GRADUATE ENGINEERING PROGRAM
DISTANCE LEARNING COURSE PLANNING SHEET
UNIVERSITY OF VIRGINIA**

Course: SYS 6001 – Introduction to Systems Engineering
Semester: Fall 2009
Instructor: William Scherer
Phone No.: 434-982-2069
Office Address: University of Virginia; Dept. of Systems and Industrial Engineering;
PO Box 400747, 151 Engineer's Way, Olsson Hall, Rm. 102D;
Charlottesville, VA 22903
E-Mail Address: wts@virginia.edu

Textbook(s): (Student to purchase)

- 1) John E. Gibson, William T. Scherer and William F. Gibson, "How to Do Systems Analysis", Wiley 2007, **Publisher:** Wiley-Interscience (May 18, 2007), **ISBN-10:** 0470007656, **ISBN-13:** 978-0470007655
- 2) John Allen Paulos, "Innumeracy: Mathematical Illiteracy and Its Consequences", **Paperback:** 208 pages, **Publisher:** Hill and Wang (August 18, 2001), **ISBN-10:** 0809058405, **ISBN-13:** 978-0809058402
- 3) Dennis M. Buede, "The Engineering Design of Systems: Models and Methods", **Publisher:** Wiley; 2 edition (February 3, 2009), **ISBN-10:** 0470164026, **ISBN-13:** 978-0470164020

Reference(s): Limit 4

Computer Needs:

Computer Capability:

Software required:

Provided?

Other: Internet access; UVA Email account

Course Description: An integrated introduction to systems methodology, design, and management. An overview of systems engineering as a professional and intellectual discipline, and its relation to other disciplines, such as operations research, management science, and economics. An introduction to selected techniques in systems and decision sciences, including mathematical modeling, decision analysis, risk analysis, and simulation modeling. Overview of contemporary topics relevant to systems engineering such as reengineering and total quality management. Elements of systems management, including decision styles, human information processing, organizational decision processes, and information system design for planning and decision support. Emphasizes relating theory to practice via written analyses and oral presentations of individual and group case studies. (Prerequisite: Admission to the graduate program)

See attached Syllabus

6/16/09

WILLIAM T. SCHERER
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**SCHOOL OF
ENGINEERING
& APPLIED SCIENCE**



*DEPARTMENT OF SYSTEMS and
INFORMATION ENGINEERING
University of Virginia
Thornton Hall
Charlottesville, VA 22903*

**SYS 6001: Introduction to Systems Engineering
Opening of Course Memo
Fall 2009**

Instructor: William T. Scherer
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Office Hours: TBA

Teaching Assistant: TBD
Office: TBA
Phone: TBA
E-mail: TBD
Office Hours: TBA

Class Time/Location: Tuesday/Thursday, 5:00-6:15 p.m.
Thornton Hall A119

Course Prerequisites: Graduate Standing or Permission of Instructor

Catalog Description: An integrated introduction to systems methodology, design, and management. An overview of systems engineering as a professional and intellectual discipline, and its relation to other disciplines such as operations research, management science, and economics. An introduction to selected techniques in systems and decision sciences, including graphical techniques, decision analysis, and simulation. Elements of systems management, including decision styles, human information processing, organizational decision processes, and information system design for planning and decision support. Emphasis is placed on relating theory to practice via written analyses and oral presentations of individual and group case studies.

Course Philosophy: The primary goal of this course is to challenge the way in which the student thinks; the way in which students approach problem solving. Secondary goals are to familiarize the student with systems engineering methodologies (the "systems approach"), systems engineering science tools (e.g., decision analysis, graphical tools, etc.), systems management concepts (e.g., TQM, team building), and systems modeling.

Students are encouraged to proactively participate throughout the semester. This includes classroom interactions and outside the classroom activities, such as group meetings. The nature of this material is not the kind that can be "spoon-fed" to students - the material requires active engagement of the material

by the student. Reading assignments cannot be briefly scanned -- the student must read the material and reflect on the nature of what the author is trying to communicate.

If any student has any problems with the material, the instructor, the Teaching Assistant, homework assignments, etc., I encourage them to see me or phone as soon as possible. Don't wait for a small problem to escalate into a serious problem. I also encourage feedback from the students throughout the semester. You can leave a note in my mailbox (signed or unsigned), stop-by my office, or telephone.

Texts:

Required:

- *How To Do A Systems Analysis & Systems Analyst Decalog*, J.E. Gibson – Photocopy - Available UVa Bookstore (NOTE: bundled in a single spiral bound copy)
- *The Engineering Design of Systems*, D. Buede - Textbook- Available UVa Bookstore
- *Innumeracy*, J. Paulos - Paperback - Available UVa Bookstore
- *Crystal Ball Software* - Available UVa Bookstore
- *Cases* (tentative – available later in the semester) - Available UVa Bookstore

Additionally: Numerous articles and reserve readings- to be mailed (see attached Reference List)

Computer Requirements:

Every student will be required to use Excel, Crystal Ball (an Excel add-in), Solver (an Excel add-in – not provided or ordered -- typically comes with Excel), and prepare Powerpoint presentations.

Grading:	<i>(Tentative)</i>	Midterm Exam	25%
		Final Exam	25%
		Class Participation	15%
		Cases and Projects	<u>35%</u>
			100%

Course Goals: The goals of SYS 601 are:

1. To present the basic principles of systems engineering.
2. To present:
 - the history of SE,
 - the methodologies of SE,
 - the tools and techniques SE, and
 - the modeling of systems for SE.
3. To present the applications and practice of Systems Engineering across a broad spectrum of disciplines
4. To give class members the understanding of the methodology and the applications of SE as a foundation for the UVa SE graduate Program.

Detailed Topics – Tentative

PART 1: Systems Methodologies

Top-down, goal-driven problem solving (and its relation to bottom-up problem solving)
History of operations research, systems engineering, and systems analysis
Overview of systems methodologies
Comparison and Contrasting of Systems Methodologies (i.e., NASA SE, DOD Standards, industry standards -- EIA, IEEE, CMM, CMMI, etc.)
Phases of systems engineering life cycle:
 Systems definition phase
 Systems design and development phase (included requirements, trade studies, etc.)
 Systems implementation & maintenance phase (includes test and evaluation, etc.)
Systems management issues
Comparison of systems methodologies to contemporary/historical management approaches including:
 Business Process Reengineering (BPR)
 Total Quality Engineering (TQM), ISO-9000
 Concurrent Engineering (CI)
 Systems Integration (SI)

PART 2: Decision Making for Systems Engineering

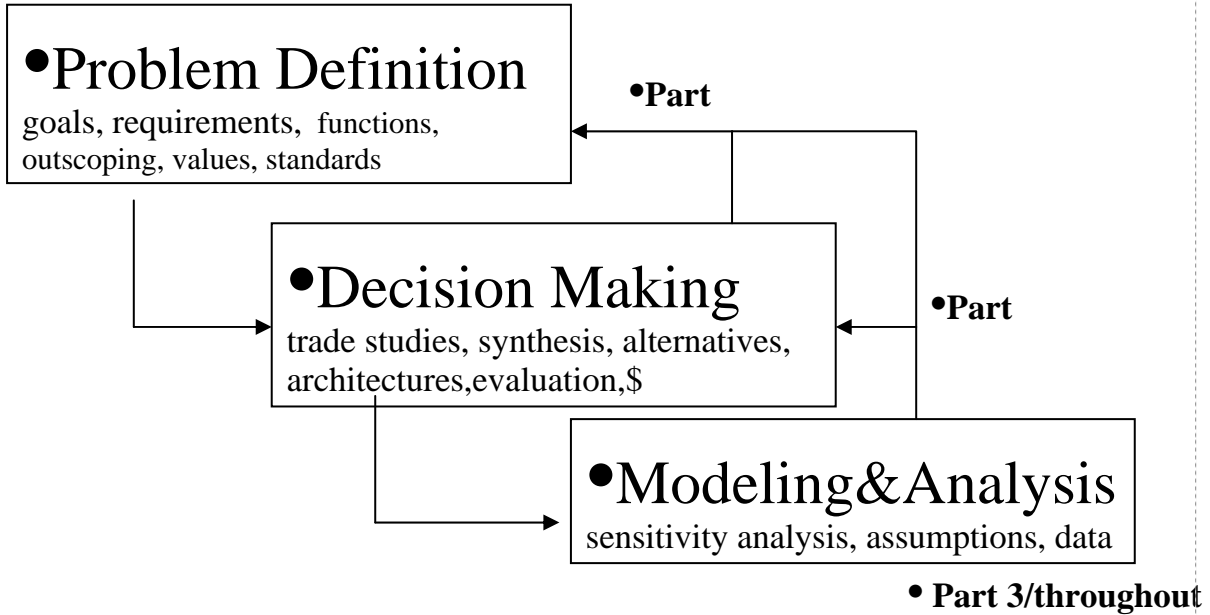
Introduction to critical issues and problems, basic decision analysis concepts
Overview of decision making pitfalls and common errors
Introduction to decision concepts:
 Measurement concepts
 Pareto optimality/dominance
 Rate and Weight
 Analytic Hierarchy Process (AHP)
 Decision Theory (Value and Utility Theory)
 Decision trees
 Software for decision making
Economic issues, including NPV, cost/benefit, project management (PERT, CPM)
Misc. Issues: Stochastic dominance, sensitivity analysis (tornado charts, single/multi-variable, graphical, etc.)

PART 3: Modeling for Systems Engineering and Tools of Systems Engineering

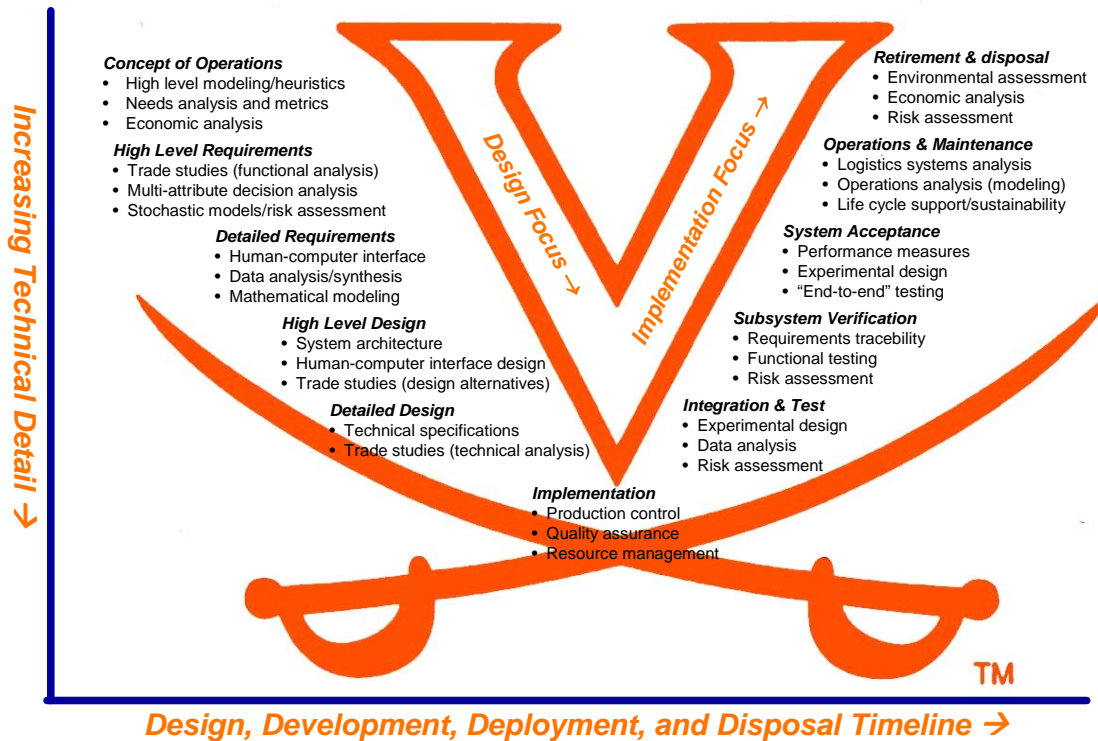
Introduction to systems modeling/problem formulation
Making the ‘business case’
Basics of system models, introduced via cases:
 Optimization concepts (Solver, OPTQuest)
 Reliability/Maintainability Concepts (Excel, Crystal Ball)
 Basic simulation modeling and dynamic systems (Crystal Ball, Excel)
 Stochastic and optimization concepts for systems engineering
Software/Graphical Tools
Other modeling tools (e.g.: Crystal Ball, optimization, etc.)

Throughout: Discussion of real world problems via systems engineering and analysis case studies

SYS 601 - Another View



Systems Engineering Methodology with illustrative analytical tools and techniques



SYS 601: Introduction to Systems Engineering
WT Scherer
A Partial Reference List

1. Blanchard, B.S., and Fabrycky, W.J., *Systems Engineering and Analysis, 4th Edition*, Prentice-Hall, Englewood Cliffs, New Jersey, 2006.
2. Blanchard, Benjamin, *Systems Engineering Management*, Wiley, 2004.
3. Buede, Dennis, *The Engineering Design of Systems: Models and Methods*, Wiley, 2000.
4. Chapman, W., Bahill, A.T., and Wymore, W., *Engineering Modeling and Design*, CRC Press, New York, 1992.
5. Chen, G., Jamieson, J.M., Schkade, L.L., and Smith, C.H., eds, *The General Theory of Systems Applied to Management and Organization*, The Systems Inquiry Series, Intersystems Publications, Seaside California, 1980.
6. Churchman, *The Design of Inquiring Systems: Basic Concepts of Systems and Organization*, Basic Books, New York, 1971.
7. Churchman, W., *The Systems Approach and Its Enemies*, Basic Books, New York, 1979.
8. Churchman, W., *The Systems Approach*, Dell Publishing Company, New York, 1968.
9. Daellenbach, Hans, *Systems and Decision Making: A Management Science Approach*, Wiley, 1994.
10. Deming, W.E., *Out of the Crisis*, MIT Press, Cambridge MA, 1986.
11. Eisner, Howard, *Computer-Aided Systems Engineering*, Prentice-Hall, Englewood Cliffs, New Jersey, 1988.
12. Eisner, Howard, *Essentials of Project and Systems Engineering Management*, Wiley, New York, 1997.
13. Flood, R.L., and Carson, E.R., *Dealing With Complexity: An Introduction to the Theory and Application of Systems Science*, Plenum Press, New York, 1988.
14. Flood, Robert L., *Creative Problem Solving: Total Systems Intervention*, Wiley, New York, 1991.
15. Gohagan, John K., *Quantitative Analysis for Public Policy*, McGraw-Hill, New York, 1980.
16. Hall, Arthur D., *A Methodology for Systems Engineering*, Van Nostrand, Princeton, N.J., 1962.
17. Hammond, J., Keeney, R., and Raiffa, H., *Smart Choices: A Practical Guide to Making Better Life Decisions*, Broadway Books, New York, 1999.
18. Hoos, Ida H., *Systems Analysis in Public Policy: A Critique*, University of California Press, Los Angeles, 1972.
19. Imai, Masaaki, *Kaizen, The Key to Japan's Competitive Success*, McGraw-Hill, New York, 1986.
20. Jackson, M.C., Mansell, G.J., Flood, R.L., Blackham, R.B. and Probert, S.V.E., *Systems Thinking in Europe*, Plenum Press, New York, 1991.
21. Majone, G., and Quade, E., editors, *Pitfalls of Analysis*, Wiley-Interscience, New York, 1980.
22. Martin, James, *Systems Engineering Guidebook: A Process for Developing Systems and Products*, CRC Press, New York, 1997.
23. Peters, T.J., and Waterman, R.H. Jr., *In Search of Excellence*, Harper and Row, New York, 1982.
24. Quade, E.S., *Analysis for Public Decisions*, North-Holland, New York, New York, 1989.
25. Reilly, Norman, *Successful Systems Engineering for Engineers and Managers*, Van Nostrand Reinhold, New York, 1993.
26. Saaty, Thomas L., and Alexander, J.M., *Thinking With Models: Mathematical Models in the Physical, Biological and Social Sciences*, Pergamon Press, New York, 1981.

27. Sage, Andrew P., *Methodology For Large-Scale Systems*, McGraw-Hill, New York, 1977.
28. Sage, Andrew P., *Systems Engineering: Methodology & Applications*, IEEE Press, New York, 1977.
29. Sage, Andrew P., " *Systems Engineering*, New York: John Wiley & Sons, Inc., 1992.
30. Sage, Andrew, and Armstrong, Jim, *Introduction to Systems Engineering*, Wiley, 2000.
31. Weinberg, Gerald M., *An Introduction to General Systems Thinking*, Wiley, New York, 1975.
32. Weinberg, Gerald M., *Rethinking Systems Analysis and Design*, Little, Brown, and Company, Boston, 1982.