



## Industrial Engineering 3331

### “Systems Engineering”

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Fall 2023

Instructor: Sergio Luna, Ph.D.

Course Web Address: [IE 3331 - SE Fundamentals - Blackboard](#)

**Course Schedule: Monday & Wednesday (1:30 pm – 2:50 pm MST)**

**Location: Liberal Arts Building 101**

Contact Information: [salunafong@utep.edu](mailto:salunafong@utep.edu)

Virtual Office Hours: Wednesday 3:00 p.m. – 4:30 p.m. MST or by appointment

### COURSE DESCRIPTION

Systems engineering is a multidisciplinary approach that incorporates a *holistic* perspective to developing complex systems. This discipline presents the community with methods, tools, and processes that facilitate the transformation of stakeholder needs into operational solutions that effectively meet such needs. In this course, Systems Engineering Fundamentals, students are introduced to the system development lifecycle starting with understanding the problem space, capturing, and decomposing system requirements, exploration of design and cost trade-offs, system architecture, integration and testing of systems and legacy systems, verification and validation of system’s behavior, system maintenance and retirement, among others.

The course acquaints students with both the theory and practice of the systems engineering discipline by developing and presenting a multidisciplinary group project aiming to meet a particular stakeholder need. Students will be implementing learned concepts through the development of a model-based system description where they will be required to apply systems thinking to transform customer needs into system requirements, identify the proper system development process, create potential design solutions, present conceptual architectures, describe the plan for interface integration, discuss the proposed testing, verification, and validation strategies, and review the planned maintenance and retirement activities.

### STUDENT LEARNING OUTCOMES

After successful completion of this course, students will be able to:

- Assess the development and management of complex systems from a holistic perspective
- Articulate systems engineering concepts and terminology
- Analyze multiple system life cycle development models
- Describe the value that systems engineering to enterprises
- Apply systems engineering methods, tools, and processes to the design of complex systems

### COURSE FORMAT AND STRUCTURE

- Our weeks will run from **Monday** to **Wednesday**. I will post all the information (online activities, discussion starters, etc.) on Blackboard for the upcoming week on **Wednesday** evening after class, so you can begin the new week and submit your deliverables, if any, by the following **Monday**.
  - Course Web Address: [IE 3331 - SE Fundamentals - Blackboard](#)

- Virtual office hours will be held Wednesday from 3:00 p.m. - 4:30 p.m. MST or by appointment. Please email me at [salunafong@utep.edu](mailto:salunafong@utep.edu) to schedule a meeting.
- Assignments are due by 11:59 p.m. MST on the due date listed in the course schedule.
- An assignment file should be appended by the respective assignment number, your Last Name and First Name, such as "assignment1\_LastName\_FirstName.pdf". This makes it easier for me to manage assignment files when downloading to my computer.

## COURSE MATERIALS

- The following materials are **required**:

1. INCOSE Handbook. International Council on Systems Engineering, *Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities*. 4<sup>th</sup> Edition, Wiley 2015.

A handbook's electronic version is included with the INCOSE student and professional's membership. It is also available, free of charge, to INCOSE's Corporate Advisory Board (CAB) limited members. Several organizations in industry, academia, and government are INCOSE's CAB members. To join INCOSE or confirm that your organization is a CAB member please visit the following link:

- [Join INCOSE - International Council on Systems Engineering](#)
  - [UTEP is a CAB member. Hence, we can access it at no cost.](#)
2. *NASA Systems Engineering Handbook* (NASA SP-2016-6105 Revision 2)
    - [https://www.nasa.gov/sites/default/files/atoms/files/nasa\\_systems\\_engineering\\_handbook\\_0.pdf](https://www.nasa.gov/sites/default/files/atoms/files/nasa_systems_engineering_handbook_0.pdf)
  3. NoMagic System of Systems Architect
    - Download instructions in Blackboard

- The following materials are not mandatory but are **recommended**:

3. Product Design and Development 6ed (Ulrich, Eppinger) McGraw Hill
    - [Link to sample book](#)
  3. Kossiakoff, A., Biemer, S. M., Seymour, S. J., & Flanigan, D. A. (2020). *Systems engineering principles and practice* (2nd ed.). John Wiley & Sons.
  4. Blanchard, B. S., & Fabrycky, W. J. (2010). *Systems engineering and analysis* (5th ed.). Pearson College Division.
  5. Product Design and Development 6ed (Ulrich, Eppinger) McGraw Hill
    - i. [Link to sample book](#)
- **Knowledge Repository**
    6. SEBoK Link - [SEBoK - Systems Engineering Body of Knowledge](#)

## Tentative Course Schedule

The schedule below is subject to change. If, for any reason, I am required to make any amendments, I will inform you via Blackboard, email, and MS Teams.

Assignments are due by 11:59 p.m. MST on the day specified in the “Assignment” column seen below.

### Tentative Schedule – This is subject to updates based on the university’s protocols

Module	Date	Topic(s)	Assignment
			<b>Quizzes: Every Wednesday</b> <b>Project Updates</b>
Week 01	Aug 28 <sup>th</sup> – Aug 30 <sup>th</sup> , 2023	Orientation & Introduction to Systems Engineering	Student Introduction
Week 02	Sep 4 <sup>th</sup> – Sep 6 <sup>th</sup> , 2022	Systems Engineering Principles	INCOSE SE Handbook: Ch. 1, 2 DoD SE Fundamentals: Ch. 1, 2 NASA SE Handbook: Ch. 1, 2 <b>Quiz #1: SE Principles</b>
Week 03	Sep 11 <sup>th</sup> – 13 <sup>th</sup> , 2022	Systems Engineering Processes and Life Cycles	INCOSE SE Handbook: Ch. 3 NASA SE Handbook: Ch. 3 <b>Quiz #2: SE Processes</b> <b>Disseminate team members</b> <b>Select Projects</b>
Week 04	Sep 18 <sup>th</sup> – 20 <sup>th</sup> , 2022	Mission and Business Analysis  Stakeholders and CONOPS	INCOSE Handbook: Ch. 4.1 - 4.2 NASA SE Handbook: Ch. 4.1 <b>Quiz #3: Mission and Business Analysis</b>
Week 05	Sep 25 <sup>th</sup> – 27 <sup>th</sup> , 2022	System Requirements Elicitation	INCOSE Handbook: Ch. 4.3 NASA SE Handbook: Ch. 4.2, 6.2, App. C <b>Quiz 4#: Requirements Elicitation</b> <b>Project Update #1: Project Description</b>
Week 06	Oct 2 <sup>nd</sup> – Oct 4 <sup>th</sup> , 2022	System Requirements Management	INCOSE Handbook: Ch. 9.3 NASA SE Handbook: Ch. 4.3 <b>Quiz #5: Requirements Management</b>
Week 07	Oct 9 <sup>th</sup> – Oct 11 <sup>th</sup> , 2022	Functional Analysis	INCOSE Handbook: Ch. 4.4 – 4.5 NASA SE Handbook: Ch. 4.4 <b>Quiz #6: Functional Analysis</b>

Week 08	Oct 16 <sup>th</sup> – 18 <sup>th</sup> , 2022	Architecture Definition	INCOSE Handbook: Ch. 4.6, 5.2 – 5.7 and 9.1 NASA SE Handbook: Ch. 6.3 – _6.7, App. L <b>Quiz #7: Architecture Definition</b>
<b>Week 09</b>	<b>Oct 23<sup>rd</sup> – 25<sup>th</sup>, 2022</b>	<b>System Analysis</b>	<b>Mid Term due: 10/25</b>
Week 10	Oct 30 <sup>th</sup> – Nov 1 <sup>st</sup> , 2022	Implementation and Integration	INCOSE Handbook: Ch. 4.7, 4.8, 4.10, 5.8, 9.6-9.7 NASA SE Handbook: Ch. 5.1 – _5.2, 5.5, App H <b>Quiz #8: Implementation and Integration</b> <b>Project Update #2: Project Implementation</b>
Week 11	Nov 6 <sup>nd</sup> – Nov 8 <sup>th</sup> , 2022	Testing, Verification, Validation, Quality	INCOSE Handbook: Ch. 4.9, 4.11 NASA SE Handbook: Ch. 5.3-5.4, App D, E, I <b>Quiz 9#: Testing, VVQ</b>
Week 12	Nov 13 <sup>th</sup> – 15 <sup>th</sup> , 2022	Specialty Engineering	INCOSE Handbook: Ch. 5.3, 10 NASA SE Handbook: Ch. 6.8 <b>Quiz #10: Specialty Engineering</b>
Week 13	Nov 20 <sup>th</sup> – 22 <sup>nd</sup> , 2023	Model-Based Systems Engineering (MBSE) & Operation	INCOSE Handbook: Ch. 4.12 – 4.14, 9.1-9.2 NASA SE Handbook: Ch. 6.8 <b>Project Update #3: Project Implementation</b>
Week 14	Nov 27 <sup>ht</sup> – Nov 29 <sup>th</sup> , 2022	Maintenance and Disposal	<b>Quiz #11: Maintenance and Disposal</b>
<b>Week 15</b>	<b>Dec 4<sup>th</sup> – Dec 6<sup>th</sup>, 2022</b>	<b>Final Project – MBSE Model</b>	<b>Final Project Presentations</b> <b>Final Project Report (12/6<sup>th</sup>)</b>

## COURSE REQUIREMENTS

- **Attendance:** We will meet in the Liberal Arts Building, Room 101. Attendance is required.

- **Assignments**

Class assignments are described by the following breakdown:

- (20%) – Quizzes
- (20%) – Project Updates
- (25%) – Mid-term project – Lectures 2 to 8
- (25%) – Final Project
- (10%) – Team Presentation

- **Team Project – Development of System Description Architecture using model-based engineering**

- Students will work in multidisciplinary teams to develop a Systems Engineering Management Plan (SEMP). This document sets the foundation for establishing how a system will come to life by describing the technical project planning and control, systems engineering process, and engineering specialty integration.
- Each team member will be asked to assess each other’s contribution to the team’s contribution.

## GRADING PROCEDURES

Grades will be based on the following weights:

Quizzes	20%
Project Updates	20%
Midterm project	25%
Final Report	25%
Team Presentation	10%

The final grading rubric will be as follows:

A	90 - 100
B	80-89
C	70 - 79
D	60 – 69
F	< 60

## COVID 19-PRECAUTION STATEMENT

Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to [covidaction@utep.edu](mailto:covidaction@utep.edu), so that the Dean of Students Office can provide you with support and help with communication with your professors. The Student Health Center is equipped to provide COVID-19 testing.

The Center for Disease Control and Prevention recommends that people in areas of substantial or high COVID-19 transmission wear face masks when indoors in groups of people. The best way that Miners can take care of Miners is to get the vaccine. If you still need the vaccine, it is widely available in the El Paso area, and will be

available at no charge on campus during the first week of classes. For more information about the current rates, testing, and vaccinations, please visit [epstrong.org](http://epstrong.org)

## LEARNING ACCOMMODATIONS

The Center for Accommodations and Support Services (CASS) aspires to provide students with disabilities, accommodations and support services to help them pursue their academic, graduation, and career goals. For more information concerning services for students with disabilities, please contact the Center for Accommodations and Support Services at <https://www.utep.edu/student-affairs/cass/>

## INCLUSIVITY

### **Name and Pronoun Usage**

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.