Problem 1: (15 points; 10 minutes) Briefly explain any 3 of the following concepts and a situation in which it is used.

1. Mode switch
2. Atomicity (saying that a block of code is atomic)
3. Process Control Block
4. Peterson’s Algorithm

Problem 2: (10 points; 5 minutes) Give very brief (one word, or sentence) answers to the following

• Semaphores can be built using locks (Yes/No)
• Monitors can be built using condition locks and semaphores (Yes/No)?
• Mode switch is faster than context switch (Yes/No)?
• Enforcing mutual exclusion on a shared variable among multiple readers and writers is (incorrect/correct)?
• Continuing the previous question, this approach is (liberal/conservative)?

Problem 3: (15 points; 8 minutes) Consider the following two scheduling algorithms. One algorithm rewards newly arrived processes by giving them higher priority or longer quanta (e.g., like multi-level feedback). Another does the reverse – it delays newly arrived processes (assuming there is something else to run) until they have accumulated some wait time and then starts scheduling them. Scheduling is done in round-robin fashion after the delay period.

(a) Explain the intuition behind the two algorithms.
(b) What are the primary metrics that they differ in?

Problem 4: (15 points; 12 minutes) Explain any 3 of the following potentially wrong statements.

1. Test and set or similar hardware instruction is needed to implement semaphores
2. A system call is needed to create a user level thread
3. The medium term scheduler should swap out/in kernel level threads instead of processes
4. A concurrent program where two threads access a shared variable will either always work correctly (correctly synchronized) or never work correctly (incorrectly synchronized)

Problem 5: (20 points; 15 minutes) Drawbridges are bridges that open up to let boats/ships pass. Multiple ships can pass concurrently when the bridge is open, and multiple cars can pass concurrently when it is closed.

(a) How is this problem similar/different from readers/writers?
(b) Show pseudocode implementation for this problem (through a simple modification of readers/writers). What problems, if any, does it suffer from?

Problem 6: (25 pts; 20 minutes) At the coffee shop in the library, people queue up to buy coffee from the register. After placing their order, they go and wait for their coffee. There are three workers, in addition to the person on the cash register, and each works on one order at a time.

(a) Write pseudocode to simulate the coffee shop operation
(b) Since there are many types and flavors of coffee, its important that everyone picks up their correct order. Assume now that coffees may not be ready in the order that they were placed – for example, regular coffee is ready much faster than a double shot latte. Explain (in words, but be specific) how the implementation could be done now.