# SYSTEMS ENGINEERING ARCHITECTURE AND DESIGN

**Course Information:**
**Course**: SYSM 6301 / MECH 6337
**Term**: Fall 2016
**Classroom Building**: **JSOM**
**Section**: 001 / 001
**Classroom Number: 2.901**
**Class Meeting Times**: Fridays from **4:00pm – 6:45pm**

**Professor Contact Information:**
**Professor**: Alix Minden, P.E., PMP
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**Office Phone:** (972) 883-3894
**Office Location**: **ECSS** 3.209
**Office Hours**: Tuesdays, Wednesdays, and Fridays 1:00pm – 3:30pm
After class and by appointment, as needed.

**Course Pre-requisites, Co-requisites, and Other Restrictions:**
**Pre- & Co-requisites**: None.
**Other Restrictions**: Problem-solving, analytical, and advanced mathematics skills.

**Course Description:**
SYSM 6301 (CS 6301 / MECH 6337) Systems Engineering, Architecture and Design (3 credit hours) Architecture and design of large-scale and decentralized systems from technical and management perspectives. Systems architectures, requirements analysis, design tradeoffs, and reliability, through case studies and mathematical techniques. International standardization bodies, engineering frameworks, processes, notations, and tool support from both theoretical and practical perspectives. (3-0) Y

**Course Structure:**
The course's "face time" will be conducted as a mix of lectures, group and seminar-style discussions, in-class projects, and group presentations. There will be weekly assigned readings and/ or webinars required to review. The content will be assigned from two required textbooks, the INCOSE Systems Engineering Handbook, INCOSE's website, and potentially other case studies. Deliverables will include pre- & post- course knowledge assessments, various homework assignments, quizzes (mini-exams), a group term project, and an individual term paper. As appropriate, guest presenters may be invited to present their unique perspectives.

**Learning Objectives:**

Upon successful completion of this course, students will:

- Understand the established concepts and best practices in systems architecture and design, including model driven architecture and design.
- Understand the history of system architecture and design as a discipline.
- Understand the need for systems architecture and design for large-scale decentralized systems.
- Understand the stakeholders involved in systems architecture and design (roles, skills, responsibilities).
- Understand the role of product models in systems architecture and design; how to represent, analyze, and use the models.
- Understand the role of business process models in systems architecture and design; how to represent, analyze, tailor, and use the models.
- Understand the impact of quality-of-service attributes in systems architecture and design, including reliability and security capabilities.

**Topics the Course Will Cover:**

- Introduction to Systems Engineering
- Systems Engineering Fundamentals (Core SysE Methods and Skills)
- Systems Engineering Analysis Techniques & Tools
- Systems Engineering Metrics
- Systems Engineering frameworks and processes
- Related international standards (engineering, management, education)
- Brief introduction to Requirements Engineering and Risk Management
- Application of SysE Fundamentals to System Architecture
- System Architecture Modeling Overview
- Verification Notations and Approaches
- Application of SysE Fundamentals to System Design

**Required Textbook and Materials:**

1. Wasson, Charles S. *Systems Engineering Analysis, Design, and Development*. Hoboken: John Wiley & Sons, Inc., 2015. (ISBN: 9781118442265)
2. Maier, Mark W. *The Art of Systems Architecting*. Boca Raton: CRC Press, 2009. (ISBN: 9781420079135) ***[ONLY A COUPLE CHAPTERS, NO NEED TO BUY]***
3. Walden, David D., Garry J. Roedler, Kevin J. Forsberg, R. Douglas Hamelin, and Thomas M. Shortell. *International Council on Systems Engineering (INCOSE) Systems Engineering Handbook*. Version 4, July 2015. (ISBN: 9781118999400)
4. **NOTE:** Textbook #1 and the required textbook chapters of Textbook #2 will be available for **free** in electronic form for UT-Dallas students, via the UTD McDermott electronic Library.

5. **NOTE:** The electronic version of "Textbook" #3 is available to students for **free**, as INCOSE "CAB" Members, via INCOSE's website.
6. Others to be identified later, and posted to eLearning (Blackboard).

**Required Software (NO SOFTWARE TO BUY!):**

1. Microsoft Office (***available free as a UTD student***)
2. Microsoft Visio ***(available free via a Premium account of Dreamspark)***
3. **NOTE:** Your premium "Dreamspark" account will not be available until census day for the semester.

**Great Reference Materials:**

**Textbooks and Handbooks:**

1. Dickerson, Charles, and Dimitri N. Mavris. *Architecture and Principles of Systems Engineering.* Boca Raton: CRC Press, 2009. (ISBN: 9781420072532)
2. Kossiakoff, Alexander, and William Sweet. *Systems Engineering Principles and Practice*. Hoboken: John Wiley and Sons, 2003. (ISBN: 0-471-23443-5)
3. Montgomery, Douglas C., and George C. Runger. *Applied Statistics and Probability for Engineers*. Hoboken: John Wiley and Sons, 2007. (ISBN: 9780471745891)
4. Stair, Ralph M. *Quantitative Analysis for Management.* Englewood Cliffs: Prentice-Hall, Inc., 1999. (ISBN 0-13-021538-4)

**Standards and Frameworks:**

1. ISO/IEC 15288:2008 "Systems and Software Engineering – Systems Life Cycle Processes".
2. ISO9000 / AS9100.

**Grading Policy:**

| Item | Total Weight |
|---|---|
| **Pre-** & Post- **Course** Knowledge Assessments (50% each) | 5.0% |
| "*Homework*" - Reflective Assignments | 5.0% |
| "*Homework*" - Knowledge Application Assignments (3 to 5) | 10.0% |
| Class Participation | 10.0% |
| Term Group Project | 30.0% |
| Individual Term Paper | 15.0% |
| Quizzes (~5 to 10) | 25.0% |
| **Total:** | **100%** |

**Grading Policy (Continued):**

**NOTE:** Assignment due dates will be identified within eLearning (Blackboard), but typically by 7pm CT two days before the next class. The quizzes will be ***random*** throughout the semester. The individual term paper and term group project due dates will be identified during class and also in eLearning.

**NOTE:** Course quizzes (mini-exams) are NOT available for "make-up". However, your ***(one)*** lowest score will be "dropped," with the *possibility* of a second ***(two)*** depending on the total number of quizzes for the semester (~ >7).

**NOTE:** All assignments, including the quizzes shall be submitted via **eLearning**, *unless otherwise specified by the professor*. Email and / or hardcopy submission will not be accepted (unless otherwise approved by professor.)

**Instructor & Other Course Policies:**

- Students are expected to attend all classes and participate. Student participation contributes to the overall learning experience.
- Late delivery of assignments will not be accepted unless receiving *prior* professor approval.
- Unless specifically discussed during class, no extra credit is planned or available.
- All written communication will be via eLearning, and sometimes via email, but only using your UTD email account. You may initiate email communication via a non-UTD email account (although discouraged), but email communication initiated by professor will never be to a non-UTD address.
- Professor reserves the right to modify syllabus, as needed. If changed, notification will be provided to students via eLearning syllabus link, eLearning Announcements, and during the following class period.

**UT Dallas' Policy on Sharing Confidential Information:**

Per UTD Administration direction, the following policy is explicitly included in the syllabus.

*"Students considering sharing personal information in email, in person, or within assignments or exams should be aware that faculty members and teaching/research assistants are required by UT Dallas policy to report information about sexual misconduct to the UT Dallas Title IX Coordinator. Per university policy, faculty have been informed that they must identify the student to the UT Dallas Title IX Coordinator. Students who wish to have confidential discussions of incidents related to sexual harassment or sexual misconduct should contact the Student Counseling Center (972-883-2527 or after hours 972-UTD-TALK or 972-883-8255), the Women's Center (972-883-8255), a health care provider in the Student Health Center (972-883-2747), the*

*clergyperson (or other legally recognized religious advisor) of their choice, or an off-campus resource (i.e., rape crisis center, doctor, psychologist). Students who are sexually assaulted, harassed, or victims of sexual misconduct, domestic violence, or stalking, are encouraged to directly report these incidents to the UT Dallas Police Department at 972-883-2222 or to the Title IX Coordinator at 972-883-2218. Additional information and resources may be found at http://www.utdallas.edu/oiec/title-ix/resources."*

**[Additional] UT Dallas Syllabus Policies and Procedures:**

The information contained in the following link constitutes the University's additional policies and procedures segment of the course syllabus.

Please go to http://provost.utdallas.edu/syllabus-policies/ for these policies.

## Planned Weekly Topic(s) and Relevant Textbook Chapter(s):

| Week | Date | Lec # | Major Focus Area | Topic / Description | Wasson Chapter(s) | INCOSE SE HB (4E) | INCOSE Webinar | Other Articles from eLearning |
|---|---|---|---|---|---|---|---|---|
| 1 | 8/26 | 1 | #0 - Overview of course content and its connections | Intro of Students | | | | |
| 1 | 8/26 | 2 | | Course Overview | | | | |
| 1 | 8/26 | 3 | | Course Purpose & How All Topics Tie Together | | | | |
| 2 | 9/2 | 4 | #1 - Introduction to Systems Engineering (SysE) | What is SysE? | 1 | | | |
| 2 | 9/2 | 5 | | Intro to Roles of SysE | 3.3-3.5 | | | "Twelve Systems Engineering Roles" by Sarah A. Sheard; In: "Course Materials/Reference Reading Materials/ SysE Overview/12-Roles" |
| 3 | 9/9 | 6 | | SysE LC Processes | 3.8.1-3.8.7, 15 | | | |
| 3 | 9/9 | 7 | #2 - SysE Fundamentals & Core Methods / Processes | Intro To SysE Modeling & Sim | 33 | | | |
| 4 | 9/16 | 8 | | Overview of SysE Core Skills | | 2.10, 2.11 | | |
| 4 | 9/16 | 9 | | Core 4 - Planning | 28.4 | 5.1 | Webinar 62 https://connect.incose.org/Library/Webinars/Documents/Webinar%20Archives/Webinar%2062%20Propose%20Plan%20and%20Innovate.mp4 | |

## SYSM 6301 – Systems Engineering Architecture and Design

| Week | Date | Lec # | Major Focus Area | Topic / Description | Wasson Chapter(s) | INCOSE SE HB (4E) | INCOSE Webinar | Other Articles from eLearning |
|---|---|---|---|---|---|---|---|---|
| 5 | 9/23 | **10** | | **Core 4 - Analysis** | **30.4, 32** | **10.2-10.7** | | |
| 6 | 9/30 | **11** | | **Core 4 - Synthesis** | **11** | | | |
| 6 | 9/30 | **12** | | **Core 4 - Implementation** | **28.1-28.3, 28.7, 27.3-27.3.2.1.3, 13.3** | | | |
| 7 | 10/7 | **13** | | **Core App to Requirements** | **6.4-6.5, 19.4-19.7** | | **Webinar 29 - https://connect.incose.org/Library/Webinars/Documents/Webinar%20Archives/Webinar%2029%20N%20Squared%20Diagram%20and%20Commercial%20SE%20Projects.wmv** | |
| 8 | 10/14 | | | **Project - Part 2** | | | | |
| 8 | 10/14 | **14** | | **Core App to Risk** | **34.3.8-34.3.10** | | | |
| 9 | 10/21 | **15** | **#3 - Application of SysE Fundamentals to Architecture** | **Intro to SysE Arch** | | | | **Course Materials/ SysE Architecture/ For Other SysE Arch Material / Systems Architecting-An Emergant Discipline.pdf** |
| 10 | 10/28 | **16** | | ***SysE Arch ZF Views & Creation Technique*** | | | **https://www.zachman.com/resources/videos/video/25** | |
| 11 | 11/4 | **17** | | ***SysE Arch - DFDs, ERDs, & UCs*** | **8.1,8.2,8.4-8.6.3** | | | **Course Materials/ Reference Reading Materials/ SysE Architecture/ ERD, DFD, & Use Cases** |

## SYSM 6301 – Systems Engineering Architecture and Design

| Week | Date | Lec # | Major Focus Area | Topic / Description | Wasson Chapter(s) | INCOSE SE HB (4E) | INCOSE Webinar | Other Articles from eLearning |
|---|---|---|---|---|---|---|---|---|
| 12 | 11/11 | 18 | #4 - Application of SysE Fundamentals to Design | Intro to SysE Design | 12.1 - 12.5 | 3.6, 4.5-4.6 | | |
| 12 | 11/11 | 19 | | SysE Design Roles | | 9.4-9.5 | | |
| 13 | 11/18 | 20 | | SysE DF-Reliability | 34.3 - 34.3.3 | 10.8 - 10.8.2 | | |
| break | 11/25 | | | FALL BREAK | | | | |
| 14 | 12/2 | | #5 - TIATA & Course Wrap-Up | Project - Part 3 | | | | |
| 14 | 12/2 | 21 | | TIATA (*Start of*) | | | | |
| 14 | 12/2 | 21 | | TIATA (*Finish of*) | | | | |
| 15 | 12/9 | 22 | | 6301 Course Wrap-Up | | | | |