Embedded Systems Design
Design of Embedded Systems/Model-Based

- Covers the main stages in the development of embedded systems, with emphasis on model-based development and formal methods for the analysis of system properties.
- We review problems and approaches related to all the stages of development including
  - requirements analysis,
  - system-level design (UML and SysML),
  - component oriented modelling, (AUTOSAR)
  - behavioural modelling, (FSM-Simulink)
  - verification of properties, architecture selection and design,
  - code generation and testing.
- Hands-on approach, use of tools, use of embedded boards
  - UML/SysML – Papyrus
  - Simulink/Stateflow
Design of Embedded Systems/Model-Based

- Boards

STM32F4

STM32F7
Course Plan

- Intro to ES, V-model and Model-based Design
- *Project intro*
- Requirements and Functional Testing
- *Project step1 – Requirements and test plan*
- Models and systems
- FSMs part1
- Communication buses – event driven - Controller Area Network
- *Project step2 – Intro to Flex, programming IDE, Erika, Device drivers*
- FSMs part2
- Communication buses – time driven – FlexRay
- FSMs part3
- Extensions to FSMs – Statecharts
- *Project step3 – Models*
- Timed automata
- An Introduction to Uppaal and verification
- *Project step4 – Verification*
- Translating an FSM into code: Part 1
- Statecharts in practice – Mathworks Stateflow
- Translating an FSM into code: Part 2
- Automatic code generation with Mathworks tools
- *Project step5 – Production of Code*
- Conformance testing
- Structural testing – coverage
- *Project step6 – Testing*
- Advanced topic: semantics preservation in multiprogramming implementations
- Advanced topic: component-based design and AUTOSAR
# Course Plan

## Embedded Systems - Model-Based Design

### Lessons - Handouts

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<tr>
<th>Lesson</th>
<th>Description</th>
<th>Slides</th>
<th>Video</th>
<th>Add. Material</th>
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<tbody>
<tr>
<td>0 Introduction</td>
<td>Course layout and contents, prerequisites, the development process</td>
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<tr>
<td>1 Requirements Analysis</td>
<td>Requirements in the development process, how to write requirements, tracing requirements to test and design</td>
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<tr>
<td>2 SysML</td>
<td>The SysML modeling language, metamodel, diagrams, blocks and BBDs, introduction to Papyrus</td>
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<td>3 Functional testing</td>
<td>Introduction to functional (black-box) testing</td>
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<td>4 Introduction</td>
<td>Introduction to Simulink models,</td>
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Course organization and evaluation

- Evaluation is based on
  - Project: development of simple application on Flex board using model-based derivation techniques. Teams of 4. Each member of the team must be capable of discussing the project steps. 40%
  - Final test - written 30%
  - Final test - oral 20%
- Available Projects
  - Elevator controller mockup (all)
  - Elevator subsystem (pick one)
  - Interface prototyping (Linux with Qt or Microchip)
End of introduction

• Questions/Issues?