National University of Computer & Emerging Sciences, Karachi
Spring-2020 CS-Department
Final Examination
22nd June 2020, 9:00 am – 12:30 pm

Course Code: CS220	Course Name: Operating Systems
Instructor Name: Nausheen Shoaib	
Student Roll No:	Section No:

Instructions:

- Start of Exam: 9:00 am; End of Exam: 12:30 pm including submission time
- Read each question completely before answering it. There are 11 question and 3 pages.
- In case of any ambiguity, you may make assumptions. But your assumption should not contradict any statement in the question paper.
- You will attempt this paper offline, in your hand writing.
- You may use cam-scanner, MS lens or any equivalent application to scan and convert your hand-written answer sheets in a single PDF file.
- The paper should be submitted using Google Classroom. You are given 30 minutes for this purpose, which is already included in the exam time mentioned above. Additionally, after submitting, you should email it to your instructor which should be exactly same pdf as uploaded earlier.
- WRITE YOUR ID ON TOP OF EVERY PAGE by your hand. Write also page # on every page. You should also sign on every page.

Time: 180 minutes. **Max Marks: 80**

Process, Threads, Process Scheduling & Process Synchronization

Q1. Answer the following questions: **[Marks=10]**

I. What are the drawbacks of many to one threading model?
II. Differentiate between Monolithic and Microkernel operating system structure?
III. The problem arises when a lower-priority process holds a lock needed by higher-priority process. How this problem can be resolved? Explain.
IV. Differentiate between user and kernel level threads, giving the pros and cons of each?
V. How would you differentiate between data parallelism and task parallelism?

Q2. Draw block diagram using fork( ) and exec ( ) for the following concatenated commands.
ps | sort | less **[Marks=5]**

Q3. A single-lane bridge connects the two Vermont villages of North Tunbridge and South Tunbridge. Farmers in the two villages use this bridge to deliver their produce to the neighboring town. The bridge can become deadlocked if a northbound and a southbound farmer get on the bridge at the same time. (Vermont farmers are stubborn and are unable to back up.) Using semaphores and/or mutex locks, design an algorithm in pseudo code that prevents deadlock. Initially, do not be concerned about starvation (the situation in which northbound farmers prevent southbound farmers from using the bridge or vice versa). **[Marks=5]**

Q4. Consider the following set of processes, with the length of the CPU burst given in milliseconds:
Draw Gantt charts that illustrate the execution of these processes. Calculate average turnaround time, and average waiting time using the following scheduling algorithms: **[Marks=15]**

Process	Arrival Time	Burst Time	Priority
P1	0	9	5
P2	1	4	3
P3	2	5	1
P4	3	7	2
P5	4	3	4

I) Preemptive Priority (Consider the lowest integer as a high priority).
II) Round Robin (quantum = 3).
III) Shortest Remaining Time First

Memory Management & Virtual Memory

Q5. Consider the following page reference string: **[Marks=15]**

1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6.
How many page faults and page hits would occur for the following replacement algorithms, assuming three frames? Remember that all frames are initially empty, so your first unique pages will cost one fault each.

a) LRU replacement
b) Optimal replacement
c) Second Chance

Q6. Assuming a 4-KB page size, what are the page numbers and offsets for the following address references (provided as decimal numbers): **[Marks=5]**
a. 3085
b. 42095
c. 215201
d. 650000
e. 2000001

Q7. Consider a computer system with a 32-bit logical address and 4-KB page size. The system supports up to 512 MB of physical memory. How many entries are there in each of the following? **[Marks=5]**

Q8. A 1MB block of memory is allocated to using buddy system: **[Marks=5]**
a) Show the binary tree representation
b) Show the how buddy system satisfy the following request: R1 = 70KB, R2 = 35KB, R3= 80KB, R4=60KB.

Q9. Assume a memory access takes 40 ns, and the machine provides a Translation Lookaside Buffer (TLB) with a hit rate of 90% and a search time of 10 ns. What is the effective memory access time? **[Marks=5]**

Deadlock

Q10. Given the following statement for banker algorithm: **[Marks=5]**
6 Processes P0 through P5
4 Resource Types A (15 instances) B(6 instances) C(9 instances) D(10 instances)
Snapshot at Time T0:8

Available			
A	B	C	D
6	3	5	4

Process	Current allocation				Maximum demand			
	A	B	C	D	A	B	C	D
P0	2	0	2	1	9	5	5	5
P1	0	1	1	1	2	2	3	3
P2	4	1	0	2	7	5	4	4
P3	1	0	0	1	3	3	3	2
P4	1	1	0	0	5	2	2	1
P5	1	0	1	1	4	4	4	4

a) Calculate the need matrix
b) Show the safe sequence of processes. In addition to the sequence show the Available (Work Array) changes as each process terminates.

Q11. Dining Philosopher problem states that there are 5 philosophers and 5 chopsticks. Using resource allocation graph, show how a deadlock occurs? **[Marks=5]**

----------Best of Luck----------