Tik-106.530 Embedded Systems Exam - 8.5.2002

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INSTRUCTIONS:

- Read the **entire** exam before starting
- Stay in the scope of the question
- Answer all questions in any way possible.
- Justifications and explanations are considered
- The total points of the exam is 112. You need 100 points to score 100%

BACKGROUND INFORMATION FOR THE QUESTIONS:

Known facts:

- Normal elevator connecting three floors
- The elevator has three floor selection buttons inside
- The elevator doors have a safety switch so they will not close on a person
- Each floor has a single elevator request button (omnidirectional)

Goals:

- Move people between floors safely
- Pass exam

OSe - The errors on the exam paper were of my own making, and I apologize for them. Although the vast majority of persons understood correctly what was meant by the misreferences, no-one was penalized for a misreference.

For questions 1-3[correction: 6] assume the following:

a) There is no fault-tolerance

b) There is no remote control

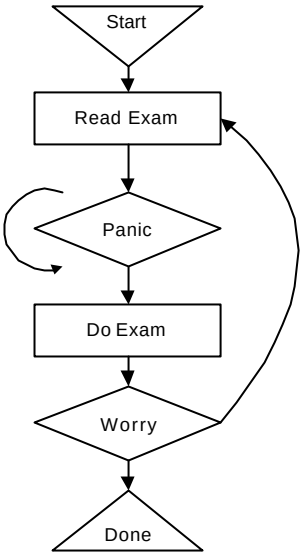
- THE EXAM STARTS BELOW -

1. Draw a Use Case diagram of the elevator system (10 pt)
   (Hint: Identify Use Cases, Actors, relationships between them,etc.)
2. Identify Classes in the elevator system (5pt)
   (Hint: for each use case find a set of collaborating objects/classes)
3. Identify the structural relations (association, generalization) among the classes (5pt)

4. Create interaction diagrams

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

   4.2. Choose a use case and draw a collaboration diagram (5pt)



5. What are the 4 main phases of the ROPES macro cycle? (2 pt)

6. Kernels

   6.1. Draw the flowchart of the program structure to describe the operation and sequence of operation if the elevator control system was built as a:

      6.1.1. polling system (5pt)

      6.1.2. interrupt based system (5pt)

      6.1.3. process-based system (5pt)

   6.2. Which of the above is best suited to implement the elevator control system according to the goals listed in the beginning? Explain why? (5pt)

7. How could this elevator control system be made more fault-tolerant?

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

   7.2. Briefly describe what changes are necessary to the elevator and the system to ensure a basic level fault tolerance in an office environment. (10pt)

   7.3. Which of the types of systems in Question 2[correction: 6] is best suited for these modifications? Describe and justify. (5pt)

8. Fault tolerance is most often considered to be what is done after a fault has already occurred. Briefly explain what are the following items and what are their roles preventing larger faults from happening: (20pt)

   8.1. Watchdog timers

   8.2. Self calibration

   8.3. Limits

   8.4. Mechanical and Software Interlocks

   8.5. Testing

9. Answer the following with **brief** explanations: (20pt)

   9.1. What specific car hardware improvements would have made your programming tasks easier for the car project?

   9.2. Describe the (PI, PD, PID) control system methods their uses.

   9.3. The Therac case was an example of serious failures of many types (two parts!!!)
      9.3.1. Describe at least one design flaw
      9.3.2. Describe success or failure of the Therac manufacturer in response to the above

   9.4. The requirements change again. What changes are needed to add remote control ability to the elevator? How does that affect your choice in question 3.3[correction 7.3]?