King Fahd University of Petroleum and Minerals

Information and Computer Science Department

ICS 431: Operating System

EXAM 2

ID:							

Name:	

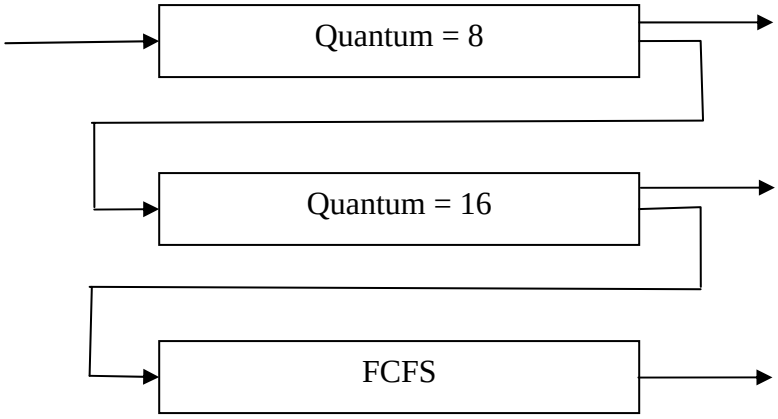
Grades		
Section	**Max**	**Scored**
A	**12**	
B	**24**	
C	**24**	
TOTAL	**60**	

A. **CPU scheduling questions**:

1. Consider the following set of processes, with the length of CPU-burst time given in milliseconds.

Processors	Burst-time
A	20
B	4
C	42
D	8
E	12

Assume processes A, B, C, and D arrived at time 0 in the order A, B, C, D. Process E arrived 40 milliseconds later. Assume the processes were scheduled using the multi-level feedback queue shown bellow.



a) Draw Grant chart illustrating the execution of the processes **a**nd then calculate the average waiting time . **[8 points]**

2. In a multi-user system in which mainly interactive jobs run, which CPU scheduling algorithm would you choose and why? **[4 points]**

B. Process synchronization questions:

1. Does the following solution satisfy all the three requirements that a solution to a critical-section problem must satisfy? If YES, explain why, if NO, modify the program so that it satisfies at least two of the three requirements. **[7 Points]**

Shared variable:

```
Boolean lock = true;
```

Process i:

```
do {
    while (TestAndSet(lock)) ;
            critical section
    lock = false;
    remainder section
  }
```

2. Using semaphores show how to enforce executing statement S2 of process P2 after statement S1 of process P1, and statement S3 of P3 after S2 of P2.
[5 points]

3. The following is a semaphore solution to the readers-writers problem: **[12 points]**

```
 semaphore mutex = 1
semaphore wrt = 1
int variable: readcount = 0

Reader:
0       wait(mutex)
1       readcount = readcount + 1
2       if readcount == 1 then wait(wrt)
3       signal(mutex)
4       <read database>
5       wait(mutex)
6       readcount = readcount – 1
7       if readcount == 0 then signal(wrt)
8       signal(mutex)

Writer:
9        wait(wrt)
10      <write database>
11      signal(wrt)
```

(When possible, answer by pointing out to the line numbers and operations. If a process blocks, you have to tell me where and on what operation.) Assume for each situation initially there are no readers and no writers. Now, assuming the following situations and each situation is independent:

I. If you have a reader just finished reading the database and times out after it executed instructions at line 6, and two writers and two readers show up. Explain what will happen to the new readers and writers.

   a. Readers:

   b. Writers:

II. If you have a writer writing to the database at line 10, and two writers and two readers show up. Explain what will happen to the new reader and writers.

   a. Readers:

   b. Writers:

C. Deadlock questions:

1. If a counting semaphore S is initialized to the positive integer x, then after y waits and z signals on S, what is the value of S [**3 points]**

2. Explain prevention techniques used to negate each of the following two of the four necessary conditions for deadlock**..** **[6 points]**

   a. Hold and wait

   b. Cyclic waiting

3. Consider a system with 12 magnetic tape drivers and 3 processes. A, B, and C. A may need 10 tape drivers, B may need 4, and C may need up to 11. Suppose at time T_0, A is holding 5, B is holding 2, and C is holding 2 tape drives. Thus there are 3 free tape drives. **[5 points]**

	Maximum Needs	Allocated
A	10	5
B	4	2
C	11	2

   If at time T_0, C requests and is allocated 1 more tape drive will the system will be in **safe** state. Explain Why?

4. A snapshot of a system at time T_0 is as shown below. **[10 points]**

	Allocation	***Request***	***Available***
	A B C	**A B C**	**A B C**
P_0	0 2 2	0 0 0	0 0 0
P_1	2 0 0	0 0 1	
P_2	3 0 3	1 2 1	
P_3	2 2 1	1 0 0	
P_4	0 0 2	0 0 1	

At T0, is the system in

a. a safe state

b. unsafe state

c. a deadlock

- If your answer is a, show a sequence that satisfies the safety criteria.

- If your answer is b, explain why.

- If your answer is c, show which processes are in a deadlock. Also, suggest a way of recovering from this deadlock with out killing all the processes.