Carnegie Mellon University
Master of
Software Engineering

17-627: Requirements for Embedded Systems
In Person: TR 4:40pm – 6:00pm
MSE Online: M 7:00pm – 8:00pm
A2, Fall 2021, 6 Units

Instructor	Email	Office Location & Hours
Scott Pavetti	spavetti@cmu.edu	zoom, by appointment

Course Description. The purpose of this course is to understand and negotiate the factors that drive embedded systems projects. Additionally, students will experience conceptualizing and analyzing a software intensive embedded system of their choosing. The course consists of lectures, weekly assignments, in class discussions, and a semester long project. For the project component, students will create an idea for an embedded product aimed at improving people's lives in some way. This idea is developed and matured throughout the course and delivered as a ready-to-go requirements document fit for downstream consumption. This course is aimed at creating software engineers capable of being product owners or team leads of embedded systems projects. This is also the prerequisite course for Quality Management.

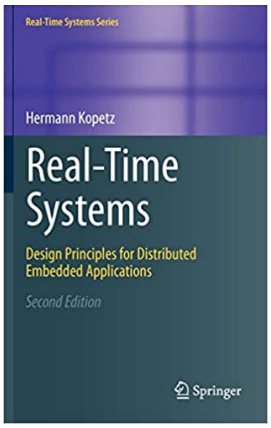
Prior Knowledge. Students should have a background in computer science and have some understanding of software development life cycles.

Learning Objectives. After completing this course, you will be able to:

- Create and analyze requirements for software intensive embedded systems so they have quality and are suitable for downstream software engineering activities particularly verification, validation, and design.
- Analyze and identify targeted user groups and cultivate a set of diverse Personas with characteristics important to the development of software systems, and to use those personas for elicitation and refinement activities.
- Effectively use key diagramming techniques to support the analysis of software requirements in embedded systems to promote software requirements documentation and for bridging the gap between written requirements and software architecture.
- Identify and mathematically model physical aspects of embedded systems to correctly characterize the expected behavior of the controlled system's control system requirements.

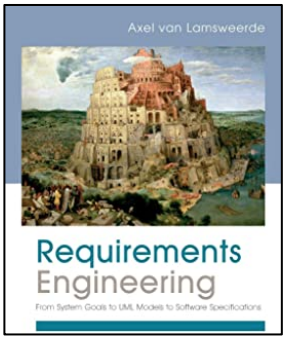
- Create a detailed concept for an embedded system that is analyzable and fit for downstream use in engineering lifecycles.

Learning Resources.



Author: Hermann Kopetz

Real-Time Systems focuses on hard real-time systems, which are computing systems that must meet their temporal specification in all anticipated load and fault scenarios. The book stresses the system aspects of distributed real-time applications, treating the issues of real-time, distribution and fault-tolerance from an integral point of view. A unique cross-fertilization of ideas and concepts between the academic and industrial worlds has led to the inclusion of many insightful examples from industry to explain the fundamental scientific concepts in a real-world setting. Compared to the first edition, new developments in complexity management, energy and power management, dependability, security, and the internet of things, are addressed. Springer, 2011. Order it from Amazon or get it from the Library at no cost.



Author: Axel van Lamsweerde

Requirements Engineering (RE) deals with the variety of prerequisites that must be met by a software system within an organization for that system to produce stellar results. With that explanation in mind, this must-have book presents a disciplined approach to the engineering of high-quality requirements. Serving as a helpful introduction to the fundamental concepts and principles of requirements engineering, this guide offers a comprehensive review of the aim, scope, and role of requirements engineering as well as best practices and flaws to avoid. Wiley, 2009. Order it from Amazon.

Assessments. Students learn more by applying and explaining ideas to others, thus, the course requires the following activities:

- **ES Requirements Project:** In this assessment, students will create a concept for an embedded system product that is aimed at the betterment of people in the world, develop detailed requirements, use software design affordances to model requirements, and conduct peer reviews.
- **Weekly Assignments**: There will be 6 weekly assignments that are tied to readings and lecture topics.
- **Class participation**, to enrich the discussion with your insight, relevant experience, critical questions, and analysis of the material. The quality of contribution is more important than the quantity.

Grade	Percentage Interval
A+	98-100%
A	93-97%
A-	90-92%
B+	88-89%
B	83-87%
B-	80-82%
C	70-79%
D	60-69%
R (F)	59% or below

Assessment	**Final Grade %**
Quizzes	20%
Project	40%
Assignments	30%
Class Participation	10%

Course and Grading Policies

- **Late-work policy**: All work is expected to be handed in at the indicated due date and time. For fairness to the whole class, no late submissions will be accepted for any group work. In the first week of classes, you should receive a course schedule for each course; please use them to plan ahead.

  Each student is allowed one late submission for the individual homework assignments. You should immediately notify the course TA(s) before the submission deadline that you will submit late. Late work must be submitted as soon as circumstances allow, ordinarily within 24 hours of the due date. If you have any questions, you should raise them immediately rather than waiting for conflicts to arise. Late work will be assessed a penalty daily, for three days, then assessed with a score of 0. I understand that conflicts happen, so please make arrangements to submit late assignments ahead of time if possible.

- **Participation policy**. Class participation will be graded by in-class engagement, including asking relevant questions based on a critical review of required readings, lectures, and comments made by your peers. The lack of attendance, and the use of mobile devices, including phones and laptops, will count against your participation grade.

Course Schedule. The following schedule provides a general overview of topics and assignments. Please refer to the syllabus online in Canvas for specific lecture topics, reading assignments and due dates. Schedule is subject to minor changes which will be updated on canvas when they occur as well as announced during class. Readings are listed in Canvas.

Class	Topic
10/19	**Introduction to ES, Need for Requirements Engineering, Sources of Requirements**
10/21	**Availability, Maintainability, Safety, Security, Simplicity, Reliability, Efficiency, Constraints**
10/26	**People and Personas**
10/28	**Requirements, Requirements Quality**
11/2	**Operational Scenarios, Use Cases**
11/4	**Modeling 1**
11/9	**Modeling 2**
11/11	**Downstream Activities, Traceability**
11/16	**Guest Lecturer**
11/18	**Formal Requirements**
11/23	**Architecture, Deriving Technical Requirements**
11/25	Thanksgiving, no class
11/30	**Requirements Quality, Requirements Reviews**
12/2	**Public Infrastructure, Cloud, Course Review**

Accommodations for Students Disabilities. If you have a disability and have an accommodations letter form the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu.

Academic Integrity. Honesty and transparency are important to good scholarship. Plagiarism and cheating, however, are serious academic offenses with serious consequences. If you are discovered engaging in either behavior in this course, you will earn a failing grade on the assignment in question, and further disciplinary action may be taken.

For a clear description of what counts as plagiarism, cheating, and/or the use of unauthorized sources, please see the University's Policy on Academic Integrity.

If you have any questions regarding plagiarism or cheating, please ask me as soon as possible to avoid any misunderstandings. For more information about Carnegie Mellon's standards with respect to academic integrity, you can also check out the Office of Community Standards & Integrity website.

Student Wellness. As a student, you may experience a range of challenges that can interfere with learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. CMU services are available, and treatment does work. You can learn more about confidential mental health services available on campus at the Counseling and Psychological Services website. Support is always available (24/7) from Counseling and Psychological Services: 412-268-2922.

Respect for Diversity. [Please refer to the Eberly Center's page on Diversity Statements for other examples, if this one does suit your needs.] It is my intent that students from all diverse backgrounds and perspective be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know if any of our class meetings conflict with your religious observations so that I can make alternate arrangements for you.