Last Updated: 15 January 2012

ENGR 5004 – The Systems Engineering Process
Spring 2012 Syllabus
Tuesday, 4 PM – 6:45 PM

COURSE DESCRIPTION

Systems Engineering has emerged as an important profession in the design, development, implementation, and management, of systems of all sizes. The importance of this engineering discipline will only increase as systems become more complex, and systems-of-systems continue to emerge. The purpose of this course is to present and apply the principles of systems engineering to the design and analysis of systems.

ENGR 5004 will focus on four overarching tenets. Those tenets are:

- Life-cycle Engineering – An engineering orientation that addresses all phases during the life-cycle of a system from definition of a need to the retirement of the system;
- Systems Thinking – A holistic mental framework and global view that recognizes systems as part of larger systems, or systems-of-systems, and its environment, and considers impact on each;
- Human Systems Integration (HSI) – The technical and managerial concepts and processes, with specific emphasis on methods of integrating the human element into systems;
- Model-based Systems Engineering (MBSE) – The use of models to describe and analyze various aspects of the system.

INSTRUCTOR

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PREREQUISITES

Graduate standing in a graduate program at Virginia Tech.

REQUIRED TEXT

Blanchard, B.S. and W.J. Fabrycky (2010). *Systems Engineering and Analysis, 5th Edition*, Prentice-Hall, Englewood Cliffs, N.J.

Additional Systems Engineering related materials will be provided during the course.

The electronic mail and a course Scholar web site will be used as the primary mechanisms for distributing course-related information and updates. The Scholar website is located at:

http://scholar.vt.edu/portal

Course materials will be posted no later than 9:00 PM on the Sunday evening prior to class.

GRADING

Mid-Term Project	25%
Exam	30%
Final Project	30%
Class Presentation	10%
Class Participation	5%

SYSTEMS ENGINEERING APPLICATION PROJECTS

Two systems applications projects and a team presentation will be assigned during the course of the semester. The systems engineering application project will involve the application of the systems engineering process for the preliminary design and development of a system. Each design team will consist of three students (unless otherwise approve by the instructor). A final presentation will be required during the last class session.

EXAM

One examination will be administered during the course. The exam will be a take home exam, which students will have one week to complete. The examination is an individual effort.

ACADEMIC HONESTY

Honesty in your academic work is important in developing professional integrity. The Virginia Honor Code will be strictly enforced. All aspects of your course work are covered by the Honor Code. Any suspected violations of the Honor Code will be promptly reported to the Honor System. The faculty and students of Virginia Tech will not tolerate any form of academic dishonesty.

The "Graduate Honor System Constitution" is detailed in the Graduate Policies, Procedures, and Course catalog, and is posted on the Virginia tech web site:
http://www.honorsystem.vt.edu/?q=node/33

INCLEMENT WEATHER POLICY

Winter often brings inclement weather to Virginia forcing the University to cancel classes. If either the Main Campus in Blacksburg, or the Campus in Northern Virginia is closed due to inclement weather, class will be cancelled for that evening. However, I will make every effort to record the lecture, and make that available for you to view on-line at your leisure.

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SPECIAL ACCOMODATIONS
Any student with special needs or circumstances should feel free to meet to contact me."

PRINCIPLES OF COMMUNITY STATEMENT
"Virginia Tech is a public land-grant university, committed to teaching and learning, research, and outreach to the Commonwealth of Virginia, the nation, and the world community. Learning from the experiences that shape Virginia Tech as an institution, we acknowledge those aspects of our legacy that reflected bias and exclusion. Therefore, we adopt and practice the following principles as fundamental to our on-going efforts to increase access and inclusion and to create a community that nurtures learning and growth for all of its members:

- *We affirm the inherent dignity and value of every person and strive to maintain a climate for work and learning based on mutual respect and understanding.*
- *We affirm the right of each person to express thoughts and opinions freely. We encourage open expression within a climate of civility, sensitivity, and mutual respect.*
- *We affirm the value of human diversity because it enriches our lives and the University. We acknowledge and respect our differences while affirming our common humanity.*
- *We reject all forms of prejudice and discrimination, including those based on age, color, disability, gender, national origin, political affiliation, race, religion, sexual orientation, and veteran status. We take individual and collective responsibility for helping to eliminate bias and discrimination and for increasing our own understanding of these issues through education, training, and interaction with others.*
- *We pledge our collective commitment to these principles in the spirit of the Virginia Tech motto of Ut Prosim (That I May Serve)."*

The Virginia Tech Principles of Community are intended to increase access and inclusion and to create a community that nurtures learning and growth for all of its members. They are defined at: http://www.vt.edu/principles.php

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LEARNING OBJECTIVES

Session - Date	Topic	Assignment
1 – 17 Jan	Introduction to Systems Engineering Course Overview & Introduction	Blanchard - Ch. 1, pp. 1-20;
2 – 24 Jan	Introduction to Systems Thinking Systems Engineering Life-cycles Systems Engineering Documentation Overview Semester Project: Desalination Challenge	Blanchard – Ch. 2, pp. 23-52; Schoening – pp.1-4. **Project Distribution**
3 – 31 Jan	**On-line Lecture:** Overview of Human Systems Integration (HSI) – Dr. Bob Beaton (21 April 2008)	Blanchard – Ch. 14, pp. 468-495; Insight (vol 11, no. 2) pp. 5, 7-10, 11-14, 15-18, and 19-23; Wallace – pp. pp. 1-10. **Project Teams Due**
4 – 7 Feb	Conceptual System Design Quality Function Deployment	Blanchard – Ch . 3, pp. 55-86; Barabba – pp. 20-34. Hauser – pp. 63-73.
5 – 14 Feb	Preliminary System Design: Functional Analysis	Blanchard – Ch. 3, pp. 86-97; Appendix A, pp. 699-708.
6 – 21 Feb National Engineers Week	System Architectures	Wagenhals-pp. 248-287; DoDAF 2.0 (review).
7 – 28 Feb	Preliminary System Design: Requirements & Synthesis	Blanchard - Ch. 4, pp. – 100-126; Dorfman – pp. 1-30; Marchant-pp. 1-13; Piaszczyk – pp. 305-326. **Mid-term Project Due**
6 Mar	Spring Break – No Class	
8 – 13 Mar	Systems Analysis	Blanchard – Ch. 7 pp. 170-199;

		Roedler – pp. 1-65. **Exam Distribution**
9 – 20 Mar	Detailed Design	Blanchard – Ch. 5, pp. 128-148. Robinson – pp. 1-12. **Exam Due**
10 – 27 Mar	Reliability & Maintainability Engineering	Blanchard – Ch. 12, pp. 362-404, Ch. 13, pp. 410-463; Barnard – pp. 1-9; Kujawski – pp. 405-412.
11 – 3 Apr	Systems Mission Assurance	Blanchard– Ch. 6, pp. 150-166;
12 – 9 Apr	Systems Integration Systems Implementation	Blanchard – Ch. 16, pp. 541-560; Jain – pp. 274-288; Vaneman (1) – pp. 1-11.
13 – 17 Apr	Life-cycle Costing Failure Mode Effects and Criticality Analysis (FMECA)	Blanchard-Ch. 8, pp. 204-234 (reference); Blanchard –, Ch. 17, pp. 566-631.
14 – 24 Apr	System of Systems Engineering	Carlock– pp. 242-261; Sheard-pp. 295-311; Vaneman (2) – pp. 1-?? **Final Projects Due**
14 – 1 May	**Project Presentations**	

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ASSIGNMENT KEY/BIBLIOGRAPHY

Assignment Code	**Reference**
Barabba	Barabba, V., C. Huber, F. Cooke, N. Pudar, J. Smith, and M. Paich (2002). *A Multimethod Approach for Creating New Business Models: The General Motors OnStar Project*. Interfaces, Vol. 32, No. 1, pp. 20-34.
Barnard	Barnard, R.W.A. (2008). What is wrong with Reliability Engineering? Proceedings of the Eighteenth Annual International Symposium of the International Council On Systems Engineering (INCOSE) 15-18 June 2008, pp. 1-9.
Blanchard	Blanchard, B.S. and W.J. Fabrycky (2010). *Systems Engineering and Analysis, 5th Edition*, Prentice-Hall, Englewood Cliffs, N.J.
Carlock	Carlock, P.G. and R.E. Fenton (2001). *System of Systems (SOS) Enterprise Systems Engineering for Information-Intensive Organizations.* Systems Engineering, Vol. 4 No. 4., pp. 242-261.
DoDAF	U.S. Government (2010). *DoD Architecture Framework,* Version 2.02, http://dodcio.defense.gov/sites/dodaf20/products/DoDAF_v2-02_web.pdf
Dorfman	Dorfman, M. (1999). *Requirements Engineering.* SEI Interactive, pp. 1-30
Hauser	Hauser, J.R. and D. Clausing (1988). *The House of Quality*. Harvard Business Review. May-June, pp. 63-73.
Insight (vol. 11, no. 2)	Mueller, M.W. (2008). *Remembering the Human.* INCOSE Insight, Vol. 11, Issue 2, p. 5 Mueller, M.W. (2008). *Human Systems Integration-What's It All About.* INCOSE Insight, Vol. 11, Issue 2, pp. 7-10. Muralidhar, A. (2008). *How Human Systems Integration and Systems Engineering Can Work Together.* INCOSE Insight, Vol. 11, Issue 2, pp. 11-14. Folds, D., D.L. Gardner, and S. Deal (2008). *Building Up to the Human Systems Integration Demonstration.* INCOSE Insight, Vol. 11, Issue 2, pp. 15-18 Hardman, N., J. Colombi, D. Jacques, and R. Hill (2008). *What Systems Engineers Need to Know About Human-Computer Interaction.* INCOSE Insight, Vol. 11, Issue 2, pp. 19-23.
ISEH	Haskins, C., K. Forsberg, and M. Krueger (2007). *INCOSE Systems Engineering Handbook, v. 3.1*, International Council on Systems Engineering, Seattle, WA.

Jain	Jain, R., A. Chandrasekaran, and O. Erol (2010). *A Systems Integration Framework for Process Analysis and Improvement.* Systems Engineering, Vol. 13, No. 3., pp. 274-288.
Kujawski	Kujawski, E. (2010). *Unintended Consequences of Performance Specifications for the Reliability of Military Weapons Systems.* Systems Engineering, Vol. 13, No. 4, pp. 405-412.
Marchant	Marchant, A.B. (2010). *Obstacles to the Flow of Requirements Verification.* Systems Engineering, Vol 12, No. 1, pp. 1-13.
Piaszczyk	Piaszczyk, C. (2011). *Model Based Systems Engineering with Department of Defense Architectural Framework.* Systems Engineering, Vol. 14, No. 3, pp. 305-326.
Robinson	Robinson, C., T. Enderwick, J. Freese (unknown). *HSI Risk Reduction in a COTS Environment.* The Space and Naval Warfare Systems Command (SPAWAR) HSI Directorate, pp. 1-12.
Roedler	Roedler, G.J. (2005). *Technical Measurement.* INCOSE Measurement Working Group.
Schoening	Schoening, B (date unknown). *Penetrating the Technical Fog: Eight Questions to Help You Find Out What is Really Going On.* INCOSE Paper, pp. 1-4.
Sheard	Sheard, S.A. and A. Mostashari (2009). *Principles of Complex Systems for Systems Engineering.* Systems Engineering, Vol 12, No. 4, pp. 295-311.
Vaneman (1)	Vaneman, W. K. and K. Triantis (1999). *Defining, Evaluating, and Controlling the Implementation Phase of a System's Life-cycle.* Proceeding of the American Society for Engineering Management National Conference, Virginia Beach, VA, pp. 1-11.
Vaneman (2)	Vaneman, W.K. (2012 pending). *Addressing Navy's Information Dominance Warfare through System of Systems Engineering.* 2012 Industrial and Systems Engineering Research Conference, Orlando, FL, May 19-23, 2012, pp. 1-???
Wagenhals	Wagenhals, L. W., I. Shin, D. Kim, and A. Levis (2000). *C4ISR Architectures:A Structured Analysis Approach for Architecture Design.* Systems Engineering, Vol. 3, No. 4, Winter 2000, pp. 248-287.
Wallace	Wallace, D., D. White, and K. Davidson (unknown). *Warfighter Inclusion in System Development: The Operational Perspective in Defining Design Requirements.* Naval Surface Warfare Center, Dahlgren, VA, pp. 1-10.