Roll Number: _____ Name: _____

Thapar Institute of Engineering & Technology, Patiala

Department of Computer Science & Engineering

Operating Systems (UCS303): Auxiliary Exam

Faculty Name: Garima Singh ***Date & Time: 24/08/2024 at 5:30pm***

Maximum Marks: 100 ***Maximum Time: 3 Hrs***

Note: *Attempt all questions and each sub-part like (a), (b), (c) for each question at one place. Do mention Page No. of your attempt at front page of the answer sheet. Assume missing data (if any). Show all intermediate computations properly*

<table>
<tr><td>1.</td><td>a) Discuss the key functionalities of an Operating System (OS) and explain how each function contributes to the overall efficiency and user experience of a computer system.</td><td>5</td></tr>
<tr><td></td><td>b) Compare monolithic kernels and microkernels in terms of architecture, performance, security, and real-world applications. What are the trade-offs of each approach?</td><td>5</td></tr>
<tr><td></td><td>c) Why are system calls essential in an operating system? What will be the output of following program?
int main() {
fork();
fork() && fork() || fork();
fork();
printf("Auxiliary exam n");
return 0; }</td><td>10</td></tr>
<tr><td>2</td><td>a) Describe the critical section problem and its significance in concurrent programming. How can semaphores be used to solve this problem without resorting to busy waiting?</td><td>5</td></tr>
<tr><td></td><td>b) Consider a non-negative counting semaphore S initialized to 15. The operation P(S) decrements S, and V(S) increments S. During an execution, 7 P(S) operations and 10 V(S) operations are issued in some order. What will be the final value of S.?</td><td>2</td></tr>
<tr><td></td><td>c) Consider the four main sections of a process's memory: text section, data section, heap, and stack. Identify and explain which section is used for each of the following types of information: global variables, static variables, dynamic memory allocation, function call, and local variable storage.</td><td>5</td></tr>
<tr><td></td><td>d) There are six processes named as P1, P2, P3, P4, P5 and P6. Their arrival time and burst time are given below. The time quantum of the system is 4 units. Schedule processes using RR algorithm. Find out average waiting time and average turnaround time.
<table>
<tr><th>Process ID</th><th>Arrival Time</th><th>Burst Time</th></tr>
<tr><td>1</td><td>0</td><td>5</td></tr>
<tr><td>2</td><td>1</td><td>6</td></tr>
<tr><td>3</td><td>2</td><td>3</td></tr>
<tr><td>4</td><td>3</td><td>1</td></tr>
<tr><td>5</td><td>4</td><td>5</td></tr>
<tr><td>6</td><td>6</td><td>4</td></tr>
</table></td><td>8</td></tr>
</table>

3	a)	How does the operating system manage programs that do not fit entirely into physical memory?	4
	b)	Differentiate between paging and segmentation techniques. Consider a single level paging scheme. The virtual address space is 4 *MB* and page size is 4 *KB*. What is the maximum page table entry size possible such that the entire page table fits well in one page?	6
	c)	Explain Belady's Anomaly. A system uses 3 page frames for storing process pages in main memory. It uses the First in First out (FIFO) page replacement policy. Consider the Pages referenced by the CPU in the order are 6, 7, 8, 9, 6, 7, 1, 6, 7, 8, 9, 1. Weather the algorithm suffer with Belady's anomaly or not for the given reference string if yes then demonstrate.	5
	d)	Calculate the hit ratio and miss ratio for the reference string given in previous question using the following schemes? i) LRU ii) Optimal Page Replacement	5
4	a)	Consider a system with three types of resources (R1, R2, and R3) and four processes (P1, P2, P3, and P4). The current state of the system is represented by the following Resource Allocation Graph (RAG): P1 is holding 1 unit of R1 and is requesting 1 unit of R2, P2 is holding 2 units of R2 and is requesting 1 unit of R3, P3 is holding 1 unit of R3 and is requesting 1 unit of R1 and P4 is holding 1 unit of R1 and 1 unit of R3. Draw the Resource Allocation Graph (RAG) for the given scenario. Determine if there is a deadlock.	6
	b)	Let there are 5 processes P1, P2, P3, P4, P5, and 3 types of resources X, Y, Z. Total resources are X=7, Y=5, Z=7. If state of the system is presented by the table given below, find out system is in safe state or not. If it is in safe state, then find out safe sequence using Banker's algorithm.	8
	c)	Define deadlock. Explain all four mandatory conditions for the occurrence of deadlock in system.	6
5	a)	Explain significance of RAID (Redundant Array of Independent Disks) in a system, and explain various RAID levels with their advantages and disadvantages?	5
	b)	Suppose a disk has 200 tracks (0-199). The request sequence is as follows: 82, 170, 43, 140, 24, 16, 190 and the head position is at 50. Find out which scheduling algorithm (SSTF, SCAN, C-LOOK) will perform best in terms of total seek time.	10
	c)	Discuss the different file allocation methods used in operating systems. For each method, explain its advantages and disadvantages, and provide examples of scenarios where one method might be preferred over others.	5

Process	**Maximum Need**			**Allocation**		
	X	Y	Z	X	Y	Z
P1	6	5	3	1	0	2
P2	4	2	1	3	1	0
P3	5	1	2	0	1	1
P4	1	0	2	1	0	1
P5	5	2	3	1	0	2