CSE 4049: Design of Operating Systems

ASSIGNMENT 3:

This assignment is designed to give you practice with concepts of

- Process Synchronization

1. A counting semaphores s is initialized to 10. 8wait operations followed by 6signal operations are carried out. What is the final value of the semaphore s?

2. Two concurrent processes P and Q are accessing their critical sections by using Boolean variables S and T as follows:

Process P	Process Q

While(true)
{
//Entry section ?
Print(1);
Print(1);
//Exit section ?
}
	While(true)
	{
	//Entry section ?
	Print(0);
	Print(0);
	//Exit section ?
	}

   Complete the entry section and exit section of Process P and Q with suitable semaphore operations using the two Boolean semaphores S and T. Also suggest the initial values of S and T such that the execution of the processes will print the sequence 00110011…

3. Two concurrent processes P and Q are executing the following instructions. Synchonize the execution of P and Q with suitable semaphore operations and proper initialization of the semaphore values, so that the final outcome will be in the following order:
   a) 1 3 2 4 b) 3 1 2 4

Process P	Process Q
Print(1); Print(2);	Print(3); Print(4);

4. Assume the following 3 concurrent processes that use 3 binary semaphores S0, S1, S2 initialized as S0=1, S1=0, S2=0. How many maximum and minimum number of times will process P0 print '0'? Justify your answer.

Process P0	Process P1	Process P2

while (true) {
wait (S0);
print (0);
signal (S1);
signal (S2);
}
	wait (S1);
	signal (S0);
		wait (S2);
		signal (S0);

5. Let 4 concurrent processes P1, P2, P3, P4 are accessing their critical sections by using Boolean semaphores S1, S2, S3 and S4. Write the entry section and exit section of all processes using the semaphores with suitable initialization, such that P1 will complete its critical section before P2 and P3, P2 and P3 will complete their critical section in any order before P4.

6. Assume val is an atomic integer in a Linux system. What is the value of val after the following operations have been completed?

```
atomic_set(&val,10);
atomic_sub(8,&val);
atomic_inc(&val);
atomic_inc(&val);
atomic_add(6,&val);
atomic_ sub(3,&val);
```

7. Define the compare_and_swap hardware instruction. Specify a solution to critical section problem using compare_and_swap instruction and explain how the solution will satisfy all the three requirements.

8. Write a monitor solution for the bounded buffer producer consumer problem.

9. Write a solution using semaphores for a Reader's Writers problem in which writer has higher priority than reader. Once a writer is ready, that writer performs its write as soon as

possible. In other words, if a writer is waiting to access the object, no new readers may start reading.

10. The Sleeping-Barber Problem. A barbershop consists of a waiting room with n chairs and a barber room with one barber chair. If there are no customers to be served, the barber goes to sleep. If a customer enters the barbershop and all chairs are occupied, then the customer leaves the shop. If the barber is busy but chairs are available, then the customer sits in one of the free chairs. If the barber is asleep, the customer wakes up the barber.
    - Write a solution using semaphores to coordinate the barber and the customers.
    - Write a solution using monitor to coordinate the barber and the customer.