

1. Are the following claims true (**T**) or false (**F**)? Every correct answer gives you +1 p, every incorrect -1 p, and an empty answer is worth 0 p. The minimum amount of total points is 0 p and maximum 6 p.
 - a) A real-time system must satisfy bounded response-time constraints or risk severe consequences, including failure. **T** (p. 5 of the textbook)
 - b) A firm real-time system is one in which performance is degraded but not destroyed by failure to meet response-time constraints. **F** (p. 7 of the textbook)
 - c) A typical power-loss alarm belongs to the class of sporadic and asynchronous events. **T** (p. 10 of the textbook)
 - d) Extensive instruction pipelining helps in making a real-time system deterministic. **F** (p. 46 of the textbook)
 - e) There are industrial modifications of the Ethernet network, and thus the borderline between office and fieldbus networks is becoming blurred. **T** (p. 69 of the textbook)
 - f) Energy-aware operating systems are used in wireless sensor network applications. **T** (p. 141 of the textbook)

2. An individual elevator controller in a bank of multiple elevators has the following periodical tasks with execution periods of p_i and worst-case execution times of e_i $\{i = 1, 2, 3, 4\}$:
Task 1: Communicate with the group dispatcher; $p_1 = 500$ ms, $e_1 = 12$ ms.
Task 2: Update the car position information and manage runs/door; $p_2 = 25$ ms, $e_2 = 5$ ms.
Task 3: Register and cancel car calls; $p_3 = 75$ ms, $e_3 = 1$ ms.
Task 4: System supervisions and self-diagnostics; $p_4 = 200$ ms, $e_4 = 32$ ms.
What is the overall CPU utilization factor in this case? (6 p) (similar example on p. 13 of the textbook)

3. You have a 12-bit A/D converter and its input range is -12V to +12V.
If the analog input to the A/D is -4.3V what is the corresponding digital output in binary format? (6 p) (similar example on p. 87 of the slides of Chapter 2)

4. The priority inversion problem is related to real-time operating systems under certain operating conditions.
 - a) Explain such a condition with an illustrative example. (3 p)
 - b) Why is the condition undesirable? (1 p)
 - c) How could the priority inversion problem be prevented in your example case? (2 p) (example on pp. 118–120 of the textbook)

5. Consider a real-time kernel with preemptive-priority scheduling.
 - a) Draw a state diagram that shows all the possible task states and allowed transitions between them. (4 p)
 - b) Define the states and transitions. (2 p) (pp. 95–97 of the textbook)