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 event *on* or *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 (6p) Show that if a system $S : A \to B$ is strictly causal and memoryless then its output is constant. Constant means that the output $(S(x))(t)$ at time t does not depend on t.

3 (6p) Four jobs arrive simultaneously to be run. Their run times are a, b, $17ms$, and $15ms$. In what order should they be run to minimize the average response time? What is the response time?

4 (6p) PID controllers are widely used. What are the P, I, and D? Describe the general operation and the properties of each of these when applied to control tasks.

5 (6p) Considering testing of embedded systems, write an essay that is not longer than 45 lines.