

T-106.530 Embedded Systems Exam 12.5. 2004

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----- THE EXAM STARTS BELOW -----

1. Draw a Use Case diagram of the <Exam Problem> system (10pt)

(Hint: Identify Use Cases, Actors, relationships between them, system boundary, etc. )

2. Identify Classes in the <Exam Problem> system (4pt)

(Hint: for each use case find a set of collaborating objects/classes)

3. Identify the structural relations (association, generalization) among the classes and draw the diagram (4pt)

4. Choose a use case and draw a sequence diagram (5pt)

5. Create a state diagram for the overall system or part of it (5pt)

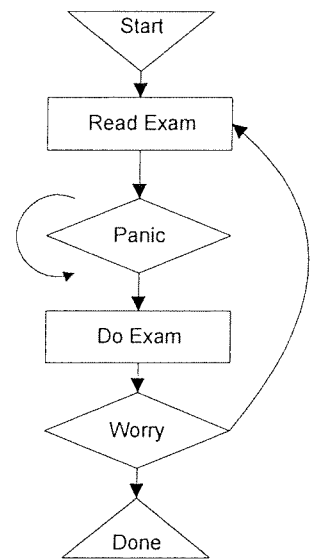
## Kernels

**NOTE: NO FAULT TOLERANCE OR REMOTE-CONTROL FEATURES ARE NEEDED FOR THIS QUESTION**

5.1. Draw the flowchart of the program structure to describe the operation and sequence of operation if the control system for the device described on the first page was built as a:

- 5.1.1. polling system (4pt)
- 5.1.2. interrupt based system (4pt)
- 5.1.3. process-based system (4pt)

5.2. Which of the above is best suited to implement the control system according to the goals listed in the beginning? Explain why? (6pt)



6. How could the above control system be made more fault-tolerant?

**NOTE: NO REMOTE-CONTROL FEATURES ARE NEEDED FOR THIS QUESTION**

6.1. Define fault-tolerance in general (5pt)

6.2. Briefly describe what changes are necessary to the system described on the first page and the system to ensure a basic level fault tolerance in normal operation. (10pt)

6.3. Which of the types of systems in Question 7 is best suited for these modifications? Describe and justify. (5pt)

7. Fault tolerance and prevention

Answer the following questions briefly in the context of fault tolerance and fault prevention.

7.1. Testing (4pt)

7.2. How do sanity checks work? (4pt)

7.3. Explain the differences between Mechanical and Software Interlocks (4pt)

7.4. What is meant by safe start-up and shutdown (4pt)

7.5. What is a watchdog? (4pt)

8. Answer the following with **BRIEF** explanations: (20pt)

8.1. What specific car hardware improvements would have made your programming tasks easier for the car project? (5pt)

8.2. Why are the (PI, PD, PID) control system methods useful? (5pt)

8.3. Explain what went wrong with the Therac-25? (5pt)

8.4. The requirements change again. What control system or related changes are needed to add remote diagnostics ability to the system in questions 7&8 (the physical method of remote controlling has been accomplished for you by unspecified means, ie. You have a black box)? How does that affect your choice in question 8.3? (5pt)

9. Any feedback about this exam or course? (this does not affect your grade)