

Aachen, June, 2025

SWS: V3/Ü1, ECTS: 6

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Exercise for  
**Embedded Systems**  
Summer Term 2025  
Sheet 4: Real Time

**Exercise 1: Basics**

- Name the two requirements needed for real time.
- Explain the terms
  - Hard real time
  - Soft real time

**Exercise 2: OSEK**

- Sketch the extended OSEK task model
- How many processes and resources are needed for
  - Deadlock
  - Priority Inversion

### Exercise 3: Real Time and Resources

Given are four tasks that are all executed only once.

**Start** denotes at which point in time the task enters the ready state.

**Run** denotes how many time units the task wishes to run without doing any requests.

**Req** denotes that a task requests exclusive access to a system resource.

**T** denotes that a task terminates releasing all resources.

**DL** denotes the absolute deadline, i.e., the point in time when the computation must be finished.

Schedule these tasks (sorted by priority; first task has highest priority)

| Task   | Execution                              | Deadline (absolute) |
|--------|--|---------------------|
| Task A | Start @ 5   runs 1   Req.   runs 1   T | DL @ 10             |
| Task B | Start @ 3   runs 1   T                 | DL @ 5              |
| Task C | Start @ 5   runs 3   T                 | DL @ 13             |
| Task D | Start @ 1   runs 3   Req.   runs 3   T | DL @ 13             |

using

- Cooperative scheduling
- Preemptive scheduling
- with priority inheritance protocol
- with priority ceiling protocol

### Exercise 4: Periodic Scheduling

Use earliest deadline first to schedule this task system:

$(4, 2, 4), (5, 2, 5), (10, 1, 2)$

Why is the following task system not schedulable?

$(3, 2, 2), (6, 2, 7), (10, 3, 10)$