Course Title: Safety-critical Real-time Software
Course Short Title: Safety-crit RT Software
Instructor: Prof. Sebastian Fischmeister

1 Calendar Description
Concepts, theory, tools, and practice to understand, design, and write embedded software. This covers topics such as embedded computing hardware, embedded computing software, modeling of timing and real-time systems, dependability and safety, security, validation, and performance of embedded systems.

2 Prerequisite Topics
computer architecture, operating systems, programming languages, C

3 Prerequisite Courses
• Operating systems course
• Compilers course
• Programming course

4 Antirequisite Courses
• ECE455 Embedded Software

5 Lab Description
No lab

6 Tutorial Description:
No tutorials

7 Project
The course project can be either a software program or a literature survey report on a topic relevant to the course.

8 Reading Material

9 Major topics

• Part 1: Embedded computing
  – Lecture syllabus
  – Embedded systems are difficult
  – Instruction sets
  – Computing units
  – Embedded computing platforms

• Part 2: Timing
  – Reference model for real-time system
  – Common approaches to scheduling
  – Worst-case execution time problem
  – Clock-driven scheduling
  – Priority-driven scheduling
  – Programming timing constraints

• Part 3: Safety
  – Overview of dependable systems
  – Software fault tolerance
  – Interrupt scheduling
  – Byzantine Generals
  – Basics of software qualification
  – Basics of safety assessment
  – ISO 26262 & IEC 62304 & DO 178C

• Part 4: Security
  – Security overview
  – STRIDE
  – Attack trees
  – String vulnerabilities

• Part 5: Correctness
  – Invariants and temporal logic
  – Equivalence and refinement
  – Reachability and model checking

• Part 6: Performance
  – Introduction to benchmarking
  – Common mistakes
  – Performance metrics
  – Probes and monitors
  – Ratio games and visualization

10 Grading

<table>
<thead>
<tr>
<th>Item</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td>Quiz 1-3</td>
<td>20</td>
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<tr>
<td>Final</td>
<td>50</td>
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<tr>
<td>Project</td>
<td>20</td>
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You need at least 50% in each category to get a positive grade.