

SIE 503 Digital Thread and Model Management

Fall 2026

Syllabus

Class Location and Times:

Arizona Online: Asynchronous.

Main campus: iCourse.

Description of Course

This course presents the foundations of the design and management of digital threads. Students will learn the fundamental characteristics of digital engineering and related approaches such as model-based engineering, before exploring key concepts such as the digital thread and the digital twin. The course will present an approach to capture the need for a digital thread as a use case. Students will then learn the concepts of data interoperability and technical interoperability and will explore the advantages and disadvantages of various approaches that support interoperability. These concepts will include APIs, data standards, data transformations, and ontologies. The course will also present the notion of change management as a crucial consideration of digital thread design. Finally, students will be required to review these considerations in parallel and describe how a digital thread could be deployed in response to a particular problem.

Course Objectives:

The objective of this course is to introduce students to the fundamental concepts and techniques associated with the design and management of a digital thread.

Expected Learning Outcomes:

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

1. Explain the defining characteristics of model-based engineering and digital engineering, and the relationship between digital engineering and key concepts such as digital thread, digital engineering environment, and digital twin.
2. Justify the need for digital threads in the form of use cases.
3. Apply the concepts of data and technical interoperability within a digital thread.
4. Evaluate the advantages and limitations of various tools and approaches to support interoperability such as APIs, data standards, data transformations, and ontologies.
5. Apply change management approaches to a digital thread.
6. Design a digital thread considering different elements, including purpose, organizational structure, digital engineering environment architecture, interoperability constraints, software requirements, product lifecycle, and model management.

Course Prerequisites or Co-requisites

SIE 503 Digital Thread and Model Management

Fall 2026

Syllabus

Pre-requisite: None.

Instructor and Contact Information

Instructor: Dr. Joe Gregory,

Office: ENG 254

Phone: 520.279.4572

Email Address: joegregory@arizona.edu

Office Hours: By appointment.

Course Text

Students will be provided with course notes and papers, developed by the instructors as part of the University of Arizona's Digital Engineering Factory (DEF).

Course Software

All tools required by the students will be available on the UA Digital Engineering Factory (DEF). The DEF provides access to engineering tools that support requirements management, system architecting, detail design, test planning, and domain-specific analyses. The DEF also provides access to data integration software (Violet) and semantic web technologies such as ontologies to support reasoning and querying (OML Rosetta).

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.

Remote students must also use a drawing enabled device during the semester so that they can contribute to group discussions and with the overall class in virtual whiteboards.

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 use a flipped classroom instructional approach. The student will read the required material and attempt to complete the homework on their own before coming to class.

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

SIE 503 Digital Thread and Model Management

Fall 2026

Syllabus

In addition to all policies and information in this document, the instructor expects of every student in this course the following:

- Be aware of all assignment due dates, including reading assignments, and read assigned materials.
- To participate in class discussions.
- To manage the learning process – seek clarification and feedback if needed.
- To complete assignments on time and in a professional manner.
- To demonstrate courtesy and respect to peers and instructor.

Grading Scale and Policies:

The grading scheme for this course is based on 1,000 points. Points are gained through several assignments during the course. Points are distributed as follows:

Assignment	Max points
Assignment 1 (Application of API for data transformation)	100
Assignment 2 (Implementation of interoperability between two tools)	200
Assignment 3 (Management of changes)	100
Assignment 4 (Architecture of a digital thread)	200
Assignment 5 (Implementation of a digital thread)	280
8 x Weekly Reflections (15 points each)	120

University policy regarding grades and grading systems is available at:

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

This course's grading scale is:

Grade:	Standard	Description
A	$900 \leq x$	excellent
B	$800 \leq x < 900$	good
C	$700 \leq x < 800$	satisfactory
D	$600 \leq x < 700$	poor
E	$x < 600$	failure

Where "x" is the total points earned in the course.

If a student believes there are errors in the grading, they should be reported in written to the instructor within 10 days of receiving the graded assignment.

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.

SIE 503 Digital Thread and Model Management

Fall 2026

Syllabus

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

University policy regarding grades and grading systems is available at:
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Tentative lecture schedule

A tentative lecture schedule is provided below. (Assignments to be delivered at the end of the corresponding week.)

Weeks	Topics	Assignment
0.5	Course introduction and overview Key terminology: Model-Based Systems Engineering (MBSE), Digital Engineering (DE), Digital Thread, Digital Twin, Ontologies.	
1	The need for digital threads and main use cases Key architectural drivers for the digital thread Existing capabilities and a look at future possibilities	
2	Concepts of data and technical interoperability Challenges in data interoperability Introduction to APIs and data standards Data transformations and ontologies	Assignment 1
3	Review of interoperability tools Advantages and limitations of interoperability tools Review of successful interoperability implementations and identification of key obstacles	Assignment 2
4	Fundamentals of change management Change management in the digital thread	Assignment 3
5	Elements of a digital thread design Organizational structures and their impact DE environment architecture Interoperability constraints and software requirements Product lifecycle and model management in DE	Assignment 4
6	Implementation of a digital thread	Assignment 5
7	Usability and maintenance of a digital thread	Assignment 6

The topics of traceability and mixed formulations are integrated within the topics in the table above.

SIE 503 Digital Thread and Model Management

Fall 2026

Syllabus

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 UArizona 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 UArizona Dean of Students (or Dean Designee) will be 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/policies/code-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 of 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.

SIE 503 Digital Thread and Model Management

Fall 2026

Syllabus

The instructor will carefully examine all your homework, reports, and exams to prevent plagiarism. For example:

- No copying of other people's homework: Thorough grading of homework and software output will be reviewed to identify patterns.
- No copy or discussion in the exam TA and other students 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.

Send Feedback to US:

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

- 1) In-class feedback
- 2) Office hours
- 3) Emails
- 4) Individual appointment (if you cannot come during office hours)
- 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:

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

UA Arizona 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

SIE 503 Digital Thread and Model Management

Fall 2026

Syllabus

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.

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

UArizona 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>.