LIMERICK INSTITUTE
OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA
LUIMNIGH

WINTER EXAMINATIONS 2017

Year 4
Friday 15th December 2017, 2 PM – 4 PM

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Course:	**Bachelor of Science (Honours) in Computing (Games Design and Development)** **Bachelor of Science (Honours) in Computing (Software Development)**
Year:	Year 4
Subject:	CONCURRENT ALGORITHMS COMP 08034
Time Allowed:	2 Hours

Instructions:

1. Attempt any **FOUR (4)** Questions.
2. All question carry equal marks.
3. Start each question on a new page.
4. Write the question number at the top of each page.
5. Circle the numbers of the questions you answer at the front of your answer book.

Additional Attachments or Exam Material to accompany this paper: None

Internal Examiners:
Eugene Kenny

External Examiners:
Derek O Reilly

Question 1 **(Total 25 Marks)**

a) What are atomic actions in the context of concurrent programs? Distinguish between *fine-grained* and *course-grained* atomic actions. **(10 marks)**

b) What type of actions are atomic and what problems arise when we rely on them to achieve mutual exclusion? **(15 marks)**

Question 2 **(Total 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 **(Total 25 Marks)**

a) What are *semaphores* and show how they can be used to implement critical sections. **(10 marks)**

b) Describe the *Dining Philosophers* problem. Using semaphores, implement a solution to the Dining Philosophers problem. **(15 marks)**

Question 4 **(Total 25 Marks)**

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

b) Describe the *Readers and Writers* problem. Outline a *fair* monitor based solution to the Readers and Writers problem. **(15 marks)**

Question 5 **(Total 25 Marks)**

a) What is a `Thread` in Java? Briefly outline the major stages in the life cycle of a thread and explain how the transitions between stages occur. **(10 marks)**

b) A savings account is accessed by several processes. A process making a deposit never has to delay (except for mutual exclusion), but a withdrawal has to wait until there are sufficient funds. **(15 marks)**

Develop a Java `SavingsAccount` class which allows safe concurrent update of `SavingsAccount` objects. The class should have three public methods:

- `void deposit(int amount)` which adds amount to the current balance;
- `void withdraw(int amount)` which subtracts amount from the current balance;
- `int balance()` which returns the current balance.

Assume the arguments to deposit and withdraw are positive. Explain your answer.