

**OLLSCOIL NA hÉIREANN**  
**THE NATIONAL UNIVERSITY OF IRELAND, GALWAY**

**SEMESTER II EXAMINATIONS 1998/99**

CT420 – Real-Time Systems

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Time Allowed: **Three Hours**

**Answer 4 questions**

1. Describe the main features of a real-time operating system. Illustrate your answer by contrasting UNIX with QNX.

You have been asked to design a system to control the lock gates of a commercial port. The basic operation is to allow ships into the port no matter what level the tide is at and to keep the water level in the dock constant. You must ensure that no ships (or people) are in the vicinity when the gates start to move. Describe the system using a simple Petri net.

2. What are the main features of real-time system scheduler. How would you determine which scheduling algorithm is the most appropriate.

A uni-processor system controlling a power station has 4 priority levels, 1 – 4. Level 1 is the highest corresponding to a hard real-time process. Priority levels 2 and 3 are soft with priority level 4 being non-real-time. The following table shows the arrival-time, estimated duration and dead-lines for a number of processes. Describe a scheduling algorithm that will ensure that most dead-lines are met.

Process	Arrival Time	Priority	Duration	Dead-line
A	0	1	10	20
B	0	2	30	45
C	5	2	35	45
D	10	1	10	25
E	10	2	5	30
F	20	1	10	40
G	20	3	10	50
H	25	4	20	?
I	30	1	10	45

3. You have been asked to design a communications system for real-time and non-real-time traffic. The real-time traffic consists of two components – one at a low bandwidth the other at higher bandwidth. Both streams have to be synchronised at destination. Describe the protocols you would use to enable this type of communication.

Each stage of the communication described above will pass through a router running a real-time operating system. What would be the limitations of such a router and how could these be minimised?

4. How does a real-time database differ from a conventional one? Explain the importance of serialisation to real-time databases.

A transaction P has read set  $\{x_1, x_2, x_3, x_4\}$  and a write set  $\{x_3, x_4, x_5\}$ . If P is given a time stamp of 150 when the read and write time stamps are as follows

	$x_1$	$x_2$	$x_3$	$x_4$	$x_5$
Read Timestamp	80	90	90	200	10
Write Timestamp	50	65	65	200	200

What are the time-stamps after the commitment of P.

5. What are the main causes of failure in a complex computer controlled system? What measures can you usefully take to minimise the effects of these failures?

An aircraft control system consists of three independent computers and a sensor system using majority voting. In such a system how would you guard against common mode failures?

6. A financial futures company has a number of dealers connected to a local server. This server is in turn connected (via the Internet) to a central time server which delivers the timestamp to a number of dealer rooms. Each transaction within the market must be verified with a time stamp. How would you ensure that each dealer room is telling the same time?