1a. How does the signal() operation associated with monitors differ from the corresponding operation defined for Semaphores?  
1b. What is the meaning of busy waiting? What are the other kinds of waiting in operating system? Can busy waiting be avoided altogether? Explain.

2a. Show that if wait() and signal() semaphore operations are not executed atomically then mutual exclusion may be violated.  
2b. Explain why spinlocks are not appropriate for single processor systems yet are often used in multiprocessor environments.

3. Implement a Bounded producer consumer solution with Monitors. Assume the condition variables as : full, empty, initialization code for producer and consumer and procedures -Enter and Remove in the Monitor implementation.

4. Consider the following snapshot of the following:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Allocation | | | | Max | | | | Available | | | |
|  | A | B | C | D | A | B | C | D | A | B | C | D |
| P0 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 2 | 1 | 5 | 2 | 0 |
| P1 | 1 | 0 | 0 | 0 | 1 | 7 | 5 | 0 |  |  |  |  |
| P2 | 1 | 3 | 5 | 4 | 2 | 3 | 5 | 6 |  |  |  |  |
| P3 | 0 | 6 | 3 | 2 | 0 | 6 | 5 | 2 |  |  |  |  |
| P4 | 0 | 0 | 1 | 4 | 0 | 6 | 5 | 6 |  |  |  |  |

Answer the following questions using the banker’s algorithm?

1. What is the content of the matrix Need.
2. Is the system in a safe state?
3. If a request from process P1 arrives for (0,4,2,0) can the request be granted immediately?

5. What are the Conditions for Deadlock to occour? Briefly explain. In a system, the following state of processes and resources are given: R1→P1, P1→R2, P2→R3, R2→P2, R3→P3, P3→R4, P4→R3, R4→P4, P4→R1, R1→P5. Draw Resource Allocation Graph for the system and check for deadlock condition. Explain your answer.