

**TENTAMEN TDDD07 Realtidssystem**

DATUM: 14 December 2009

TID: 14-18

PLATS: T1, KÅRA, TER2

ANSVARIG JOURLÄRARE: Examinator Simin Nadjm-Tehrani (Tel: 013-282411, 0702 282412), Mikael Asplund (Tel: 0707 481462).

Material: English-Swedish-English dictionary  
Calculator

No of assignments: 5

Total no. of points: 40

Preliminary grade limits for grades: 3, 4 and 5

3:	20 - 26 p
4:	27 - 33 p
5:	34 - 40 p

**INSTRUCTIONS:**

Please write your anonymous ID on each sheet of paper that you hand in. Further, pages should only contain one answer per page (answers to sub-questions can be on the same page). You are asked to only write on one side of each paper. Please sort all the sheets that you hand in, in the order of the question number.

Make sure your answers are supported by clear explanations. Figures or charts can be used to provide a clearer explanation but should be accompanied by a textual description. Points will not be given to answers for which the reasoning cannot be followed or that cannot be read due to bad handwriting. You may answer in Swedish or English as you prefer.

**Hints:** Try to dispose of your time on each question in proportion of the assignment points. In any case where you are in doubt about the question, write down your interpretation and assumptions, and answer the question based on the interpretation. A correct answer that is embedded in errors may give reduction in points, so make sure your answers are to the point.

Results are reported no later than January 7<sup>th</sup>.

Good luck!

Simin Nadjm-Tehrani

- b) Take a stand on the following propositions (true or false), and motivate your answer:
- 1) A real-time operating system may tolerate program design faults by redundancy in time, i.e. a scheduling algorithm that runs a process again if the first run of the process fails.
  - 2) Simulation of the design of a program can be used to eliminate all requirements faults.
  - 3) Voting systems (e.g. triple modular redundancy) can be used to tolerate transient faults but not permanent faults.
  - 4) A method for fault forecasting is to build in adaptive load control in the design of the system.
- (4 points)
- c) Describe four functions in a real-time operating system that need to be implemented in a different manner from an ordinary operating system.
- (4 points)

**Q3: Design**

- a) Describe two approaches that provide higher assurance for a system to meet its functional and extra-functional properties. For each approach/method describe whether it is addressing issues at hardware, system software, program development, or application modelling and whether it is addressing functional or extra functional properties.
- (4 points)



### Notation for Tasks/Processes

- $C$  - Worst-case-execution time of the task
- $B$  - Worst-case blocking time
- $n$  - Number of tasks in the system
- $T$  - Minimum inter-arrival time (period) of task
- $R$  - Worst-case response time of the task

### Schedulability test Rate Monotonic algorithm:

$$\sum_{i=1}^n \left( \frac{C_i}{T_i} \right) \leq n(2^{1/n} - 1).$$



### Response time analysis

$$R_i = C_i + B_i + \sum_{\forall j \in hp(i)} \left\lceil \frac{R_j}{T_j} \right\rceil * C_j$$

- Where  $hp(i)$  contains the tasks that have a higher priority than task  $i$
- Solved using recurring equations:

$$w_i^{n+1} = C_i + B_i + \sum_{\forall j \in hp(i)} \left\lceil \frac{w_i^n}{T_j} \right\rceil C_j$$