4 Concurrent and Distributed Systems (djg11)

(a) A guarded resource needs to be locked in three different ways by readers, moderators and writers. A thread will gain access to the resource in one of these three ways, operate, and then relinquish access. At any instant, the resource may be unlocked or held be any number of readers, or up to two moderators, or at most one writer.

(i) Define some number of locks, mutexes and/or shared variables to manage the system. Sketch the core of a state transition diagram. [5 marks]

(ii) Using a monitor approach, give pseudocode for these six methods:

```
start_write()   start_moderate()   start_read()
end_write()     end_moderate()     end_read()
```
[5 marks]

(b) Very briefly describe two techniques for deadlock avoidance and one technique for graceful deadlock recovery (i.e. not reboot). Describe two burdensome aspects of deadlock recovery. [6 marks]

(c) A system has T threads. These use 3 types of resource that each have 4 instances provided. A deadlock avoidance system restricts resource acquisition. What state space does the system potentially have before and after restriction? [4 marks]