

SIE-654 Advanced Concepts in Systems Engineering Syllabus Spring 2022

Class Location and Times:

Classroom: ENGR 301

9.30-10.45AM Tuesdays and Thursdays, 12 January – 4 May

Description of Course

This semester, this class presents advanced concepts in problem formulation. The course will combine a practical focus on improving the quality of problem formulation and a research focus on advancing the state of the art in problem formulation. Topics include different types of problem spaces (outcomes vs functions), formal distinction between problem and solution, formal modeling of needs and requirements, formal syntax and ontologies for textual formulation of needs and requirements, elicitation and derivation as a byproduct of mission engineering, decomposition as a byproduct of systems architecture, mixed-formulation approaches, traceability, techniques to identify necessary vs constraining needs and requirements, and techniques to identify gaps in needs and requirements.

Course Objectives and Expected Learning Outcomes:

Having successfully completed this course, the student will be able to:

1. Elicit and formulate high quality stakeholder needs.
2. Derive and formulate high quality system requirements.
3. Decompose system requirements into high-quality component requirements.
4. Apply traceability techniques to identify orphan requirements and unaddressed needs.
5. Choose the right formulation strategy for different problem types.
6. Describe the state of the art in problem formulation.

Course Prerequisites or Co-requisites

Prerequisite: SIE-454A/554A – Systems Engineering Process

Instructor and Contact Information

Instructor: Dr. Alejandro Salado

Office: ENG 268 or ENG 121

Phone: 520.626.0728

Email Address: alejandrosalado@arizona.edu

Home Page: <https://sie.engineering.arizona.edu/faculty-staff/faculty/alejandro-salado>

Office Hours: By appointment.

Course Text

No course textbook is required.

Course Software

Academic license for Innoslate (by SpecInnovations) will be provided at no cost to the

SIE-654 Advanced Concepts in Systems Engineering

Syllabus Spring 2022

student. The course is not a tutorial on this or any other software. Students will be expected to familiarize themselves with the toolset and resolve problems independently. Students are encouraged to collaborate on making best use of the tool set. A discussion forum in D2L will be set up for this purpose

Course Format and Teaching Methods

All course information is located on the course homepage, which is in Desire2Learn at <https://d2l.arizona.edu/>. **NOTE:** The course site includes information about the course structure, dynamics, and grading beyond that reported in this syllabus. All students must review such information in advance of class.

The course will utilize lecture, in-class discussion, and progressive development of a requirements portfolio (for master students) and a research paper (for doctoral students). The Desire2Learn course website organizes the course into modules. Each module contains archives of classroom lectures & discussions, presentations, notes and other instructional materials on each session's topic, and assignments.

Class meetings will be recorded and archived on the Desire2Learn course website. Online & Distance Learning students are encouraged to attend the scheduled class meetings and use the archives to review lectures. The instructor may record and post additional lectures beyond the scheduled class meetings as needed to assist the class in understand the material.

Between class meetings, students should read the indicated references and complete assignments. Students should visit the course's D2L website often (not just during scheduled class meetings) for announcements, other important instructions, and to participate in online discussions. Online and Distance Learning students will work on MS OneNote asynchronously to replicate the experience of in-class discussions. Detailed instructions are in D2L.

A detailed schedule of the different activities during the semester will be posted in D2L.

Semester Project:

Master students will be required to prepare a requirements portfolio during the semester for a project of their own choosing. Details are provided in D2L. The progress in the portfolio will be graded at different points during the semester.

Doctoral students will be required to produce a research paper in problem formulation on a topic of their own choosing. Details are provided in D2L. The progress in the research will be graded at different points during the semester.

Grading Scale and Policies:

University policy regarding grades and grading systems is available at:

SIE-654 Advanced Concepts in Systems Engineering Syllabus Spring 2022

<http://catalog.arizona.edu/policy/grades-and-grading-system>

This course's grading scale is:

Grade:	Standard	Description
A	$90\% \leq x$	excellent
B	$80\% \leq x < 90\%$	good
C	$70\% \leq x < 80\%$	satisfactory
D	$60\% \leq x < 70\%$	poor
E	$x < 60\%$	failure

Where "x" = (points earned divided by points available X 100%) in the course.

Grading in this course will be based on attaining the learning outcomes of the course and will be assessed differently for master and doctoral students.

For master students, five levels of attainment have been established for each learning outcome:

- **Unattained (level 1):** The student exhibits substantial misunderstanding in the interpretation and/or use of the fundamental course concepts of a particular learning outcome.
- **Unattained (level 2):** The student produces fair problem formulations (i.e., needs, requirements, etc.), but does so with the quality expected for SIE 654. That means, the sets of needs and requirements present several qualities of poor requirements, comprehensiveness of the resulting sets is low, the use of elicitation, derivation, and decomposition methods present several weaknesses, etc.
- **Basic attainment:** The student applies the concepts with no errors in general problem formulations but is unable to address advanced problem formulations.
- **Good attainment:** The student applies the concepts in advanced problem formulations with minor errors.
- **Excellent attainment:** The student applies the concepts in advanced problem formulations with no error.

Attainment will be assessed during the course, as the student creates their portfolio.

The final grade will be calculated as a function of the level of attainment of learning outcomes achieved by the end of the semester. The final grade will be calculated as follows:

- The level of attainment of each learning outcome will be established as a letter F to A, including intermediate grades in between different letters. Unattained level 1 (F), Unattained level 2 (E- to D+), Basic attainment (C- to C+), Good attainment (B- to B+), or Excellent attainment (A- to A).
- Each letter grade is converted into its GPA equivalent.

SIE-654 Advanced Concepts in Systems Engineering Syllabus Spring 2022

Each learning outcome has been allocated a specific weight within the course: Elicit and formulate high quality stakeholder needs (25%), Elicit and formulate high quality system requirements (25%), Decompose system requirements into high-quality component requirements (20%), Apply traceability techniques to identify orphan requirements and unaddressed needs (10%), Choose the right formulation strategy for the different problem types (15%), Describe the state of the art in problem formulation (5%). A total number grade will be determined as the weighted average of all learning outcomes. The number of points will be converted to their letter grade equivalent, using the rounding function in Excel.

For doctoral students, five levels of attainment have been established for each learning outcome:

- **Unattained (level 1):** The student exhibits substantial misunderstanding in the interpretation and/or use of the fundamental course concepts of a particular learning outcome.
- **Unattained (level 2):** The student describes the fundamental course concepts but is unable to engage in discussions about the state of the art.
- **Basic attainment:** The student understands the state of the art and engages in theoretical discussions about the course concepts.
- **Good attainment:** The student applies the state of the art to model simple problems and identifies research gaps.
- **Excellent attainment:** The student identifies research paths to address research gaps.

Attainment will be assessed during the course, both through in-class discussions and the final project.

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

Dispute of Grade Policy: Provide within the acceptable time period for disputing a grade on a paper, project, or exam.

Participation

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>. The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, see: <http://policy.arizona.edu/human-resources/religious-accommodation-policy>. Absences pre-approved by the UA Dean of Students (or Dean Designee) will be

SIE-654 Advanced Concepts in Systems Engineering

Syllabus Spring 2022

honored. See: <http://policy.arizona.edu/employmenthuman-resources/attendance>.

Classroom Behavior Policy:

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Mainly from the university classroom policy (adopted by the Faculty Senate):

- Not leaving early. Early leaving will distract both the instructor and students
- Not talking with other classmates while the instructor or another student is speaking. If a student has a question or comment, he or she should raise a hand, rather than starting a conversation about it with a neighbor
- Not packing backpacks to leave until the instructor has dismissed class
- Showing respect and concern for others by not monopolizing class discussion. Students must allow others time to give their input and ask questions. Students should not stray from the topic of class discussion
- Not eating and drinking during class time

Academic Integrity and Code of Academic Integrity:

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog.

See: <http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>. The University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>.

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement. Instructor and/or TA will carefully exam all of your homework, reports and exams to prevent plagiarism. For example:

- No copy of other people's homework In grading your homework, TA will exam all of your homework carefully and catch anyone who is copying other people's homework. Even if they are from the same software's output, TA can still judge whether it is a copy of others or not based on your writing and formatting.
- No copy or discussion in the exam TA and other students all will report these behaviors in exams and your exam papers will also be checked carefully for any cheating behavior. Do not sit too close to each other in the exam.

SIE-654 Advanced Concepts in Systems Engineering

Syllabus Spring 2022

Teaching Assistant's Responsibility

TA is mainly responsible for assisting the instructor in various issues, including grading homework/quizzes/exams, teaching part of software and tutorial, and helping students in programming and homework during the office hour.

Send Feedback to US:

If you have any questions, suggestions or comments related to the class, you are very welcome to contact the instructor or TA. We have several ways for communications:

- 1) In-class feedback
- 2) Office hours
- 3) Emails
- 4) Individual appointment (if you cannot come in office hour)
- 5) Feedback in D2L

Threatening Behavior Policy:

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See:

<http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

UA Nondiscrimination and Anti-harassment Policy:

The University is committed to creating and maintaining an environment free of discrimination, see: <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>.

Inclusive Excellence is a fundamental part of the University of Arizona's strategic plan and culture. As part of this initiative, the institution embraces and practices diversity and inclusiveness. These values are expected, respected and welcomed in this course. This course supports elective gender pronoun use and self-identification; rosters indicating such choices will be updated throughout the semester, upon student request. As the course includes group work and in-class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect.

Additional Resources for Students Statement: Office of Diversity

<http://diversity.arizona.edu/>

<http://www.health.arizona.edu/counseling-and-psych-services>

Accessibility and Accommodations (for students with Disability)

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, you are welcome to let me know so that we can discuss options. You are also encouraged to contact Disability Resources (520-621-3268, <https://drc.arizona.edu/>) to establish reasonable accommodations.

SIE-654 Advanced Concepts in Systems Engineering Syllabus Spring 2022

Requests for incomplete (I) or withdrawal (W)

Must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

Additional Resources for Students

UA Academic policies and procedures are available at

<http://catalog.arizona.edu/policies>

Student Assistance and Advocacy information is available at

<http://deanofstudents.arizona.edu/student-assistance/students/student-assistance>

Subject to Change Statement

The information contained in the course syllabus, may be subject to change, as deemed appropriate by the instructor, see <http://policy.arizona.edu/faculty-affairs-and-academics/course-syllabus-policy-undergraduate-template>.