

## SE 5000: Introduction to Systems Engineering, Spring 2021

**Course Instructor:** Amy E. Thompson, Ph.D.

**Catalog Description.** 3 credits. An introduction to the hard and soft skills that are required of good systems engineers. Lectures follow the competency models for systems engineers and include topics such as systems thinking, needs identification, requirements formulation, architecture definition, technical management, design integration, as well as verification and validation of designs. Some of the key systems engineering (SE) standards will be covered and the roles of organizations in enabling engineers to develop systems will be explored. Applications of SE concepts and tools in various settings will be discussed through examples and case studies. Students will learn to apply the SE methodologies in modern complex system development environments such as aerospace and defense, transportation, energy, communications, and modern software-intensive systems.

**Pre-Requisites.** An undergraduate degree in engineering, computer science, or science.

**Intended Audience.** The course is designed for all graduate students in engineering or computer science.

**Course Delivery Method.** The course will be offered in an online synchronous and asynchronous format, according to the course schedule and syllabus. Direct and live communication with the instructor will be available each week by Collaborate and can be found at “Weekly Live Sessions” inside HuskyCT. Attendance at live sessions is strongly recommended, and you must notify the instructor in advance if you cannot attend. The HuskyCT Discussion Board and MS Teams Collaboration Tool will be used to communicate with students and the instructor between live sessions.

### Course Goals.

- (1) Student obtains a foundational knowledge of systems engineering processes and practices.
- (2) Student uses the knowledge and information gained in the course to expand and improve the application of systems engineering in their field.
- (3) Student pursues further in-depth education and training in systems engineering.

**Course Learning Objectives.** By the end of SE 5000, a student will be able to:

- (1) Describe processes, methods, and practices of systems engineering.
- (2) Apply systems engineering practices and methods to engineered systems.
- (3) Develop, define, and create use cases, operating scenarios, technical measures of performance, requirements, architectures, behaviors, specifications, verifications and tests for an engineered system.
- (4) Create views of systems using SysML and other diagramming approaches.
- (5) Allocate requirements and functions to define and create design spaces for an engineered system.
- (6) Recognize important systems engineering and systems thinking strategies and practices in examples and cases.

**Course Organization.** The contents and organization of the course follows Buede and Miller's The Engineering Design of Systems, Models and Methods, which presents in-depth engineering methods needed to design engineering systems, and we will use content from that text to support the INCOSE Systems Engineering Handbook Version 4.

**Course Outline.** The course's five learning units are divided into 13 modules, defined below:

----- *Unit 1: Introduction to Systems Engineering* -----

**Module 1: Introduction to the Field of Systems Engineering and System Lifecycles**

**Module 2: Introduction to MBSE, Frameworks, and Tools**

----- *Unit 2: Defining the Design Problem* -----

**Module 3: Defining the Design Problem Part 1 - Creating and Analyzing Requirements, Capability Engineering**

**Module 4: SysML and Graphical Modeling Techniques for MBSE**

**Module 5: Defining the Design Problem Part 2 - Context & Environment**

**Module 6: Midterm Course Project Submission**

----- *Unit 3: System Engineering Technical Processes: Down the Systems Vee* -----

**Module 7: Functional Architecture Development**

**Module 8: Physical Architecture Development**

**Module 9: Allocated Architecture Development**

**Module 10: Interface Design**

----- *Unit 4: System Engineering Technical Processes: Up the Systems Vee* -----

**Module 11: Implementation, Integration, Verification, Validation, Qualification, and Transition**

**Module 12: Systems Science and Systems Thinking and Course Wrap-Up**

----- *Unit 5: Systems Thinking and Course Wrap-Up* -----

**Module 13: Defining the Design Space and Final Course Project Submission**

**USEFUL READING.**

Required course materials should be obtained before the first day of class. Required textbooks are available for purchase through the [UConn Bookstore](#) (or use the Purchase Textbooks tool in HuskyCT). Textbooks can be shipped ([fees apply](#)).

**Required Text**

- (1) Buede, Dennis and William D. Miller. The Engineering Design of Systems: Models and Methods, 3rd Edition. Wiley. ISBN: 978-1-119-02790-4.
- (2) INCOSE, Systems Engineering Handbook Version 4. Available with membership from INCOSE.

**Obtaining INCOSE Materials**

Each student will be required to access the INCOSE ([www.incose.org](http://www.incose.org)) site to download course materials. Students will be able to download their own personal copy of the INCOSE, Systems Engineering Handbook Version 4, along with other support material, which are important resources for the course. Students are able to sign up for a CAB Limited access account for no fee. For a list of INCOSE CAB Organizations, click here: <http://www.incose.org/ChaptersGroups/CAB>. UCONN is a CAB organization, so you can indicate UCONN as your CAB Organization. Raytheon, General Dynamics, Lockheed Martin, and many other engineering companies are also CAB organizations, and if you are an employee of a CAB company, you can indicate your company as your CAB organization.

**Other Useful Reading and Materials**

- (3) Sillitto, Hillary. Architecting Systems. Concepts, Principles and Practice. January 1, 2014
- (4) M. Ryan and L. Wheatcraft, Guide for Writing Requirements, INCOSE Technical Product INCOSE-TP-2010-006-02, 1 July 2015. Available with membership from INCOSE.

(5) Other INCOSE Materials

- INCOSE-TP-2003-002-04, 2015.
- BKCASE Editorial Board. 2015. The Guide to the Systems Engineering Body of Knowledge (SEBoK), v. 1.5., R.D. Adcock (EIC). Hoboken, NJ: The Trustees of the Stevens Institute of Technology. [www.sebokwiki.org](http://www.sebokwiki.org).
- INCOSE, Journal of the International Council on Systems Engineering, Seattle, W.A.: International Council on Systems Engineering.
- See also the INCOSE web site: <http://www.incose.org/> for other useful products and resources.

(6) Relevant Standards

- ANSI/EIA-632-1998, EIA Standard—Processes for Engineering a System, Arlington, V.A.: Electronic Industries Association, 1999.
- IEEE-STD-1220-2005, IEEE Standard for Application and Management of the Systems Engineering Process, New York: IEEE Computer Society, 2005.
- MIL-STD-498, Military Standard: Software Development and Documentation, Washington D.C.: United States of America Department of Defense, 1994.
- MIL-STD-499B, Military Standard—Systems Engineering—Draft, Washington D.C.: United States of America Department of Defense, 1994.
- ISO/IEC 15288-2015, Systems and Software Engineering—System Life Cycle Processes, 2015.
- ISO/IEC, ISO/IEC 29148, FDIS, Systems and Software Engineering—Life Cycle Processes—Requirements Engineering, 2011.
- International Institute for Business Analysis, A Guide to the Business Analysis Body of Knowledge® (BABOK® Guide), Version 2, 2009.
- ANSI/AIAA G-043A-2012, Guide for the Preparation of Operational Concept Descriptions, American National Standards Institute, American Institute of Aeronautics and Astronautics (sponsor), 2012.

**Copyright.** Copyrighted materials within the course are only for the use of students enrolled in the course for purposes associated with this course and may not be retained or further disseminated.

**Grading.** Student grades are based upon discussion boards, case study assignments, and a course-long project. I will make every effort to provide feedback and grades in the timeframe indicated below. To keep track of your performance in the course, refer to My Grades in HuskyCT. Breakdown:

- Class Participation (20%): Discussion Boards and Effective Interaction with Classmates (Grades & feedback in one week.)
- Project Proposal (20%) (Grades & feedback in one week.)
- Case Studies (20%) (Grades & feedback in two weeks.)
- Midterm Submission (20%) (Grades & feedback in two weeks.)
- Final Submission (20%) Final Grade posted in Student Admin by Due Date.

<b>Grade</b>	<b>Letter Grade</b>	<b>GPA</b>
<b>93-100</b>	<b>A</b>	<b>4.0</b>
<b>90-92</b>	<b>A-</b>	<b>3.7</b>
<b>87-89</b>	<b>B+</b>	<b>3.3</b>
<b>83-86</b>	<b>B</b>	<b>3.0</b>
<b>80-82</b>	<b>B-</b>	<b>2.7</b>
<b>77-79</b>	<b>C+</b>	<b>2.3</b>
<b>73-76</b>	<b>C</b>	<b>2.0</b>
<b>70-72</b>	<b>C-</b>	<b>1.7</b>
<b>67-69</b>	<b>D+</b>	<b>1.3</b>
<b>63-66</b>	<b>D</b>	<b>1.0</b>
<b>60-62</b>	<b>D-</b>	<b>0.7</b>
<b>&lt;60</b>	<b>F</b>	<b>0.0</b>

**Due Dates and Late Policy.** All due dates will be identified in blackboard when the work is posted. Deadlines are based on Eastern Standard Time; if you are in a different time zone, please adjust your submittal times accordingly. The instructor reserves the right to change dates accordingly as the semester progresses. All changes will be communicated in an appropriate manner. Points will be deducted for late submissions, 20% per week.

**Course Project.** A project is to be developed by each student, which is expected to evolve during the entirety of the semester. The project will entail applying system engineering principles and methods to a product or system of your choosing, that meets certain minimum criterion. A separate rubric with the details of the project will be provided to the students on HuskyCT. A developing System Definition Document (SDD) is the major deliverable of the course-long project.

**Case Studies.** Case studies in systems engineering offers the opportunity to see how systems engineering gets implemented in industry. These case studies provide insight into best practices, benefits of application of SE, and how SE implementation may fail.

**Discussion Board.** Discussion board assignments are a great opportunity to collaborate and learn from their peers in the class. Posting to discussion board assignments encourage you to think about real-world application of SE and tailoring of key SE concepts to your industry. Reading and responding to other student posts provides you insight into how SE may relate to industries other than your own.

**Participation.** In an online format, participation by prepared students during live sessions fosters a healthy, vibrant, learning community. Active participation during live sessions is encouraged. Come prepared to discuss the materials.

**Student Conduct.** Students are responsible for adhering to student policies: <http://ecampus.uconn.edu/policies.html>. Students are responsible for adherence to the University of Connecticut student codes of conduct: <https://community.uconn.edu/the-student-code-preamble/> and <https://policy.uconn.edu/2014/04/11/policy-on-scholarly-integrity-in-graduate-education-and-research/>. Academic misconduct is dishonest or unethical academic behavior that includes, but is not limited, to misrepresenting mastery in an academic area (e.g., cheating), intentionally or knowingly failing to properly credit information, research or ideas to their rightful originators or representing such information, research or ideas as your own (e.g., plagiarism). Examples of academic misconduct in this class include, but are not limited to: copying solutions from the solutions manual, using solutions from students who have taken this course in previous years, copying your friend's homework, looking at another student's paper during an exam, and being untruthful with a professor or teaching assistant.

**Attendance.** Students should make every effort to attend the live sessions, participate in discussion boards, and to talk with students in the MS Teams chat forum to get help and assistance from others. It is practically impossible to follow the class if live classes are missed.

**Absences.** Students who miss the interactive live session due to work schedule or other reason shall inform the instructor by email within 24 hours of the class and take responsibility to watch the recorded live session.

**Adding or Dropping a Course.** If you should decide to add or drop a course, there are official procedures to follow:

- Matriculated students should add or drop a course through the Student Administration System.
- Non-degree students should refer to Non-Degree Add/Drop Information located on the registrar's website.

**You must officially drop a course to avoid receiving an "F" on your permanent transcript.** Simply discontinuing class or informing the instructor you want to drop does not constitute an official drop of the course. For more information, refer to the online [Graduate Catalog](#),

[Academic Calendar](#). The University's [Academic Calendar](#) contains important semester dates.

**Students with Disabilities.** The University of Connecticut is committed to protecting the rights of individuals with disabilities and assuring that the learning environment is accessible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, please let me know immediately so that we can discuss options. Students who require accommodations should contact the Center for Students with Disabilities, Wilbur Cross Building Room 204, (860) 486-2020 or <http://csd.uconn.edu/>. Blackboard measures and evaluates accessibility using two sets of standards: the WCAG 2.0 standards issued by the World Wide Web Consortium (W3C) and Section 508 of the Rehabilitation Act issued in the United States federal government." (Retrieved March 24, 2013 from [Blackboard's website](#))

**Software/Technical Requirements (with Accessibility and Privacy Information).** The software/technical requirements for this course include:

- HuskyCT/Blackboard ([HuskyCT/ Blackboard Accessibility Statement](#), [HuskyCT/ Blackboard Privacy Policy](#))
- [Adobe Acrobat Reader](#) ([Adobe Reader Accessibility Statement](#), [Adobe Reader Privacy Policy](#))
- Google Apps ([Google for Education Privacy Policy](#))
- Microsoft Office (free to UConn students through [uconn.onthehub.com](http://uconn.onthehub.com)) ([Microsoft Accessibility Statement](#), [Microsoft Privacy Statement](#))
- VITECH - GENESYS ([VITECH Privacy Policy](#), No Accessibility statement)
- Dedicated access to high-speed internet with a minimum speed of 1.5 Mbps (4 Mbps or higher is recommended).
- Slack chat tool. ([Privacy Policy](#), [Accessibility Statement](#))

**NOTE:** This course has NOT been designed for use with mobile devices.

**Course Schedule.** Check the updated Course Schedule in HuskyCT on the first day of class.

**Help.** [Technical and Academic Help](#) provides a guide to technical and academic assistance. This course is completely facilitated online using the learning management platform, [HuskyCT](#). If you have difficulty accessing HuskyCT, you have access to the in person/live person support options available during regular business hours through the [Help](#)

[Center](#). You also have [24x7 Course Support](#) including access to live chat, phone, and support documents.

**Minimum Technical Skills.** To be successful in this course, you will need the following technical skills:

- Use electronic mail with attachments.
- Save files in commonly used word processing program formats.
- Copy and paste text, graphics or hyperlinks.
- Work within two or more browser windows simultaneously.
- Open and access PDF files.
- Familiar with installing software on your computer and following software use instructions.

University students are expected to demonstrate competency in Computer Technology. Explore the [Computer Technology Competencies](#) page for more information.

**Evaluation of the Course.** Students will be provided an opportunity to evaluate instruction in this course using the University's standard procedures, which are administered by the [Office of Institutional Research and Effectiveness](#) (OIRE). Additional informal formative surveys may also be administered within the course as an optional evaluation tool.

#### Instructor's Contact Information:

- Amy Thompson: [amy.2.thompson@uconn.edu](mailto:amy.2.thompson@uconn.edu) Phone: (860)486-8462
- Office Hours: Email instructor to setup individual or regular office hour appointments.

#### Helpful Links:

- Virtual Computer Lab at UConn AnyWare: <https://software.uconn.edu/uconn-software-online/>
- Course Material: <https://lms.uconn.edu>
- Institute for Advanced Systems Engineering: <http://www.utc-iase.uconn.edu/>