

T-106.5300 Embedded systems

The exam contains five questions. The maximum points for each question are listed in the beginning of the questions. Read the questions carefully. Give clear and compact answers. Remember to write the name of the course and your own personal information on each of your answer papers. No extra appliances are allowed in the exam.

- 1 (6p) Consider an embedded system for a parking lot for 40 cars. The lot has coils under the pavement of the driving ways in and out. The both coils give a short electric pulse when a metallic body, such as a car, moves over them. The pulse voltage is linear with respect to the amount of metal. The lot has a sign that should show red if the lot is full and green otherwise. Model a control system for the sign using actor modeling. Include a reset button for the system and assume a threshold of 100mV (small bodies are not to be recognized as cars). Justify and explain your modeling.
- 2 (6p) Consider a single processor real-time system with three tasks, whose periods are 14 ms, 17 ms, and 7 ms. The required processor times for the tasks are 1 ms, 2 ms, and 3 ms, respectively. Can the system be schedulable if static priorities are used? Give a proof and explain your proof.
- 3 (4p) Explain how interrupts are processed by software. What kind of hardware support there exist for the processing?
- 4 (6p) You are the head designer of the on-board software of an earth satellite mission, whose task is to take pictures (rate = 1 per 10 seconds), analyze them with a fast analysis algorithm, and transmit the compact analysis results to ground. In addition to the 100 Mpixel camera, the satellite has a 1.5 kb/s radio subsystem and a power subsystem that is based on solar cells. The on-board computing hardware and software structures and peripheral interfaces are under design. Cheap COTS (Commercial Off-The-Shelf) are assumed to be used. Justify your design choices to minimize total mission costs.
- 5 (6p) Considering dependability in embedded systems, write an essay that is not longer than 45 lines.