BG/K/TX

Reg. No:

Final Assessment Test – November 2024

VIT
Vellore Institute of Technology

Course: **BCSE303L - Operating Systems**

Class NBR(s): **1551/1561/1567/1573/1579/1583/1589/ 1594/1600/1606/1610/1614/1620/1624/1628/1632/ 1636/1640/1645/1652/1656/1662/1667**

Slot: **B1+TB1**

Time: **Three Hours**

Max. Marks: **100**

- **KEEPING MOBILE PHONE/ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

Answer ALL Questions

(10 X 10 = 100 Marks)

1. a) Compare and contrast clustered systems with multiprocessor systems. Further analyse the requirements of two machines within a cluster to collaborate effectively to deliver a highly available system. **[5]**

   b) Evaluate the main advantage of the microkernel approach to system design. Furthermore, analyse how user programs and system services interact within a microkernel architecture. Finally, assess the disadvantages associated with using the microkernel approach. **[5]**

2. a) Including the initial parent process, how many processes are created by the program shown below, Justify your answer with explanation. **[4]**

```
#include <stdio.h>
#include <unistd.h>
int main()
{
  if (fork()) {
    if (!fork()) {
      fork();
      printf("1 ");
    }
    else {
      printf("2 ");
    }
  }
  else {
    printf("3 ");
  }
  printf("4 ");
  return 0;
}
```

   b) Differentiate user level threads and kernel level threads. Evaluate the scenario in which one type of thread is more advantageous than the other. **[6]**

3.a) Investigate and break down the scheduling of the following 6 processes, paying close attention to their arrival times and burst times.

Process No:	Arrival Time	Burst Time
P1	5	5
P2	4	6
P3	3	7
P4	1	9
P5	2	2
P6	6	3

Evaluate and assess the average waiting time and average turnaround time using the Round Robin scheduling policy with a time quantum of 3 and Shortest Remaining Time First (SRTF) scheduling policy. Create and illustrate the Gantt chart for these scheduling scenarios.

OR

3.b) Critically assess and compute the average waiting time and average turnaround time for a set of 5 processes using a priority pre-emptive CPU scheduling policy (with higher numbers indicating higher priority) and Shortest Remaining Time First (SRTF).

Process No:	Arrival Time	Burst Time	Priority
P1	0	4	2
P2	1	3	3
P3	2	1	4
P4	3	5	5
P5	4	2	5

Analyse and compute these performance metrics based on their arrival and burst time and create a Gantt chart for this scheduling scenarios to visually represent the execution order and timing of each process.

4. Analyse the following system snapshot using the Banker's algorithm:

	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	0	0	1	2	0	0	1	2	1	5	2	0
P1	1	0	0	0	1	7	5	0				
P2	1	3	5	4	2	3	5	6				
P3	0	6	3	2	0	6	5	2				
P4	0	0	1	4	0	6	5	6				

i. What is the content of the Need matrix?

ii. Is the system in a safe state, If yes, provide the sequence of safe state.

iii. If a request from process P1 arrives for (0,4,2,0) can it be granted immediately?

5.a) Imagine an online ticket booking system where multiple users can book tickets for a show. Some users (checkers) simply want to check the availability of seats, while others (bookers) want to book or cancel tickets. The system must ensure that while a user is booking or cancelling a ticket, other users cannot check the availability to avoid inconsistencies. However, multiple users should be able to check seat availability simultaneously if no one is booking or cancelling tickets. Analyse the necessity of process synchronization for this scenario and develop a pseudocode solution using synchronization techniques to ensure data consistency while allowing efficient access for multiple checkers and bookers.

OR

5.b) Imagine a library with a study room that has a limited number of study desks. Each desk has a single chair and a single lamp. Students come to the library to study, but they need both a desk and a lamp to do so. The rules are:

- Limited Resources: There are only five desks and five lamps.
- Resource Allocation: A student must acquire both a desk and a lamp to start studying.
- Resource Release: Once a student finishes studying, they release both the desk and the lamp.

Develop a solution that ensures all students can efficiently use a shared study room with limited desks and lamps, avoiding deadlock and starvation.

6. a) Evaluate the final value of a counting semaphore S, which is initially set to 7, after performing 20 P(wait) operations and 15 V (signal) operations on it. **[3]**

b) Evaluate the methods used by processes P1 and P2 for accessing their critical section, given that the initial values of the shared Boolean variables S1 and S2 are randomly assigned. Assess in detail whether these methods achieve the critical section requirements? **[7]**

Method used by P1	Method used by P2
while (S1 == S2); Critical Section S1 = S2	while (S1 != S2); Critical Section S1 != S2

7. a) Consider a system using multilevel paging scheme. The page size is 1 GB. The memory is byte addressable and virtual address is 72 bits long. The page table entry size is 4 bytes. Determine the number of page table levels required and give the breakdown of the physical and virtual address. **[7]**

b) Differentiate external and internal fragmentation in contiguous memory allocation. **[3]**

8. a) Evaluate the effective memory access time for a three-level paging scheme that incorporates a Translation Lookaside Buffer (TLB). Assume no page fault occurs. It takes 20ns to search the TLB and 100ns to access the physical memory. With a TLB hit ratio of 80%, what is the effective memory access time in milliseconds? **[4]**

b) Analyse a memory allocation scenario with six partitions of sizes 100MB, 170MB, 40MB, 205MB, 300MB and 185MB (in order). For processes requiring 200MB, 15MB, 185MB, 75MB, 175MB and 80MB (in order), determine how the first-fit, best-fit and worst-fit algorithms will allocate these processes. Identify any requests that cannot be satisfied. **[6]**

9. Describe the different file allocation methods used in operating systems. Discuss the characteristics, advantages and limitations of each method.

10. Evaluate the total distance (in cylinders) that the disk arm will move to satisfy all the pending requests for the following disk scheduling algorithms: FCFS, SSTF, SCAN, LOOK, C-SCAN, C-LOOK. The disk drive has 200 cylinders, numbered 0 to 199. The drive is currently at cylinder 55 and the previous request was at cylinder 35. The queue of pending request, in FIFO order is: 20, 15, 150, 90, 70, 30, 45, 170, 60, 195. Depict the disk scheduling algorithms with a neat sketch for the scenario given above.

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