IEOR E4521 – Spring 2015
Systems Engineering Tools and Methods
Instructor: Ebad Jahangir, Ph.D.

Course Description: Systems engineering as a technical discipline needs both qualitative and quantitative tools / methods to understand customer requirements, explore design options, design robust and optimized systems, and validate designs in the intended environments. This class is an introduction to the quantitative and semi-quantitative toolset that is primarily concerned with generating and managing information. These tools and methods can be broadly categorized by their use. The categories and some examples under these categories are provided below:

Collaboration: Brainstorming, NGT, MFA, Affinity Diagrams, Context Diagram, Benchmarking
Requirements Management: MBSE, Systemic Textual Analysis, Viewpoint Analysis, QFD, Functional Modeling, Kano Model, Need / Function Means Analysis, Stakeholder Map
System Design: Heuristics, Taguchi Method, DSM, N2 Analysis, TRIZ, OFH, Axiomatic Design
Project Management: EVMS, WBS/OBS/RAM, Gantt Chart, CPM, PERT, Probabilistic PM
Problem Solving: RRCA, Ishikawa Diagram, 5 Whys, QCPC, Mistake Proofing, FFMEA
Decision Making: System Optimization, System Dynamics, Risk Cubes, Cost-Risk-Benefit Analysis, Pugh Matrix, Analytical Hierarch Process, Kepner-Tregoe

Applications of SE tools and methods in various settings will be discussed through examples, case studies, and homework assignments that will encompass the modern complex system development environments including aerospace and defense, transportation, energy, communications, and modern software-intensive systems.

After taking the class, the students will become familiar with the key SE methodologies in various settings and will have at their disposal a suite of tools that can be drawn upon during various phases of product or process development. The importance of a toolset that emphasizes a holistic and integrative view of systems and the environment will be emphasized.

Intended Audience: Engineers with depth in one "technical" discipline who have some practical experience in an interdisciplinary environment and who want to lead design and engineering projects.

Prerequisites: B.S. in Engineering or Applied Sciences; at least 5 years experience (recommended)
Calculus, Probability and Statistics, Optimization, Linear Algebra, and Basic Economics

Required Text(s): None Required

Reference Text(s):

- INCOSE SEBoK
- NASA SE Handbook
- Systems Engineering Principles and Practice by Kossiakoff, Sweet, Seymour, and Biemer; 2nd Edition
- System Engineering Management by Blanchard; 4th Edition
- Decision Making in Systems Engineering and Management by Parnell, Driscoll and Henderson; 2nd Edition
- The Art of Systems Architecting by Rechtin and Maier; 3rd Edition
- Links to other material will be provided

Homework: Based on lecture materials

Grading:

	Class Room Students	CVN Students
Weekly problem sets:	40%	50%
Class Participation:	20%	-
Final Project:	40%	50%

Course Outline:

Lecture 01:	Course Overview, Intro to SE
Lecture 02:	The "Science" Part of SE
Lecture 03:	Collaboration Tools
Lecture 04:	Requirements Tools I
Lecture 05:	Requirements Tools II
Lecture 06:	Guest Lecture
Lecture 07:	Design Tools I
Lecture 08:	Design Tools II
Lecture 09:	Break
Lecture 10:	Project Management Tools
Lecture 11:	Guest Lecture
Lecture 12:	Problem Solving Tools I
Lecture 13:	Problem Solving Tools II
Lecture 14:	Final Project Presentations