Athlone Institute of Technology

Faculty of Engineering & Informatics

Semester 1 Examinations 2018

December Session

AiT

Connect & Discover

Bachelor of Science (Hons) in Software Design (Cloud Computing)
Bachelor of Science (Hons) in Software Design (Game Development)
Bachelor of Science (Hons) in Software Design with Mobile Apps & Connected Devices

Year 3

OPERATING SYSTEMS & CONCURRENCY 3

External Examiner(s):	**Dr Frank Walsh & Dr Sidath Handurukande**
	Mr Jerh O'Connor & Dr Steven Davy

Internal Examiner(s):	**Mr Paul Lennon**

Instructions to Candidates: *(make sure you have received the **correct** exam paper)*

Read all questions carefully.
All questions carry equal marks.
Answer THREE out of FOUR Questions.

Time allowed: 2 Hours
No. of pages (including cover sheet, attachments/drawings): 3

Q.1. (a) In Process Management what is a context switch? In your answer, explain how an Operating System can implement a context switch. Your answer should include a description of the run and blocked queues.

(6 marks)

(b) Give two classifications of processes and explain how a Processing Scheduling algorithm should treat the two types of process.

(6 marks)

(c) Illustrate a Process State transition diagram. Explain the purpose of each state and possible transitions from state to state. Explain how the type of process e.g. MS Word\Media Player can effect state transitions.

(8 marks)

[20 marks]

Q.2. (a) Explain the difference between the thread methods **Wait**, **Sleep**, and **Yield** in Java. Your answer should include coding examples on how each can be used.

(12 marks)

(b) Compare and contrast the two ways of creating and starting threads in Java. Give example code to demonstrate your answer. Explain why a programmer may choose one way of creating threads over the other.

(8 marks)

[20 marks]

Q.3. (a) Explain the following terms: main memory, cache memory, multi-core architecture. Use a diagram to illustrate your answer.

(6 marks)

(b) Explain the function of a Cache Coherence algorithm. Describe the MESI protocol explaining the four states of data.

(8 marks)

(c) With regard to a concurrent application explain the term liveness. Briefly explain **three** common liveness issues for a concurrent application.

(6 marks)

[20 marks]

Q.4. (a) What is **Slipped Condition** in multithreading? Demonstrate your understanding using a code example.

(8 marks)

(b) Explain the code shown below?

(8 marks)

(c) What would you change to avoid a **lockout problem**?

(4 marks)

```java
public class FairLock {
  private boolean isLocked       = false;
  private Thread lockingThread  = null;
  private List<QueueObject> waitingThreads =
            new ArrayList<QueueObject>();

  public void lock() throws InterruptedException{
    QueueObject queueObject = new QueueObject();

    synchronized(this){
      waitingThreads.add(queueObject);

      while(isLocked || waitingThreads.get(0) != queueObject){

        synchronized(queueObject){
          try{
            queueObject.wait();
          }catch(InterruptedException e){
            waitingThreads.remove(queueObject);
            throw e;
          }
        }
      }
      waitingThreads.remove(queueObject);
      isLocked = true;
      lockingThread = Thread.currentThread();
    }
  }

  public synchronized void unlock(){
    if(this.lockingThread != Thread.currentThread()){
      throw new IllegalMonitorStateException(
        "Calling thread has not locked this lock");
    }
    isLocked = false;
    lockingThread = null;
    if(waitingThreads.size() > 0){
      QueueObject queueObject = waitingThread.get(0);
      synchronized(queueObject){
        queueObject.notify();
      }
    }
  }
}
```

[20 marks]