

*Ollscoil na hÉireann, Gaillimh*  
*National University of Ireland, Galway*

GX 1620

**Semester II Examinations, 2002/2003**

Exam Code(s) 4IF1

Exam(s) Fourth Year Information Technology

Module Code(s) CT420

Module(s) Real Time Systems

Paper No. 1  
Repeat Paper Special Paper

External Examiner(s) Prof. P. Nixon

Internal Examiner(s) Prof. G. Lyons

Dr. A. Shearer

**Instructions:** Answer question 1 and four others

Duration 3  
hours

No. of Answer books

**Requirements:**

Handout

MCQ

Statistical Tables

Graph Paper

Log Graph Paper

Other Material

No. of Pages 3

Department(s)

1. Why is scheduling such a crucial component of a real-time operating system? How do you determine what is the best method to schedule real-time tasks?

The following table shows the arrival time, execution time, priority and dead-line for a number of processes. What scheduling algorithm is best for this set of tasks?

Process ID	Arrival Time (secs)	Execution Time (secs)	Deadline (secs)	Priority
1	0	5	10	2
2	1	12	20	2
3	2	1	4	1
4	6	10	25	2
5	10	2	15	1
6	10	8	17	1
7	11	3	17	1
8	15	25	n/a	Not real-time
9	17	3	30	2
10	18	5	35	2
11	25	1	30	1

2. Can any computer system be genuinely safe? Why is safety such a crucial component of real-time systems?

A computer system consists of three processing units which replicate a calculation. Their results are then compared by a voting system that requires a 2 out of 3 agreement. The failure probability of each of the systems for any calculation is 1 in  $10^5$ /year. What is the probability that the system works, for 1 year? For 2 years?

3. What makes a good real-time programming language?

The safety system for a car sounds an alarm if the car approaches too close to an obstacle. How would this be programmed in ADA? What is the advantage of ADA over C for this type of problem.

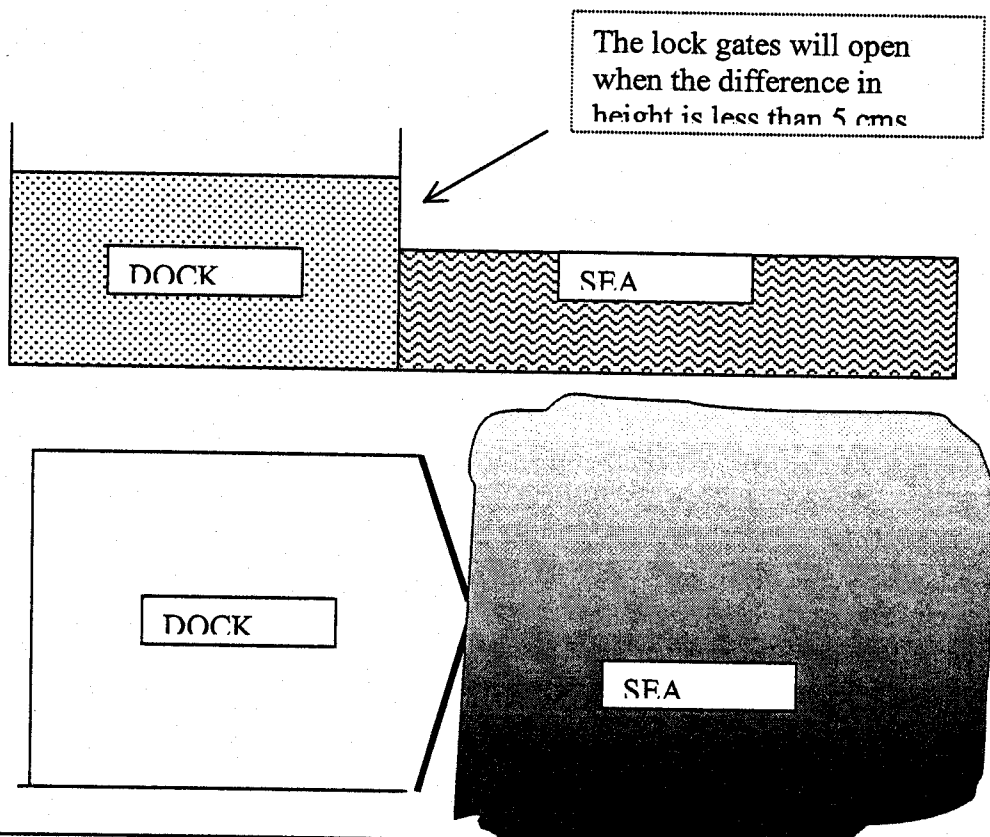
4. What makes a good real-time operating system?

You have been asked to design a control and shut-down system for an oil well. This consists of a series of transponders that send data to a central computer. If certain conditions are met – high pressure or high temperature – the oil well is closed down. Shutting down the oil well needs to be done as quickly as possible. Describe the process by which you would decide which real-time operating system, if any, you would use?

- 5 What special scheduling algorithms are required to improve the real-time performance of a database that is retrieving records at random from a single disk?

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 200 ms and the AVI for  $p_2$  is 40ms. If the relative validity interval for the two processes is 50ms what is the slowest rate at which the two processes can be scheduled.

- 6 Video Conferencing over IP is becoming very popular. What problems does it face to ensure that it can compete with standard video-conference using point-point telecommunications. How would real-time operating systems help this?
- 7 Looking at the figure that shows the opening and closing of a dock gate. The system consists of a tidal monitor that measures the height of the tide, a lock gate that opens when the tide reaches the same level as the water in the dock and closes again when the level drops back to this level after high tide. Before the dock gate opens or closes a sensor, S, determines whether there are any boats near the lock gate. If there are the system waits until they have gone out of range. If boats detect movement of the dock gate they must stop. Analyse this problem with a Petri net.



Schematic diagram of a lock gate into a dock. The gates open when the level between the sea and the dock is less than 5 cms. The gates shut again when the sea level (and hence level in the dock) drops below a certain level. A sensor on the gates detects the presence of ships in the path of the opening gate.