COMSATS University Islamabad, Lahore Campus
Block–C, Department of Computer Science
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Final Examination – Semester Fall 2021

Course Title:	Operating Systems			Course Code:	CSC322	Credit Hours:	3(2,1)
Course Instructor/s:	Nadeem Ghafoor Chaudhry; Zeenat Afzal			Programme Name:	BS SE; BS Comp Eng		
Semester:	5th	Batch:	FA19-BSE & BCE	Section:	A&B	Date:	Thursday, Jan 13, 2022
Time Allowed:	**3 Hours**			**Maximum Marks:**		**50**	
Student's Name				Reg. No.			

Important Instructions / Guidelines:

- Attempt all questions.
- Do not write anything other than your name and registration number on question paper.
- Do not give multiple answers for any question. Clearly cross out what you do not want me to read.
- Give brief but to the point answers, length of your answer is not a good predictor of your expected marks.
- You may attempt questions in order of your liking but answer all parts of a question in sequence, i.e don't write the answer of part c of question #1 after question #3. I will not mark it.

Q1) CLO4 **[3+5+5+3=16 marks]**

a) What is the main advantage of Condition variables as compared to semaphores? Give an example to demonstrate your understanding.

b) We studied Readers-Writers problem as one of the classical problems of synchronization. Below alphabetically sorted code of the Reader part is given. Your job is to put it in correct order, i.e the algorithm should work for multiple readers as discussed in class. Additionally keep in mind:

Semaphore rw_mutex initialized to 1
Semaphore mutex initialized to 1
Integer read_count initialized to 0

```
...
...
}
while (true){
signal(mutex);
wait(rw_mutex);
/* reading is performed */
if (read_count == 0) /* last reader */
if (read_count == 1) /* first reader */
read count--;
read_count++;
signal(mutex);
signal(rw_mutex);
wait(mutex);
wait(mutex);
```

Imagine there are following three processes in ystem.
P0 – A file backup batch process
P1 – A user editing a video
P2 – An electricity bill generating and printing ess

And there are four types of resources A, B, C and D

The current scenario is as follows:

Max

A	B	C	D
4	2	3	1

Available

A	B	C	D
2	1	0	0

Allocation

	A	B	C	D
P0	0	0	1	0
P1	2	0	0	1
P2	0	1	2	0

Request

	A	B	C	D
P0	2	0	0	1
P1	1	0	1	0
P2	2	1	0	0

c) Determine if the system is in a deadlock state or not. You must show all steps, just a YES/NO answer will not be accepted.
d) Ignore the above scenario and imagine that all three processes are in deadlock. What will you do and why to recover from the deadlock?

Q2) CLO1 **[3 Marks]** WhatsApp is owned by Facebook which is owned by Mark Zuckerberg. Imagine that for some reason Mark Zuckerberg decides to develop a new operating system called MarkOS. Since he owns both Facebook and WhatsApp he thinks it's a good idea to make both these applications as part of MarkOS. As a student of operating system what are the pros and cons that you can present to Mark for his idea of making Facebook and WhatsApp part of MarkOS.

Q3) CLO3 **[3+6+6+2=17 Marks]** Consider a process which is currently in execution alone and its memory space consists of 6 pages. The Main memory allocation of frames is given below. Frame size is 2048 bytes.

0	
1	3
2	
3	
4	2
5	
6	4
7	
8	1

Draw the page table with all necessary informati

b. For the given virtual addresses, compute the phy addresses and explain if there is any issue.

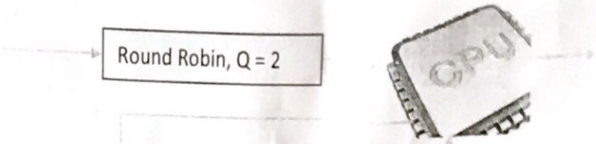
   i. 3589
   ii. 8989
   iii. 270
   iv. 14567

c. Assume the process has started from scratch, meaning no page available in memory. For the following string of page requests find the number of page faults using Optimal and LRU algorithms. Assume only four frames are allocated to each process for its execution.

   3,4,5,3,5,2,1,2,5,0,0,0,2,3,4,1,5

d. What is thrashing, and how it affects CPU utilization?

Q4) CLO2 **[6 Marks]** Imagine we have a multi-level feedback queue with 2 queues. The highest priority queue is a ***RR*** scheduler with a quantum of 2. The second priority queue runs as a ***FCFS*** queue, as shown in figure below. Processes start in the ***RR*** queue and are demoted to the FCFS queue if they exceed their quantum. Processes in the ***RR*** queue are always prioritized over the FCFS queue.



Process	Arrival Time	CPU Burst
1	0	3
2	3	3
3	4	4
4	9	4
5	10	3

The table above shows a list of processes along with their arrival times and CPU burst times. Calculate the average ***waiting time*** by using the multi-level feedback queue and draw the ***Gantt chart***.
Note: A process can only be pre-empted if it exceeds its quantum.

Q5) CLO6 **[2+3=5 Marks]**

a) If you have to develop client/server application, would you prefer developing multi-threaded server or a multi-process server. Give reasons for your choice.
b) What is a thread pool and what are its benefits?

Q6) CLO7 **[3 Marks]** Imagine that there are only two user processes P1 and P2 in a system and P1 is blocked on a binary semaphore S1. After some time P2 signals S1 and exits. Now the operating system will move P1 from blocked to Ready state and eventually from Ready to Running state. Since there is no one else to run don't you think that it would be better if OS allows P1 to go directly to Running state? Why don't operating system developers allow this short cut?