AALTO UNIVERSITY
CSE Department
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Exam
T-106.5300

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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) You have an analog source that produces a pure tone. You can switch the source on or off by the input events *on* and *off*. Construct a timed automaton that provides the *on* or *off* signals as outputs, to be connected to the inputs of the tone generator. Your system should behave as follows. Upon receiving an input event *ring*, it should produce a 80ms-long sound consisting of three 20ms-long bursts of the pure tone separated by two 10ms intervals of silence. What does your system do if it receives two ring events that are 50ms apart?

2 (4p) Five jobs arrive simultaneously to be run on a single-core computer. Their run times are $25ms$, $8ms$, $94ms$, $17ms$, and $15ms$. In what order should they be run to minimize the average response time? What is the response time?

3 (4p) Describe how RMS (Rate Monotonic Scheduling) works and what properties it has.

4 (6p) You are the head designer of the on-board software of an AUV (*Autonomous* Underwater Vehicle), whose main purpose is to find wrecks on the deep sea bed during (max. one hour) diving missions with its main instrument, a powerful side-scan sonar. In addition to the sonar producing 300MB/s of raw data that needs a lot of computation (2 TFLOPS) for the reconstruction of the final seabed 3D-images (with rate 2MB/s), the AUV has a propulsion unit with rudders, a power unit (12V, 500Ah), a GNC sensor unit (data for guidance, navigation and control), and an acoustic communication unit to the mother ship (bi-directional, 1kb/s). The on-board computing hardware and software structures and peripheral interfaces are under design. What would you suggest? Why?

5 (6p) Considering the development processes used for embedded systems, write an essay that is not longer than 45 lines.