LIMERICK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA LUIMNIGH

LIMERICK INSTITUTE OF TECHNOLOGY

SUMMER EXAMINATIONS 2019/2020

MODULE:	COMP08064-Concurrent & Distributed Systems
PROGRAMME(S): LC_KGDVM_KTH	Bachelor of Science (Honours) Games Design and Development
YEAR OF STUDY:	4
EXAMINER(S):	Eugene Kenny (Internal) Mr. Damien Costello (External)
TIME ALLOWED:	**2 HOURS**
INSTRUCTIONS:	**Answer 4 questions. All questions carry equal marks.**

PLEASE DO NOT TURN OVER THIS PAGE UNTIL YOU ARE INSTRUCTED TO DO SO.
The use of programmable or text storing calculators is expressly forbidden.
Please note that where a candidate answers more than the required number of questions, the examiner will mark all questions attempted and then select the highest scoring ones.

Requirements for this paper:
1. Calculators

QUESTION 1 **[25 Marks]**

(a) Explain what is meant by the term *interference* when applied to concurrent programs and how problems of interference can be overcome using mutual exclusion protocols. **[10 marks]**

(b) In general, statements in a high-level programming language are not atomic - they expand into fine grained actions which are atomic. **[15 marks]**

```
// Process 1                          //Process 2
`
// initialisation code                // initialisation code
integer x;
                                      y = 1;
x = y + z;                            z = 2;

// other code ...                     // other code ...

                  // Shared data structures
                  integer y = 0; z = 0;
```

In the above example Process 1 is adding two integer variables while Process 2 is assigning to those variables. Variable x is local to Process 1, while variables y and z are shared between the two processes. Assume that:

- values are manipulated by loading them into registers, operating on them there and storing the results back into memory;
- the usual load, store and arithmetic operations are available;
- each process has its own set of registers; and
- any intermediate results that occur when a complex expression is evaluated are stored in registers or in memory private to the process.

At the end of the program fragment, what are the possible values of x?

QUESTION 2 **[25 Marks]**

(a) What is the difference between *deadlock* and *livelock*? **[10 marks]**

(b) Outline *Peterson's* algorithm for ensuring mutual exclusion. What are the practical advantages and disadvantages of applying this algorithm. **[15 marks]**

QUESTION 3 **[25 Marks]**

(a) Explain the differences between *semaphores* and *monitors*. **[10 marks]**

(b) Outline a monitor based solution to the single producer – single consumer problem using a bounded buffer. **[15 marks]**

QUESTION 4 **[25 Marks]**

(a) Outline three types of distributed system. **[10 marks]**

(b) There has been a tremendous growth in the development of peer-to-peer decentralized systems. Describe the main peer-to-peer architectural configurations. **[15 marks]**

QUESTION 5 **[25 Marks]**

(a) Outline how Distributed Hash Tables (DHT) work. **[15 marks]**

(b) Describe how Lamport's logical clocks work. **[10 marks]**