

Ollscoil na hÉireann, Gaillimh
National University of Ireland, Galway

GX 15/8

Semester II Examinations, 2003/2004

Exam Code(s) CT 420

Exam(s) _____

Module Code(s) _____

Module(s) Real-Time Systems

Paper No. 1

Repeat Paper _____ Special Paper _____

External Examiner(s) Prof. Paddy Nixon

Internal Examiner(s) Prof. Gerard Lyons

Dr Andrew Shearer

Instructions: Answer question 1 and 3 others

Duration 3 hours

No. of Answerbooks _____

Requirements:

Handout _____

MCQ _____

Statistical Tables _____

Graph Paper _____

Log Graph Paper _____

Other Material _____

No. of Pages _____

Department(s) Information Technology

1. What are the main differences between a real-time and normal operating system? How would you determine the effectiveness of a real-time operating system which is being used to control a chemical works safety system?

Look at the following process details. Describe an algorithm that maximises the number of hard real-time tasks that are executed.

Process ID	Arrival Time (secs)	Execution Time (secs)	Deadline (secs)	Priority
101	0	2	3	Hard
102	1	4	8	Soft
103	2	1	5	Hard
104	2	10	25	Soft
105	2	5	15	Soft
106	5	2	10	Hard
107	5	3	15	Hard
108	5	25	n/a	Not real-time
109	10	5	33	Soft
110	10	5	40	Soft
111	13	1	20	Hard

2. In many real-time applications safety is an important aspect discuss the safety implications in the following application domains. How do the safety aspects differ from application to application?
 - a. Planetary exploration
 - b. Health Services
 - c. Transportation

3. Why is ADA a better real-time programming language compared to C?

You have been asked to design the emergency shut down system for an oil well. The problem is that you have to close all valves when a set of parameters go outside of a predefined range. It is important that the oil field closes down very quickly after this condition has occurred. How would you program this in C or Java compared to ADA.

4. Why is safety such an important component of most real-time operating systems?

A very cheap control system uses components each of which have a failure probability of 1% in any one operation. If these components are used in triple modular voting system. What is the probability that the system fails if the voting system is perfect? What is the probability of failure if the voting system itself has failure probability of 1%?

5. How can you synchronise widely separated computer systems?

A on-line bidding system will accept the first 20 bids which occur after mid-night on a particular day. Bids received before this time will disqualify the

bidder for that auction. Out-line a system which would ensure that your bid has a good chance of being in the first 20 bids.

6. How do you make a database real-time? Describe both the hardware and software systems you would need?

Two periodic processes, p_1 and p_2 are measuring the pressure and temperature in a reaction vessel as part of a chemical works. If the absolute validity interval (AVI) for p_1 is 300 ms and the AVI for p_2 is 100ms. If the relative validity interval for the two processes is 150ms what is the slowest rate at which the two processes can be scheduled. How would the situation change if a third process was introduced with an AVI of 150 and the same RVI?

7. What is a Petri net and why are they useful in analysing a real-time system?

An automated toll-booth will allow four lanes of traffic through. Two of these lanes are for prepay traffic and two for cash transactions. Drivers decide which lane they pass through. At the toll booth traffic lights and a barrier controls the flow of traffic. Analyse the problem using a Petri net.

8. Access Grids use IP protocols for video conferencing between a number of sites. How would a real-time operating system help this problem?