Reg. No.: 22BCE1351

Name :

VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

Continuous Assessment Test - II – October 2023					
Programme	:	B.Tech(CSE)	Semester	:	Fall 23-24
Course	:	Operating Systems	Code	:	BCSE303L
			ClassNbr	:	CH2023240100892, CH2023240100893, CH2023240101113
Faculty	:	Dr. Pravin Renold A, Dr. J. C. Kavitha, Dr. A. Menaka Pushpa	Slot	:	C2+TC2
Time	:	90 Minutes	Max. Marks	:	50

81.5

		Answer all Questions	Marks
1.		Suppose 3 business partners P1, P2, and P3 share a common bank account with deposit amount, withdrawal amount, and balance checking operations. Assume these three business partners initiate the money transaction operations concurrently. Under this circumstance, what issue will occur? Why does this problem occur? Explain it with a supporting code portion.	5
2.		At VIT University's library, multiple study rooms are available for students. To ensure that only one student can occupy a study room at a time and to manage access fairly, the university's SCOPE department has implemented an algorithm. Students arriving at the library take unique tickets to determine the order of access to the study rooms.	10
	(i)	Describe the problem that the university's SCOPE department is trying to solve and name the algorithm. **(2 Marks)**	
	(ii)	Consider the following four students (Student A, Student B, Student C, and Student D) who arrive at the library at different times and take tickets: Student A arrives first and takes ticket 1. Student B arrives next and takes ticket 2. Student C and D arrives at the same time, C takes ticket 4 and D takes ticket 3 Determine the order in which these students will be allowed to access the study rooms. Provide a step-by-step explanation of how the algorithm works in this scenario. **(4 Marks)**	
	(iii)	Write a pseudocode of the above-said algorithm. **(4 Marks)**	
3.		Consider a system where a counting semaphore is initialized to 3, controlling access to a critical section. Five processes P1, P2, P3, P4, and P5 sequentially request entry into this critical section. Consider the situation where the processes have varying priorities like P1-2, P2-3, P3-6, P4-1, P5-4	10

		and the processes access the critical section based on highest value assigned as the priority.	
	(i)	Analyze which processes gain entry and which are placed in the waiting queue. **(2Marks)**	
	(ii)	Determine the value of the counting semaphore when P1, P2 and P3 is already executing in the critical section and while P2 exits P4 enters the critical section. **(3 Marks)**	
	(iii)	Write a pseudocode that not only implements the priority-based access but also handles the case where processes with equal priority request access simultaneously. Ensure that the pseudocode covers all possible scenarios and provides a fair and efficient access mechanism to the critical section. **(5 marks)**	
4.		Write a C program to implement the following game with 2 players using mutex–lock to ensure synchronization among players. Players move their coins on the board as per the random number generated by rolling two dice. If Player1 gets the even numbers in both dice then the turn will be given to Player2. Player2 moves the coin by one position on the left side. Similarly, Player2 gives a turn to Player1 if he gets the odd numbers in both dice. Player1 moves the coin on the right side for one position. This game has 10 rounds for each player. After the 10th round, the player who gets more chance to move the coin will be the winner.	**10**
5.		We operate a streaming platform that offers users a diverse selection of movies and TV series. Ensuring a seamless viewing experience is of utmost importance to us. To enhance the performance of our platform, You are asked to evaluate three distinct algorithms, labeled as 'i','ii' and 'iii' for the user's history of content selections: 'Action movie/Comedy Series/Documentary/Romance movie/Comedy series/Action movie/Thriller movie/Comedy series/Drama series/Action movie/Romance movie/Documentary/Crime series/Thriller movie/Romance movie/Action movie/Comedy Series/Documentary/Romance movie/Drama series'	**15**
	(i)	When a new movie/TV series needs to be loaded into the system's memory, it replaces the movie/TV series that has been in memory for the longest period of time. **(4 Marks)**	
	(ii)	When a new movie/TV series needs to be loaded into the system's memory, it replaces the movie/TV series that has experienced the least activity in recent history, with the assumption that it has become less pertinent for ongoing operations. **(4 Marks)**	
	(iii)	When a new movie or TV series is about to be loaded into the system's memory, it replaces the movie or TV series that is not expected to be accessed in the future. **(4 Marks)**	
	(iv)	Determine which algorithm is most preferred for the above customer preference. Justify your selection. **(3 Marks)**	
		Assume the memory slots of the device are free initially and the memory is divided into equal-sized frames of size 4.	

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Continuous Assessment Test II – June 2023

Programme	:	B.Tech. CSE.	Semester	:	Fall Inter 2022-23
Course Code/Title	:	BCSE303L -Operating System	Slot	:	E2+TE2
Faculty	:	Dr. Abdul Quadir MD Dr. Bhanu Chander Balusa Dr. Rishikeshan C A Dr. Sandeep Kumar Satapathy Dr. Pradeep K Dr. Valarmathi P Dr. Indra Priyadharshini Dr. Monica Dr. Sangeetha N Dr. Anandan P Dr. Yogesh C Dr. Leki Chom Thungon Dr. Tapabrata Roy	Class Number	:	CH2022232500759 CH2022232500982 CH2022232500983 CH2022232500993 CH2022232500992 CH2022232500988 CH2022232500755 CH2022232500756 CH2022232500757 CH2022232500758 CH2022232500760 CH2022232501076 CH2022232501075
Time	:	1½ Hours	Max. Marks	:	50

Answer ALL Questions

1.	In a bakery, there are multiple baking stations where different tasks are performed to create various bakery goods. Assume that bakery has five baking stations. Each baking station requires specific resources such as oven, mixers and pans to carry out the tasks effectively. At time T_0, allocation and maximum requirement of resources for all the baking station are shown in the table below.	10

BAKING STATIONS	ALLOCATION			MAXIMUM		
	OVEN	MIXER	PAN	OVEN	MIXER	PAN
A	0	1	0	7	5	3
B	2	0	0	3	2	2
C	3	0	2	9	0	2
D	2	1	1	2	2	2
E	0	0	2	4	3	3

Current available resources are 3,3,2.

i. Check whether baking stations can finish their tasks. If so, specify the order in which each baking station completes the task.

ii. If additional request from baking station 'A' raised for (3,3,0) resources, can the request be granted immediately? If yes, specify the order in which each baking station completes the task, if no, justify.

2.	In cooking competition event conducted in Vibrance, the organizing committee has the following components: five frying pans, five cooking pots, five induction stoves, and five wooden spoons. There are four teams participating with the following	10

scenario:

- TEAM 1 having two induction stoves but waiting for four frying pans to prepare their food.
- TEAM 2 having three induction stoves, one wooden spoon, one cooking pot and two frying pans but waiting for one frying pan and one wooden spoon to prepare their food.
- TEAM 3 having two cooking pot and one wooden spoon but waiting for two induction stoves and one wooden spoon to prepare their food.
- TEAM 4 having one cooking pot and two frying pans but waiting for four induction stoves to prepare their food. .

Draw the resource allocation graph for the given problem. Perform the deadlock detection algorithm and verify if deadlock exist or not. If no deadlock exists then find the safe sequence. If there is a deadlock, suggest a technique to overcome.

3. A team of students are doing a project, where they store their results of implementation in a common drive shared drive. At a time only one student is allowed to access the drive for modification in order to avoid inconsistency of data stored. Explain how synchronization can be achieved among the students by implementing hardware instruction and also prove that the solution satisfies all the requirements of critical section. **10**

4. Consider group of kids are picking cake cubes from a container that can hold up to N cakes. A child who wants to eat a cake picks one from the Container to eat. If a kid finds the Container to be vacant, the kid updates to his mother and waits until the mother refills the container with N cakes. Unsynchronized code snippets for the kid and mother threads are shown below: **10**

//Kid
while True:
getCakeFromContainer()
eat()
	//Mother
	while True:
	refillCakeContainer(N)

The following variables have been declared for use in your solution.
int count = 0;
mutex m; // invoke lock and unlock
You may perform wait and signal or signal_broadcast with the following:
condvar fullContainer, vacantContainer
Your task is to provide modified code of the mother and kid threads by adding suitable synchronization such that a kid invokes getCakeFromContainer () only if the Container is non-empty, and the mother invokes refillCakeContainer(N) only if the Container is fully vacant. Solve this question using only locks and condition variables, and no other synchronization primitive.

5. You are a software developer working on a memory-intensive application that manipulates large amounts of data. The application frequently needs to allocate and de-allocate memory dynamically. The current memory allocation strategy is causing performance issues, hence you have been given a task to improve. Given five memory partitions of 130KB, 540KB, 220KB, 335KB, 585KB (in order), show how would the various memory allocation algorithms allocate processes of 190 KB, 390 KB, 121 KB, and 450 KB (in order)? Which algorithm makes the most efficient use of memory? Justify your answer. **10**

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A2

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING (SCOPE)

Continuous Assessment Test – II (Open Book), October 2017

B.Tech (Common to all), Fall Semester, 2017

Course Code : CSE2005 Duration : 90 Minutes

Course Name : Operating Systems Max. Marks : 50

(Answer all the questions)

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Part – A Multiple Choice Questions (5 x 1= 5 Marks)

1. Consider a positive counting semaphore S. Assume that the wait operation P(S) decrements S, and signal operation V(S) increments S. While execution, 10 P(S) operations and 6 V(S) operations are issued in sequence. The largest initial value of S for which at least one P(S) wait operation will remain blocked is _____

(a) 1 (b) 2 (c) 3 (d) 4

2. Where does the swap space reside?

(a) ROM (b) RAM (c) Disk (d) On-chip cache

3. A system has 5 identical resources and M processes competing for them. Each process can request atmost 2 resources. Which one of the following values of N could lead to a deadlock?

(a) 5 (b) 4 (c) 3 (d) 2

4. In a resident-OS computer, which of the following system software must reside in the main memory under all situations?

(a) Loader (b) Linker (c) Assembler (d) Compiler

5. A 1500 Kbyte memory is managed using variable partitions but no storage compaction. It currently has two partitions of sizes 250 Kbytes and 360 Kbytes respectively. The smallest allocation request in Kbytes that could be denied is for

(a) 151 (b) 181 (c) 231 (d) 541

Part – B Fill in the blanks (5 x 1= 5 Marks)

6. The following program consists of 3 concurrent processes and 3 binary semaphores. The semaphores are initialized as S0 = 1, S1 = 0, S2 = 0. Then the process P0 prints '0' _____ many number of times.

3

W(S0) = 0

Process P0	Process P1	Process P2

while (1) {
wait (S0);
print '0';
release (S1);
release (S2);
}
	wait (S1);
	release (S0);
		wait (S2);
		release (S0);

7. In concurrent programming, a _____ is a synchronization construct that allows threads to have both mutual exclusion and the ability to wait (block) for a certain condition to become true. They also have a mechanism for signaling other threads that their condition has been met.

8. The segmentation creates _____ fragmentation.

9. _____ is a high speed cache used to hold recently referenced page table entries a part of paged virtual memory.

10. _____ is the EAT (Effective access time) if 5 micro second is associative look-up time and 0.20 is the miss-ratio in paging hardware with TLB.

Part – C Match the following (5 × 1= 5 Marks)

11. MMU	- (a) Deadlock avoidance
12. Cycle	- (b) Best-fit
13. Unsafe state	- (c) Internal fragmentation
14. Paging	- (d) Deadlock detection
15. Little fragmentation	- (e) Hardware

Part – D (3 × 5 = 15 Marks)

16. The Thirsty Person Problem (adopted from the Cigarette Smokers Problem): To drink, a thirsty person must have three things: water, ice and a glass. There are three thirsty people, each having a different one (and only one) of the three required items. A fourth person, a server, has an unlimited supply of all three items. If nobody is drinking, the server places two of the three items (chosen at random) onto a table. The thirsty person who can make a drink from those two items will pick them up and drink a glass of ice water. When done, the thirsty person will notify the server and the process will repeat. Write a monitor solution to control the thirsty people and the server in the following program. [5 Marks]

[P.T.O]

// Server

while (1){ drinkers.Serve(); }

// Drinker (type is water or ice or glass

while (1){ drinkers.GetIngredients(type); drink(); drinkers.NotifyServer(type); }

17. On a system using simple segmentation, compute the physical address for each of the logical addresses, given the following segment table. If the address generates a segment fault, indicate so. [5 Marks]

Segment	Base	Length
0	330	124
1	876	211
2	111	99
3	498	302

(a) 0, 99

(b) 2, 78

(c) 1, 265

(d) 3, 222

(e) 0, 111

18. (a) On a simple paged system, associative registers hold the most active page entries and the full page table is stored in the main memory. If references satisfied by associative registers take 100 ns, and references through the main memory page table take 180 ns, what must the hit-ratio be to achieve an effective access time of 125 ns? [2 Marks]

(b) Why is paging faster than segmentation? [2 Marks]

(c) Valid-invalid bit for a page in a page table [1 Marks]

(i) Helps avoid unnecessary writes on paging device

(ii) Helps maintain LRU information

(iii) Allows only read on a page

(iv) None of the above

Part - E (2 X 10 = 20 Marks)

(Answer all the questions)

19. Consider a system with 4 types of resources R1 (3 units), R2 (2 units), R3 (3 units), R4 (2 units). A non-preemptive resource allocation policy is used. At, any given instance, a request is not entertained if it cannot be completely satisfied. Three processes P1, P2, P3 request the resources as follows if executed independently.

Process P1:	Process P2:	Process P3:
t=0: requests 2 units of R2	t=0: requests 2 units of R3	t=0: requests 1 unit of R4
t=1: requests 1 unit of R3	t=2: requests 1 unit of R4	t=2: requests 2 units of R1
t=3: requests 2 units of R1	t=4: requests 1 unit of R1	t=5: releases 2 units of R1
t=5: releases 1 unit of R2 and 1 unit of R1	t=6: releases 1 unit of R3	t=7: requests 1 unit of R2
t=7: releases 1 unit of R3	t=8: Finishes	t=8: requests 1 unit of R3
t=8: requests 2 units of R4		t=9: Finishes
t=10: Finishes		

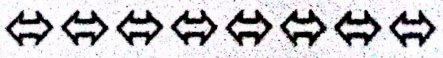
Which one of the following statement is TRUE if all three processes run concurrrently starting at time t=0? Justify your answer with necessary steps.

(a) All processes will finish without any deadlock (b) Only P1 and P2 will be in deadlock (c) Only P1 and P3 will be in deadlock (d) All three processes will be in deadlock

20. (a) Compare paging with segmentation with respect to the amount of memory required by the address translation structures in order to convert virtual addresses to physical addresses. Justify your answer with relevant diagrams. [5 Mark]

(b) Consider the following process for generating binary executables. A compiler is used to generate the object code for individual modules (files of source code), and a linkage editor is used to combine multiple object modules into a single program binary. How does the linkage editor change the binding of instructions and data to memory addresses? What information needs to be passed from the compiler to the linkage editor to facilitate the memory-binding tasks of the linkage editor? [3 Marks]

(c) Elucidate any one of the hardware locking mechanisms with suitable code. [2 Marks]



VIT

Vellore Institute of Technology

School of Computer Science and Engineering
Continuous Assessment Test II - Fall Semester 2019-20

Course Code , Name CSE2005, Operating System Slot : F2 Duration: 90...
Answer all the questions. Marks: 50

1.a) Block is a synchronization construct where a set of processes synchronizes globally i.e. each process in the set arrives at the Block and waits for all others to arrive and then all processes leave the Block [5Marks]

Let the number of processes in the set be three and S be a binary semaphore with the usual P and V functions. Consider the following 'C' implementation of a Block with line numbers.
The variables process_arrived and process_left are shared among all processes and are initialized to zero. In a concurrent program all the three processes call the Block function when they need to synchronize globally. The above implementation of Block is incorrect. Comment on the same.
	void Block(void) {
	1 P(S);
	2 process_arrived++;
	3 V(S);
	4 while (process_arrived !=3);
	5 P(S);
	6 process_left++;
	7 if (process_left==3) {
	8 process_arrived = 0;
	9 process_left = 0;
	10 }
	11 V(S);
	}

1.b) The memory access time is 1 nanosecond for a read operation with a hit in cache, 5 nanoseconds for a read operation with a miss in cache, 2 nanoseconds for a write operation with a hit in cache and 10 nanoseconds for a write operation with a miss in cache. Execution of a sequence of instructions involves 150 instruction fetch operations, 70 memory operand-read operations and 80 memory operand write operations. The cache hit-ratio is 0.9. Calculate the average memory access time (in nanoseconds) in executing the sequence of instructions. [5Marks]

2.a) In many computer systems users may encounter race conditions. Consider a banking system that maintains an account balance with two functions: deposit(amount) and withdraw(amount). These two functions are passed the amount that is to be deposited or withdrawn from the bank account balance. Assume two friends (A and B) share a bank account. Concurrently, A calls the withdraw() function and B calls deposit(). Describe how a race condition is possible and what might be done to prevent the race condition from occurring. [5Marks]

The following program consists of 3 concurrent processes and 3 binary semaphore... are initialized as S0=1, S1=0, S2=0. Comment on the number of times ... executed with appropriate explanation. [5

ss P0	Process P1	Process P2
(true) {	wait (S1);	wait (S2);
(S0);	signal (S0);	signal (S0);

that maintains an account balance with two functions deposit(amount) and withdraw(amount). These two functions are passed the amount that is to be deposited or withdrawn from the bank account balance. Assume two friends (A and B) share a bank account. Concurrently, A calls the withdraw() function and B calls deposit(). Describe how a race condition is possible and what might be done to prevent the race condition from occurring. [5Marks]

2. b) The following program consists of 3 concurrent processes and 3 binary semaphores. The semaphores are initialized as S0=1, S1=0, S2=0. Comment on the number of times "print" will get executed with appropriate explanation. [5 Marks]

Process P0	Process P1	Process P2
while (true) {	wait (S1);	wait (S2);
wait (S0);	signal (S0);	signal (S0);
print (0);		
signal (S1);		
signal (S2); }		

3. Assume that there are 4 resources A, B, C and D. The snapshot of the system is given below. [10 Marks]
Consider the following snapshot of a system

	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	

Answer the following questions using the banker's algorithm

a. What is the content of the matrix Need?

b. Is the system in a safe state?

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

4. Consider the below page reference string. How many page faults would occur in the case? Note that initially all frames are empty. (10 Mark

a. LRU

b. FIFO- Check for Belady's anomaly

c. Optimal algorithm assuming (i) 3 frames (ii) 4 frames

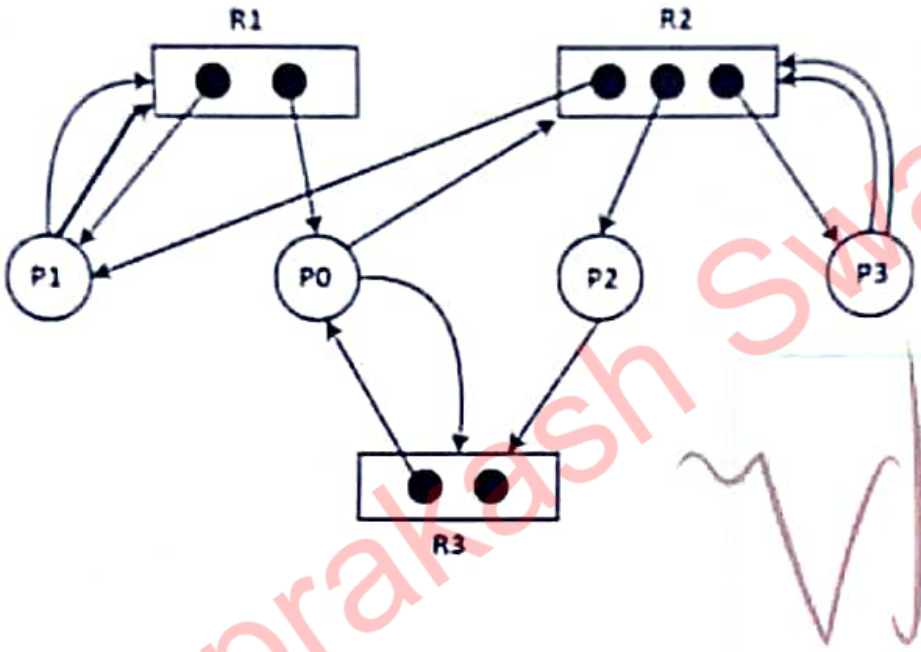
page reference string : 0,1,4,2,0,2,6,5,1,2,3,2,1,2,6,2,1,3,6,2

Check for Belady's anomaly

nal algorithm assuming (i) 3 frames (ii) 4 frames

page reference string : 0,1,4,2,0,2,6,5,1,2,3,2,1,2,6,2,1,3,6,2

5. (a) Consider the Resource Allocation Graph given below. Find if the system is in a deadlock state. Also write the Allocation Matrix and Request Matrix for the RAG



5. b) The Sleeping-Barber Problem - A barbershop consists of a waiting room with n chairs, and the barber room containing the barber chair. If there are no customers to be served, the barber goes to sleep. If a customer enters the barbershop and all chairs are occupied, then the customer leaves the shop. If the barber is busy, but chairs are available, then the customer sits in one of the free chairs. If the barber is asleep, the customer wakes up the barber. Write a pseudo code to coordinate barber and customers. (5 Marks)

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A2

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING (SCOPE)

Continuous Assessment Test – II (Open Book), October 2017

B.Tech (Common to all), Fall Semester, 2017

Course Code : CSE2005 Duration : 90 Minutes

Course Name : Operating Systems Max. Marks : 50

*(Answer all the questions)

==========

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Part – B Fill in the blanks (5 × 1= 5 Marks)

6. The following program consists of 3 concurrent processes and 3 binary semaphores. The semaphores are initialized as S0 = 1, S1 = 0, S2 = 0. Then the process P0 prints '0' _____ many number of times.

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while (1) {
wait (S0);
print '0';
release (S1);
release (S2);
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12. Cycle
13. Unsafe state
14. Paging
15. Little fragmentation

- (a) Deadlock avoidance
- (b) Best-fit
- (c) Internal fragmentation
- (d) Deadlock detection
- (e) Hardware

Part – D (3 × 5 = 15 Marks)

16. The Thirsty Person Problem (adopted from the Cigarette Smokers Problem): To drink, a thirsty person must have three things: water, ice and a glass. There are three thirsty people, each having a different one (and only one) of the three required items. A fourth person, a server, has an unlimited supply of all three items. If nobody is drinking, the server places two of the three items (chosen at random) onto a table. The thirsty person who can make a drink from those two items will pick them up and drink a glass of ice water. When done, the thirsty person will notify the server and the process will repeat. Write a monitor solution to control the thirsty people and the server in the following program. [5 Marks]

[P.T.O]

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Part - E (2 X 10 = 20 Marks)

(Answer all the questions)

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t=1: requests 1 unit of R3	t=2: requests 1 unit of R4	t=2: requests 2 units of R1
t=3: requests 2 units of R1	t=4: requests 1 unit of R1	t=5: releases 2 units of R1
t=5: releases 1 unit of R2 and 1 unit of R1	t=6: releases 1 unit of R3	t=7: requests 1 unit of R2
t=7: releases 1 unit of R3	t=8: Finishes	t=8: requests 1 unit of R3
t=8: requests 2 units of R4		t=9: Finishes
t=10: Finishes		

Which one of the following statement is TRUE if all three processes run concurrrently starting at time t=0? Justify your answer with necessary steps.

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(c) Elucidate any one of the hardware locking mechanisms with suitable code. [2 Marks]

School of Computer Science and Engineering

Continuous Assessment Test – II
Course Name & Code: Operating Systems & CSE2005

Class Number: VL2021220103538 **Slot: C2**

Exam Duration: 50 minutes **Maximum Marks: 30**

Q. No	Question	Mark	CO	BL
1	Consider the following snapshot of a system: Process Allocation max available	10	2	L2

PROCESS	ALLOCATION	MAX	AVAILABLE
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	

Answer the following questions using the banker's algorithm:
1) What is the content of the matrix need?
2) Is the system in a safe state?

Need = Max-allocation

Process	NEED			
P1	0	0	0	0
P2	0	7	5	0
P3	1	0	0	2
P4	0	0	2	0
P5	0	6	4	2

ii) Find the safe sequence of the system. Is the system is in safe state. (6)

For P1
Need ≤ available
0000 ≤ 1 5 2 0

Work = work available + allocation

= 1 5 2 0 + 0 0 1 2
= 1 5 3 2

For P2
Need ≤ available
0750 ≤ 1532

Condition not satisfied.

For P3
Need ≤ available
1002 ≤ 1532

Work = work available + allocation

= 1532 + 1354
= 2886

For P4
Need ≤ available
0020 ≤ 2886

Work = work available + allocation

= 2886 + 0632
= 2 14 11 8

For P5
Need ≤ available
0642 ≤ 2 14 11 8

Work = work available + allocation

= 2 14 11 8 + 0014
= 2 14 12 12

For P2
Need ≤ available
0750 ≤ 2 14 12 12

Work = work available + allocation

= 2 14 12 12 + 1000
= 3 14 12 12

The system is in safe state and safe sequence is <P1, P3, P4, P5, P2>

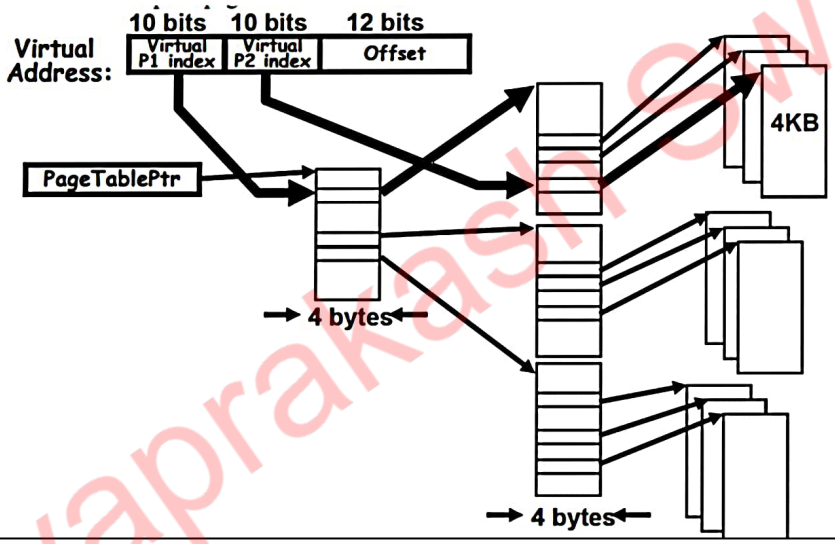
P0,P2,P3,P4,P1

2	State and implement with solution code producer -consumer problem using monitor. he following pseudo code shows a solution to the producer–consumer problem using monitors. Since mutual exclusion is implicit with monitors, no extra effort is necessary to protect the critical section. In other words, the solution shown below works with any number of producers and consumers without any modifications. It is also	10	3	L3

noteworthy that it is less likely for a programmer to write code that suffers from race conditions when using monitors than when using semaphores.[citation needed]

```
monitor ProducerConsumer
{
    int itemCount = 0;
    condition full;
    condition empty;

    procedure add(item)
    {
        if (itemCount == BUFFER_SIZE)
        {
            wait(full);
        }

        putItemIntoBuffer(item);
        itemCount = itemCount + 1;

        if (itemCount == 1)
        {
            notify(empty);
        }
    }

    procedure remove()
    {
        if (itemCount == 0)
        {
            wait(empty);
        }

        item = removeItemFromBuffer();
        itemCount = itemCount - 1;

        if (itemCount == BUFFER_SIZE - 1)
        {
            notify(full);
        }

        return item;
    }
}

procedure producer()
{
    while (true)
    {
        item = produceItem();
        ProducerConsumer.add(item);
    }
}

procedure consumer()
{
    while (true)
    {
        item = ProducerConsumer.remove();
        consumeItem(item);
```

	}
	}
	
	(5)
	Illustrate how a binary semaphore can be used to implement mutual exclusion among n processes.
	Operating systems often distinguish between counting and binary semaphores. The value of counting semaphore can range over an unrestricted domain and the binary semaphore also known as mutex locks which provide mutual exclusion can range only between 0 and 1. Binary semaphores are used to deal with critical-section problem for multiple processes as n processes share a semaphore mutex initialized to
	
	do { wait(mutex); /* critical section */ signal(mutex); /* remainder section */ } while (true);			

3	Suppose that we have a two-level page translation scheme with 4K-byte pages and 4-byte page table entries (includes a valid bit, a couple permission bits, and a pointer to another page/table entry). What is the format of a 32-bit virtual address? Sketch out the format of a complete page table  	10	3	L3

Q. No	Question	Mark	CO	BL
1	Consider the following snapshot of a system: Process Allocation max available	10	2	L2

PROCESS	ALLOCATION	MAX	AVAILABLE
P0	0 1 1 0	0 2 1 0	1 5 2 0
P1	1 2 3 1	1 6 5 2	
P2	1 3 6 5	2 3 6 6	
P3	0 6 3 2	0 6 5 2	
P4	0 0 1 4	0 6 5 6	

Answer the following questions using the banker's algorithm:

1) What is the content of the matrix need?
2) Is the system in a safe state?

1. Create the need matrix (max-allocation)

	A	B	C	D
P_0	0	1	0	0
P_1	0	4	2	1
P_2	1	0	0	1
P_3	0	0	2	0
P_4	0	6	4	2

For P0
Need ≤ available
0100 ≤ 1 5 2 0
Work = work available + allocation
= 1 5 2 0 + 0 0 11
= 1 6 3 0
Satisfied
For P1
Need ≤ available
0421 ≤ 1630
Condition not satisfied.
For P2
Need ≤ available
1 0 0 1 ≤ 1 6 3 0
Condition not satisfied
For P3
Need ≤ available
0020 ≤ 1 6 3 0
Work = work available + allocation
= 1 6 3 0 + 0 6 32
= 1 12 6 2
Satisfied
For P4
Need ≤ available
06 4 2 ≤ 1 12 6 2
Work = work available + allocation
= 1 12 6 2 + 0 0 14
= 1 12 7 6
Satisfied
For P1
Need ≤ available
04 21 ≤ 1 12 7 6
Work = work available + allocation
= 1 12 7 6 + 1 2 31
= 2 14 10 7
Satisfied
For P2
Need ≤ available
1001 ≤ 2 14 10 7
Work = work available + allocation

	= 2 14 10 7 + 1 3 6 5 = 3 17 16 12 Satisfied Safe sequence<p0,p3,p4,p1,p2>			
2	Explain how busy waiting can be overcome using Semaphores and implement with solution code *Busy waiting* is continuously executing (using the CPU) while waiting for something to happen. This is typically implemented by spinning; e.g. testing a variable in a tight loop until it changes. The alternative to busy waiting is *blocking*, where the waiting process is suspended an other processes can execute while the process is waiting. (5) Explain why spinlocks are not appropriate for single-processor systems yet are often used in multiprocessor systems. Spinlocks are not appropriate for single-processor systems because the condition that would break a process out of the spinlock can be obtained only by executing a different process. If the process is not relinquishing the processor, other processes do not get the opportunity to set the program condition required for the first process to make progress. In a multiprocessor system, other processes execute on other processors and thereby modify the program state in order to release the first process from the spinlock (5)	10	3	L3
3	Consider a machine with a physical memory of 8 GB, a page size of 8 KB, and a page table entry size of 4 bytes. How many levels of page tables would be required to map a 46-bit virtual address space if every page table into a single page? Sketch out the format of a complete page table.	10	3	L3

VIT UNIVERSITY
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A2

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING (SCOPE)

Continuous Assessment Test – II (Open Book), October 2017

B.Tech (Common to all), Fall Semester, 2017

Course Code : CSE2005 Duration : 90 Minutes

Course Name : Operating Systems Max. Marks : 50

(Answer all the questions)

==========

Part – A Multiple Choice Questions (5 × 1= 5 Marks)

1. Consider a positive counting semaphore S. Assume that the wait operation P(S) decrements S, and signal operation V(S) increments S. While execution, 10 P(S) operations and 6 V(S) operations are issued in sequence. The largest initial value of S for which at least one P(S) wait operation will remain blocked is _____

(a) 1 (b) 2 (c) 3 (d) 4

2. Where does the swap space reside?

(a) ROM (b) RAM (c) Disk (d) On-chip cache

3. A system has 5 identical resources and M processes competing for them. Each process can request atmost 2 resources. Which one of the following values of N could lead to a deadlock?

(a) 5 (b) 4 (c) 3 (d) 2

4. In a resident-OS computer, which of the following system software must reside in the main memory under all situations?

(a) Loader (b) Linker (c) Assembler (d) Compiler

5. A 1500 Kbyte memory is managed using variable partitions but no storage compaction. It currently has two partitions of sizes 250 Kbytes and 360 Kbytes respectively. The smallest allocation request in Kbytes that could be denied is for

(a) 151 (b) 181 (c) 231 (d) 541

Part – B Fill in the blanks (5 × 1= 5 Marks)

6. The following program consists of 3 concurrent processes and 3 binary semaphores. The semaphores are initialized as S0 = 1, S1 = 0, S2 = 0. Then the process P0 prints '0' _____ many number of times.

3

$\omega(S_0) = 0^{\infty}$

Process P0	Process P1	Process P2

while (1) {
wait (S0);
print '0';
release (S1);
release (S2);
}
	wait (S1);
	release (S0);
		wait (S2);
		release (S0);

7. In concurrent programming, a _____ is a synchronization construct that allows threads to have both mutual exclusion and the ability to wait (block) for a certain condition to become true. They also have a mechanism for signaling other threads that their condition has been met.

8. The segmentation creates _____ fragmentation.

9. _____ is a high speed cache used to hold recently referenced page table entries a part of paged virtual memory.

10. _____ is the EAT (Effective access time) if 5 micro second is associative look-up time and 0.20 is the miss-ratio in paging hardware with TLB.

Part – C Match the following (5 x 1= 5 Marks)

11. MMU	- (a) Deadlock avoidance
12. Cycle	- (b) Best-fit
13. Unsafe state	- (c) Internal fragmentation
14. Paging	- (d) Deadlock detection
15. Little fragmentation	- (e) Hardware

Part – D (3 x 5 = 15 Marks)

16. The Thirsty Person Problem (adopted from the Cigarette Smokers Problem): To drink, a thirsty person must have three things: water, ice and a glass. There are three thirsty people, each having a different one (and only one) of the three required items. A fourth person, a server, has an unlimited supply of all three items. If nobody is drinking, the server places two of the three items (chosen at random) onto a table. The thirsty person who can make a drink from those two items will pick them up and drink a glass of ice water. When done, the thirsty person will notify the server and the process will repeat. Write a monitor solution to control the thirsty people and the server in the following program. [5 Marks]

[P.T.O]

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Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

Continuous Assessment Test – II

Course Name & Code: Operating Systems & CSE2005

Class Number: VL2021220103538 **Slot: C2**

Exam Duration: 50 minutes **Maximum Marks: 30**

Q. No	Question	Mark	CO	BL
1	Consider the following snapshot of a system: Process Allocation max available	10	2	L2

PROCESS	ALLOCATION	MAX	AVAILABLE
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	

Answer the following questions using the banker's algorithm:

1) What is the content of the matrix need?

2) Is the system in a safe state?

Need = Max-allocation

Process	NEED			
P1	0	0	0	0
P2	0	7	5	0
P3	1	0	0	2
P4	0	0	2	0
P5	0	6	4	2

ii) Find the safe sequence of the system. Is the system is in safe state. (6)

For P1

Need ≤ available

0000 ≤ 1 5 2 0

Work = work available + allocation

= 1 5 2 0 + 0 0 1 2

= 1 5 3 2

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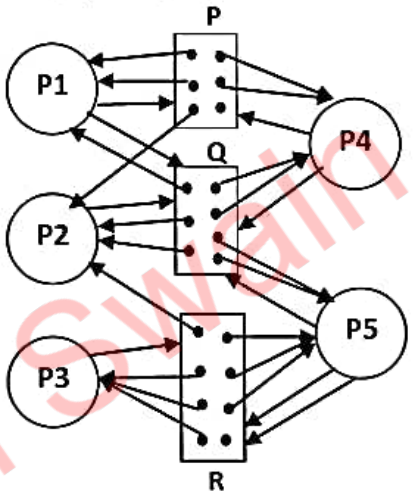
School of Computer Science and Engineering
Fall Semester 2023-24 UG Seniors (B.Tech 2021 Batch)
Continuous Assessment Test – 2

SLOT: B1 + TB1, B2 + TB2

Programme Name &Branch: B.Tech& BCB, BCE, BCI, BCT, BDS, BKT
Course Name & code: Operating Systems & BCSE303L
Exam Duration: 90 Min. **Maximum Marks: 50**

General instruction(s): Answer all the questions

Q.No.	Question	Max Marks
1.	Consider the system with 5 processes (P1, P2, P3, P4 and P5) and three resource types (P, Q and R). The following resource allocation graph represents the current allocation and the requests of each process.  i) Check whether the current system is in safe state or not? If safe, print the safe sequence. If unsafe, what is the minimum number of resource instance is needed to be available for this system to be safe. (7 Marks) ii) With reference to the above safe system, suppose process P1 requests one additional instance from R, check whether it can be granted immediately or not? If yes, print the order in which the process are completing their execution.(3 Marks)	10
2.	Write the pseudo code of Peterson's method and analyze with justification each of the output for the below given scenarios. **S.No** | **Interested[P0]** | **Interested [P1]** | **Turn** 1 | True | False | P0 2 | True | True | P0 3 | True | True | P1 4 | False | True | P1 The above table shows the interest of process P0 and P1 to enter the critical section ("True" denotes interested, "False" denotes not interested) and "Turn" denotes which process is currently under execution. Assume initially both processes are not interested to get into the critical section. (7 marks) Also justify whether mutual exclusion and progress is guaranteed for Peterson's method with an example for each. (3 Marks)	10
3.	a) Consider a speaker presenting a technical session and a maximum of 50 participants are allowed to attend the presentation. If the participant wants to interact with the speaker during the presentation, he/she must get the permission from the speaker. If the speaker agrees to interact, speaker stops his presentation and opens the session for discussion. Once the speaker closes the discussion session and resumes his presentation, the participants are not allowed to interact. The participants are	10

allowed to enter or exit the hall only during the discussion time. Discuss the need of process synchronization and develop the solution (pseudo code) to this problem. (6 Marks)

b) Apply binary semaphores to the following scenario given below. Consider two processes P_0 and P_1 are executed in sequence. Trace the algorithm and write the possible sequence of output. (4 Marks)

```
mutex a,b;
a=1, b=0;
        P0                      P1
while (true) {          while (true) {
    down (a);               down (b);
    print ("3");           print ("2");
    up (b); }               up (a); }
```

4. a) Consider there are 4 partitions of size 4MB, 8 MB, 20 MB and 2 MB respectively. Assume that the partitions are released for the next job to occupy once the previous jobs have run to completion. The list of jobs and their appropriate time for execution is given below, (10)

Job ID	J1	J2	J3	J4	J5	J6	J7
Job size (in MB)	2	14	3	6	2	10	20
Time for execution	4	10	2	1	6	1	8
Completion time	?	?	?	?	?	?	?

Identify at what time each of the jobs will get over if "Best-fit" algorithm is applied to the above scenario with the help of a chart. Also identify whether there arises a situation of external fragmentation at any time of execution. (4 Marks)

b) Consider a system which is Byte addressable which contains total main memory as 64 Bytes. Assume that the first 4 frames of the main memory are already occupied by a system level process. Now a new process has arrived with size 32 Bytes which has to be accommodated into the main memory using paging technique. Assume the frame size = page size = 4 Bytes. Identify the location (with frame number and frame offset) where the 12^{th} Byte of the process is stored in the main memory. Depict the above scenario with a detailed view of how the bytes are stored in the main memory, process table and page table. (6 Marks)

5. a)Suppose we have a page trace {4, 3, 2,1,4,3,5,4,3,2,1,5}. Use FIFO and LRU to run this page trace with 3 page frames and then with 4 page frames. For each replacement algorithm, clearly show the page replacement activities, number of page faults, hit ratio, and miss ratio. Also, indicate Belady anomaly if there is any for each of the replacement algorithms given. (7 Marks) (10)

b) A paging scheme uses Translation Lookaside Buffer (TLB). Suppose time taken to search a page entry in the TLB is 20 ns, time taken to access a byte/word from a main memory is 100 ns, and an effective memory access time is 160 ns. Assume, no page fault has occurred and two level page table is used .Determine the percentage of times that the page number of interest is found and not found in the TLB respectively. (3 Marks)

1) Banker's algorithm solution

1) i) Resources: P Q R
6 7 8

Allocation				Request			Available		
	P	Q	R	P	Q	R	P	Q	R
P_1	2	1	0	1	1	0	1	0	1
P_2	1	2	1	0	1	0			
P_3	0	0	3	0	0	1			
P_4	2	2	0	1	1	0			
P_5	0	2	3	0	1	2			

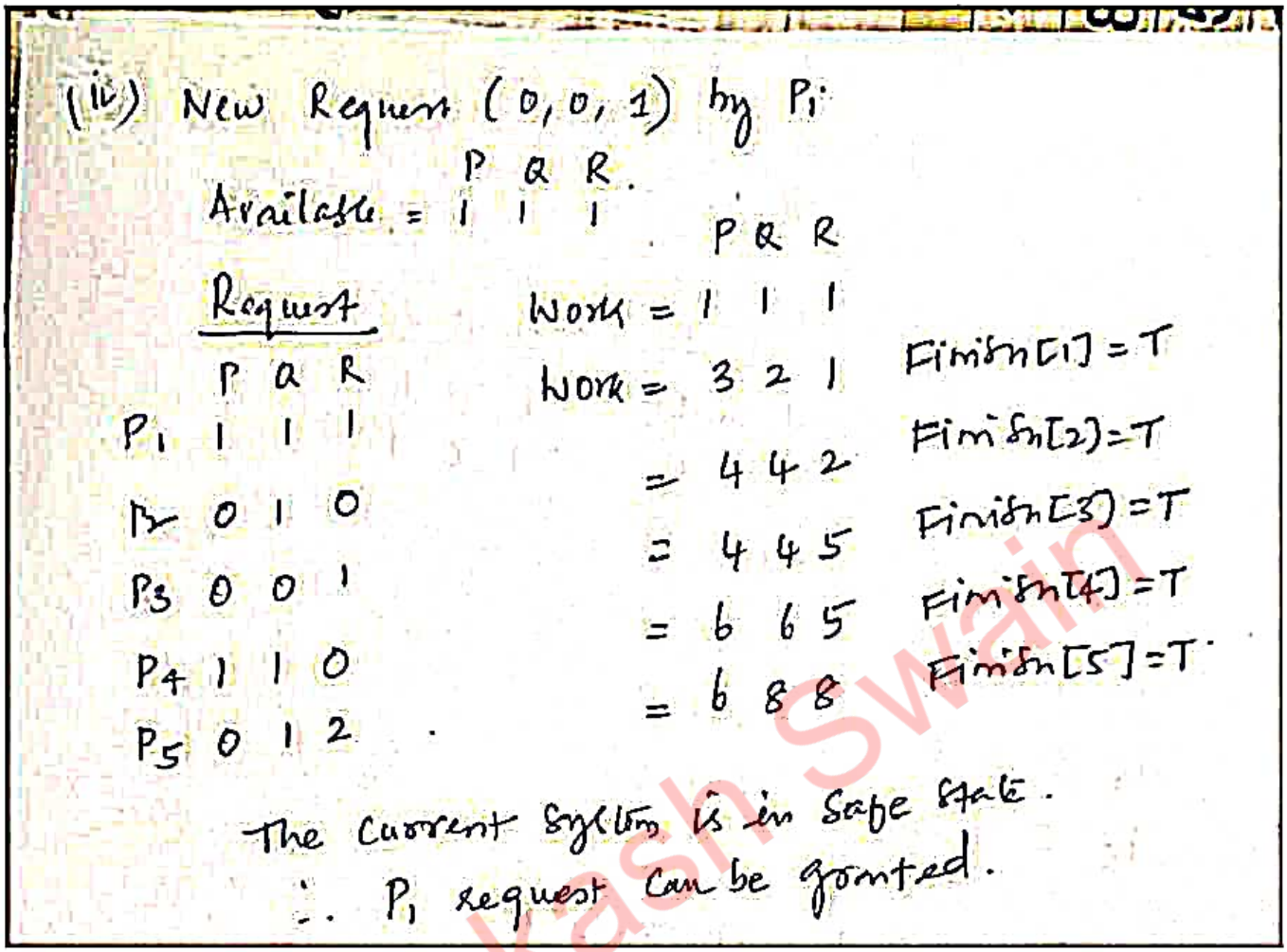
Work = 1 0 1 — Finish[1] = F
= 1 0 1 — Finish[2] = F
= 1 0 4 — Finish[3] = T
= 1 0 4 — Finish[4] = F
= 1 0 4 — Finish[5] = F

∴ the current system is in Unsafe state.

Add one instance to Q : Available = P Q R = 1 1 1

Work = 1 1 1
Work = 3 2 1 — Finish[1] = T
= 4 4 2 — Finish[2] = T
= 4 4 5 — Finish[3] = T
= 6 6 5 — Finish[4] = T
= 6 8 8 — Finish[5] = T

∴ the current system is in Safe State.



Mark splitup

1) a) Allocation Table construction – 2 marks

   To identify safe or unsafe – 2 marks

   Identification of min resource – 1 mark

   Conversion of unsafe to safe state – 2 marks

1) b) To identify whether P1 request can be granted or not - 3 marks

2) **Pseudo code of Peterson's Method** **(2 marks)**

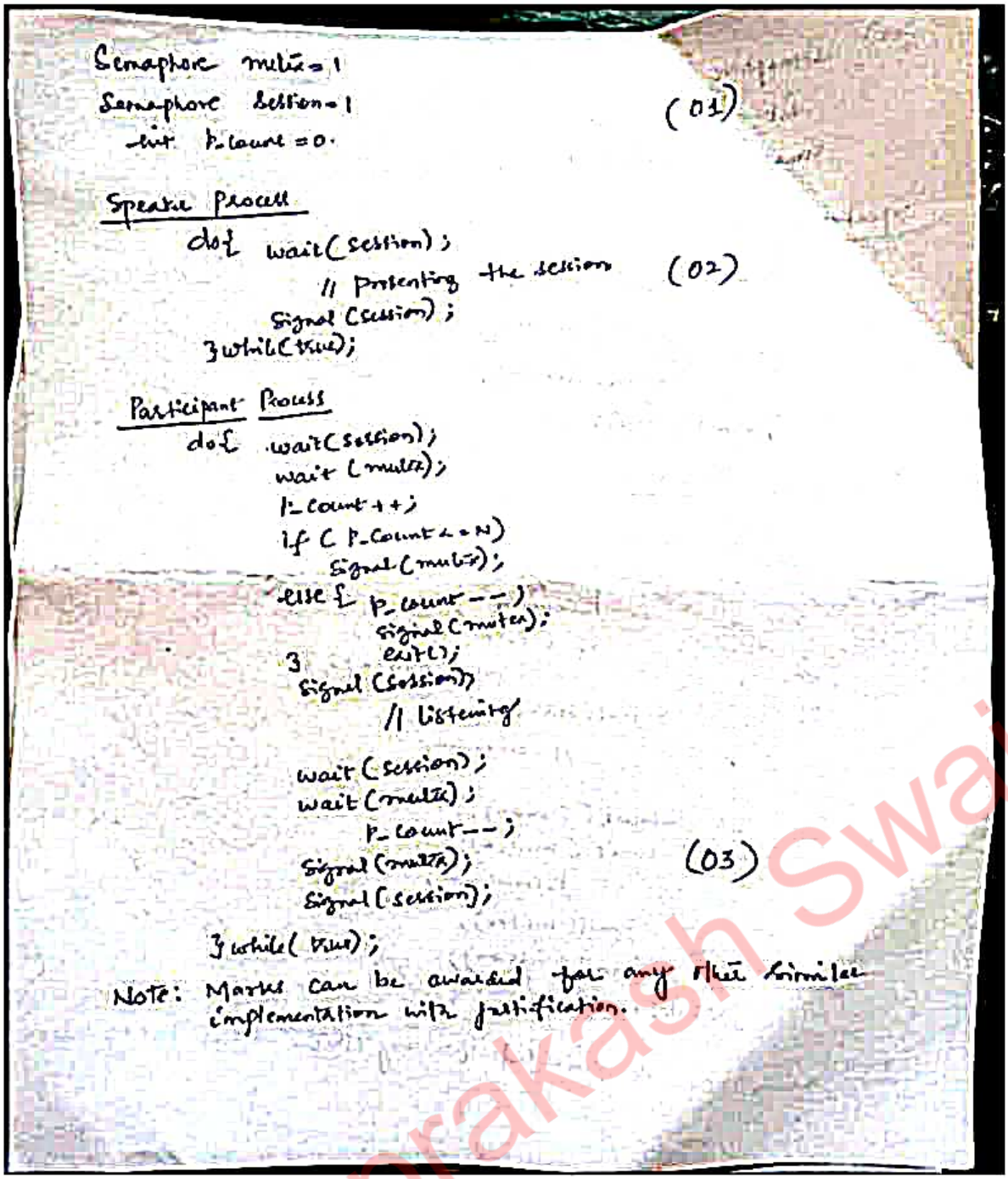
```
#define N2 // 'N' denotes total number of processes
#define TRUE 1
#define FALSE 0
int interested[N] = FALSE;
int turn;
void Entrysection (int process) {
  int other;
  other = 1 – process;
  interested [process] = TRUE;
  turn = process;
  while (interested [other] == TRUE  &&  turn = process);
 }
void Exitsection (int process) {
  interested [process] = FALSE;
}
```

S.No	Interested[P0]	Interested [P1]	Turn	Output with justification **(6 marks)**
1	True	False	P0	**Process P0 enters the critical section.** Justification: The other process P1 is not interested and it is the turn of P0, thus the while loop will break and the process P0 enters the critical section.
2	True	True	P0	**None of the processes will enter the critical section.** Justification:- It is the turn of process P0 and also the other process P1 is interested to enter the critical section. Thus, both the processes end up in an loop waiting for the other process to exit the critical section and change the interested value to FALSE.
3	True	True	P1	**None of the processes will enter the critical section.** Justification:- It is the turn of process P1 and also the other process P0 is interested to enter the critical section. Thus, both the processes end up in a loop waiting for the other process to exit the critical section and change the interested value to FALSE.
4	False	True	P1	**Process P1 enters the critical section.** Justification:- The other process P0 is not interested and it is the turn of P1, thus the while loop will break and the process P1 enters the critical section.

Mutual exclusion – Only one process must enter the critical section at a time.
Progress - If a process is not interested to enter the critical section, it should not stop the other process from entering the critical section.

Any example with justification given by the student which shows the mutual exclusion and progress is guaranteed for Peterson's method. **(2 marks)**

3) a)



3) b) As per the concept of binary semaphore, the value of the semaphore is decremented by 1 to enter the critical section. Similarly when the process gets out of the critical section, the semaphore value is incremented back.

Iteration 1: a = 1; b = 0; 32
Iteration 2: a = 1; b = 0; 32
.
.
.

Thus, the output of the above example will be "32323232……." (For multiple iterations) **(4 Marks)**

4)a)

Process execution chart when Best-fit algorithm is applied **(3 marks)**

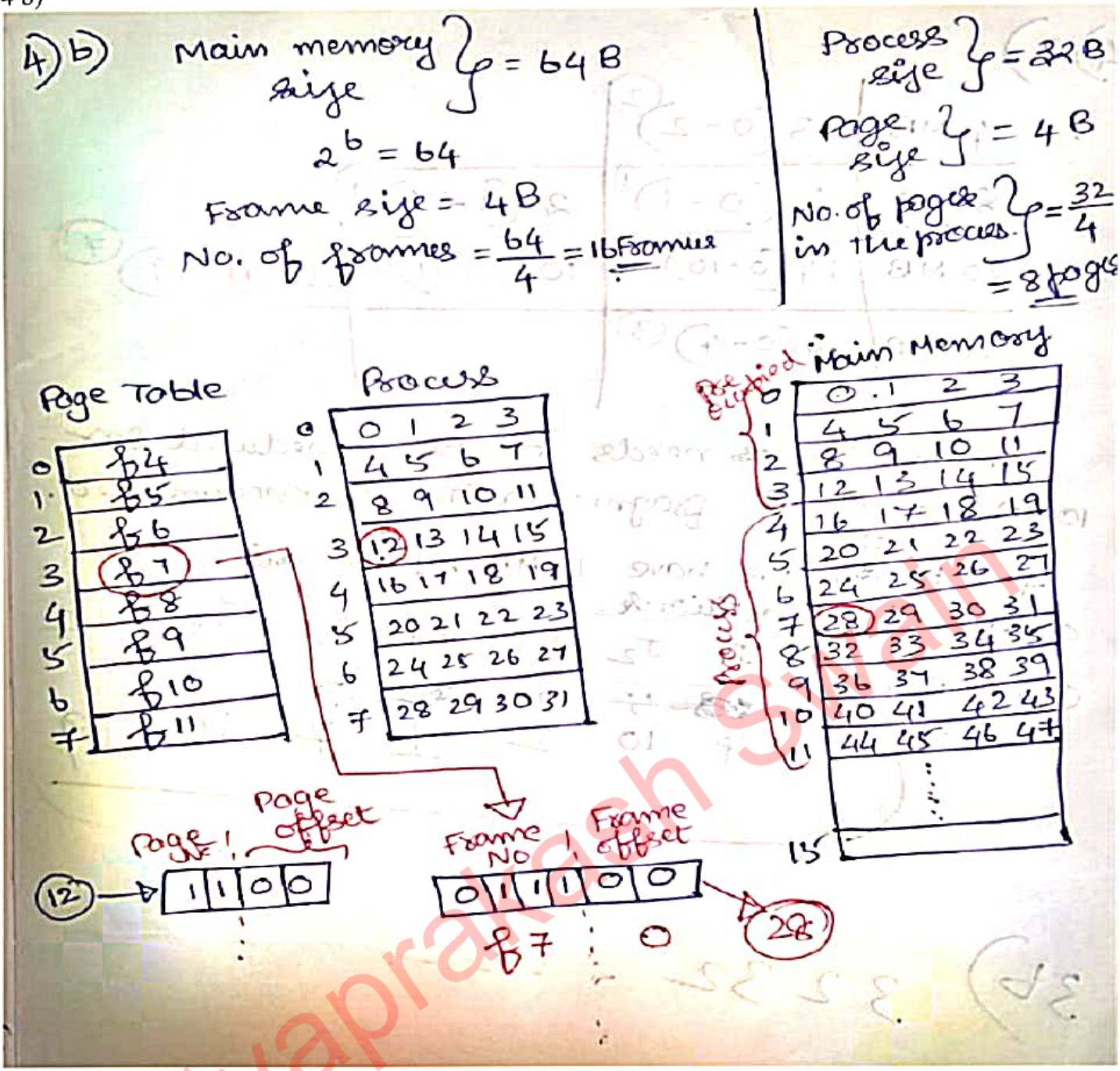
4 MB	J3 – 3 MB (0-2)		
8 MB	J4 – 6 MB (0-1)	J5 – 2 MB (1-7)	
20 MB	J2 – 14 MB (0-10)	J6 – 10 MB (10-11)	J7 – 20MB (11-19)
2 MB	J1 – 2 MB (0-4)		

When J6 – 10 MB needs to be scheduled, external fragmentation occurs. At time = 7, we have 14 MB of non-contiguous free space among all the partitions. (Or anyother instance given by the student) **(1 mark)**

Completion time based on Best-fit algorithm

Job ID	J1	J2	J3	J4	J5	J6	J7
Job size (in MB)	2	14	3	6	2	10	20
Time for execution	4	10	2	1	6	1	8
Completion time	**4**	**10**	**2**	**1**	**7**	**11**	**19**

4 b)



- Finding out the number of frames and pages from the given data **(1 mark)**
- For the depiction of the detailed view (as given in the above image) of process table, page table and main memory. **(3 marks)**
- Identification of frame offset as 011100 – 28th byte in the main memory for 12th byte in the process. **(2 marks)**

5)a)

5) i) FIFO Page frames = 3.

Index:	1	2	3	4	5	6	7	8	9	10	11	12
Page No:	4	3	2	1	4	3	5	4	3	2	1	5
Frame 1	(4)	4	4	(1)	1	1	(5)	5	5	5	5	5
Frame 2		(5)	3	3	(4)	4	4	4	4	(2)	2	2
Frame 3			(2)	2	2	(3)	3	3	3	3	(1)	1

Page Faults = 9 Miss Ratio = 9/12 = 75%

Hit Ratio = 3/12 = 25%

Page Frames = 4:

Page No:	4	3	2	1	4	3	5	4	3	2	1	5
Frame 1	(4)	4	4	4	4	4	(5)	5	5	5	(1)	1
Frame 2		(3)	3	3	3	3	3	(4)	4	4	4	(5)
Frame 3			(2)	2	2	2	2	2	(3)	3	3	3
Frame 4				(1)	1	1	1	1	1	(2)	2	2

Page Faults = 10 Miss Ratio = 10/12 = 83%

Hit Ratio = 2/12 = 17%

ii) LRU:

Page No:	4	3	2	1	4	3	5	4	3	2	1	5
Frame 1	(4)	4	4	(1)	1	1	(5)	5	5	(2)	2	2
Frame 2		(3)	3	3	(4)	4	4	4	4	4	(1)	1
Frame 3			(2)	2	2	(3)	3	3	3	3	3	(5)

No. of Page Faults = 10 Miss Ratio = 83%

Hit Ratio = 17%

Page No:	4	3	2	1	4	3	5	4	3	2	1	5
Frame 1	(4)	4	4	4	4	4	4	4	4	4	4	(5)
Frame 2		(3)	3	3	3	3	3	3	3	3	3	3
Frame 3			(2)	2	2	2	(5)	5	5	5	(1)	1
Frame 4				(1)	1	1	1	1	1	(2)	2	2

Page Faults = 8 Miss Ratio = 67%

Hit Ratio = 33%

b) FIFO algorithm shows the existence of Belady's anomaly.

Marks splitup

FIFO – Frames = 3 – 1.5 marks, Frames = 4 – 1.5 marks

LRU - Frames = 3 – 1.5 marks, Frames = 4 – 1.5 marks

Belady anomaly or not - 1 mark

5) b) Effective memory access time = p (t + m) + (1-p) (t + km + m) (1 mark)

160 = p (20+100) + (1-p)(20 + (2*100) + 100) (1 mark)

p = 0.8 => 80 % Hit 20 % Miss (1 mark)

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Continuous Assessment Test - II – October 2023

Programme	:	B.Tech(CSE)	Semester	:	Fall 23-24
Course	:	Operating Systems	Code	:	BCSE303L
			ClassNbr	:	CH2023240100892, CH2023240100893, CH2023240101113
Faculty	:	Dr. Pravin Renold A, Dr. J. C. Kavitha, Dr. A. Menaka Pushpa	Slot	:	C2+TC2
Time	:	90 Minutes	Max. Marks	:	50

		Answer all Questions	Marks
1.		Suppose 3 business partners P1, P2, and P3 share a common bank account with deposit amount, withdrawal amount, and balance checking operations. Assume these three business partners initiate the money transaction operations concurrently. Under this circumstance, what issue will occur? Why does this problem occur? Explain it with a supporting code portion.	5
2.		At VIT University's library, multiple study rooms are available for students. To ensure that only one student can occupy a study room at a time and to manage access fairly, the university's SCOPE department has implemented an algorithm. Students arriving at the library take unique tickets to determine the order of access to the study rooms.	10
	(i)	Describe the problem that the university's SCOPE department is trying to solve and name the algorithm. **(2 Marks)**	
	(ii)	Consider the following four students (Student A, Student B, Student C, and Student D) who arrive at the library at different times and take tickets: Student A arrives first and takes ticket 1. Student B arrives next and takes ticket 2. Student C and D arrives at the same time, C takes ticket 4 and D takes ticket 3 Determine the order in which these students will be allowed to access the study rooms. Provide a step-by-step explanation of how the algorithm works in this scenario. **(4 Marks)**	
	(iii)	Write a pseudocode of the above-said algorithm. **(4 Marks)**	
3.		Consider a system where a counting semaphore is initialized to 3, controlling access to a critical section. Five processes P1, P2, P3, P4, and P5 sequentially request entry into this critical section. Consider the situation where the processes have varying priorities like P1-2, P2-3, P3-6, P4-1, P5-4	10

		and the processes access the critical section based on highest value assigned as the priority.	
	(i)	Analyze which processes gain entry and which are placed in the waiting queue. **(2Marks)**	
	(ii)	Determine the value of the counting semaphore when P1, P2 and P3 is already executing in the critical section and while P2 exits P4 enters the critical section. **(3 Marks)**	
	(iii)	Write a pseudocode that not only implements the priority-based access but also handles the case where processes with equal priority request access simultaneously. Ensure that the pseudocode covers all possible scenarios and provides a fair and efficient access mechanism to the critical section. **(5 marks)**	
4.		Write a C program to implement the following game with 2 players using mutex–lock to ensure synchronization among players. Players move their coins on the board as per the random number generated by rolling two dice. If Player1 gets the even numbers in both dice then the turn will be given to Player2. Player2 moves the coin by one position on the left side. Similarly, Player2 gives a turn to Player1 if he gets the odd numbers in both dice. Player1 moves the coin on the right side for one position. This game has 10 rounds for each player. After the 10th round, the player who gets more chance to move the coin will be the winner.	**10**
5.		We operate a streaming platform that offers users a diverse selection of movies and TV series. Ensuring a seamless viewing experience is of utmost importance to us. To enhance the performance of our platform, You are asked to evaluate three distinct algorithms, labeled as 'i','ii' and 'iii' for the user's history of content selections: 'Action movie, Comedy Series, Documentary, Romance movie, Comedy series, Action movie, Thriller movie, Comedy series, Drama series, Action movie, Romance movie, Documentary, Crime series, Thriller movie, Romance movie, Action movie, Comedy Series, Documentary, Romance movie, Drama series'	**15**
	(i)	When a new movie/TV series needs to be loaded into the system's memory, it replaces the movie/TV series that has been in memory for the longest period of time. **(4 Marks)**	
	(ii)	When a new movie/TV series needs to be loaded into the system's memory, it replaces the movie/TV series that has experienced the least activity in recent history, with the assumption that it has become less pertinent for ongoing operations. **(4 Marks)**	
	(iii)	When a new movie or TV series is about to be loaded into the system's memory, it replaces the movie or TV series that is not expected to be accessed in the future. **(4 Marks)**	
	(iv)	Determine which algorithm is most preferred for the above customer preference. Justify your selection. **(3 Marks)**	
		Assume the memory slots of the device are free initially and the memory is divided into equal-sized frames of size 4.	

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Continuous Assessment Test II – October 2023

Programme	:	B.Tech. CSE B.Tech. CSE (AI&ML) B.Tech. CSE (CPS) B.Tech. CSE (AIR)	Semester	:	Fall 2023-24
Course Code	:	BCSE303L	Class Nbr(s)	:	CH2023240100698 CH2023240100697 CH2023240100699 CH2023240100696
Course Title	:	Operating Systems			
Faculty(s)	:	Dr. S. Harini Dr.K.Vallidevi Dr.G.Manju Dr.Arfuza Begum	Slot	:	F2+TF2
Time	:	90 Minutes	Max. Marks	:	50

Answer all the Questions

Make necessary assumptions and state them wherever necessary

Q. No.	Question Text	Marks

1.	A popular game is having issues with its servers lagging heavily due to too many players being connected at a time. Below is the code that a player runs to play on a server:
	
	void game_playsession (struct server *s)
	{
	Connect(s);
	Play();
	Disconnect(s);
	}
	
	After testing, it turns out that the servers can run without lagging for a max of up to 100 players connected concurrently. How can you use synchronization to enforce a strict limit of 100 players connected at a time? Assume that a game server can create synchronization variables and share them amongst the player threads. You can provide your answer as a pseudo-code. Ensure to provide a solution such that no zombie players can access the session.
		10

2.	Assume that you are going to Aadhar enrolment centre for updating your mobile number in the Aadhar card. As you enter the centre, the receptionist gives you a service number and ask to wait until your service number is called out. You were also waiting	10

in the lobby. Suddenly you receive a very important office call and you move out of the lobby without informing the receptionist. As you did not turn up for longer time, receptionist noticed it and gave the same service number to other person Y, who arrived and requested for Aadhar service. But later you return back to waiting lobby after completing the call and when your service number is called another person is also joining along with you for Aadhar service.

a. Who will get the chance for Aadhar service? (1 mark)

b. To which technique this issue can be correlated with? Why? (2 marks)

c. Can you suggest a solution for this issue? Design the pseudo-code of your solution. (7 marks)

3. Consider the following solution to the producer-consumer synchronization problem. The shared buffer size is N. Three semaphores *empty*, *full* and *mutex* are defined with respective initial values of 0, N and 1. Semaphore *empty* denotes the number of available slots in the buffer, for the consumer to read from. Semaphore *full* denotes the number of available slots in the buffer, for the producer to write to. The placeholder variables, denoted by P, Q, R and S, in the code below can be assigned either *empty* or *full*. The valid semaphore operations are: *wait()* and *sigmal()*. 10

Producer	Consumer

do {
wait(P)
Wait(mutex);
// add item to buffer
Signal(mutex);
Signal(Q);
} while(1);
	do {
	wait(R)
	Wait(mutex);
	// Consume item from buffer
	Signal(mutex);
	Signal(S);
	} while(1);

a) Which one of the following assignments to P, Q, R and S will yield the correct solution, explain why it is correct? (4 marks)

b) Re-write the above pseudo-code with one semaphore and strict alteration policy such that the "Producer" starts first and then it alternates to "Consumer" and so on. (6 marks)

4. Mr. Raj is trying to copy the trip photos available on his camera to his mobile phone. Unfortunately, he is unable to save the photos due to insufficient space. Hence, he is attempting to organize his memory space by retaining certain photos and deleting some photos based on the following criteria. 10

a. Retaining very important photos like Aadhar card, driving license etc

b. Deleting some oldest photos. For e.g., deleting photos that were taken 5 years ago

c. Deleting unnecessary photos both recent and old photos i.e., photos that will not be used at all

d. Deleting some random photos irrespective of their age and significance (just to create free space for enabling the copying operation)

i. Suggest a suitable algorithm that would consider all the above factors that delete files and give space for new photos. Justify your answer. (4 marks)

ii. Explain the techniques involved in the algorithm with appropriate examples and diagrams. (6 marks)

5. Match the following and justify your answer with an example. Consider the below functions for the pseudo-code — 10

malloc() → dynamically allocated memory chunk
pmalloc_create_pool() → creates a dynamically allocated pool of memory with read-only access
pmalloc() → protected, dynamically allocated memory chunk from the pool created. It allows only read-only access to the dynamic memory chunk
*read(*str, size) → reads from the address specified by str till the size specified in the second argument. If read results in error, read returns negative value*
*write(*str, *buf, sizeof(buf)) →writes into the address specified str, the contents of buf. If write results in error, write returns a negative value.*

Pseudo-Code	Resultant TLB
a) *struct pmalloc_pool *pool = pmalloc_create_pool();* **str1 = pmalloc(*pool, sizeof(5*char));* **buf="12345"* *write(*str1, buf, sizeof(buf))* *Last Write to str1 will result in which TLB scenario?*	A single memory access with TLB hit and a page fault
b) **str2 = (char*) malloc(sizeof(5*char));* **buf="12345"* *i= write(*str2, buf, sizeof(buf))* *//'i' value returns negative value due to some internal error* *write(*str2, buf, sizeof(buf))* *Last Write to str2 will result in which TLB scenario?*	A single memory access with TLB hit and a page hit
c) **str3 = (char*)malloc(*pool, sizeof(5*char));* **buf="12345"* *i=write(*str3, buf, sizeof(buf))* *//'i' is not less than 0* *read(str3)* *Last read to str3 will result in which TLB scenario?*	A single memory access with TLB hit and a trap

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Continuous Assessment Test- II, December 2022

Programme	: M.Tech - CSE and specializations	Semester	:	FALL 2022-23
Course	: Operating Systems	Code	:	MCSE504L
		Class Nbr	:	CH2022231700015
Faculty	: Prof. B . Rajesh Kanna	Slot(s)	:	E2+TE2
Time	: 1½ Hours	Max. Marks	:	50

Answer ALL the Questions

1. Consider a process having three threads ARISE, AWAKE, and STOP NOT. The main process receives multiple requests, and places them in a request queue that is accessible by all the three threads ARISE, AWAKE, and STOP NOT. **[15]**
   - For each request, we require that the request must first be processed by thread ARISE, then AWAKE, then STOP NOT, then AWAKE again, and finally by ARISE before it can be removed and discarded from the queue.
   - Thread ARISE must read the next request from the queue only after it is finished with all the above steps of the previous one.

   Write down pseudo code for the functions run by the threads ARISE, AWAKE, and STOP NOT to enable this synchronization.

   Note : It is important to note that you may concentrate on the synchronisation logic and disregard the application-specific processing done by the threads. You may employ any synchronisation primitive of your choice.

2. A modern restaurant employs three people, namely John, Shiva, and Feroz, to make pizza. They share a chopping board, two knives, and a rolling mat. **[15]**
   - Shiva needs to use one knife and one rolling mat.
   - Feroz must use one knife and one chopping board.
   - John needs to use 1 knife, 1 rolling mat, and 1 chopping board.

   At a certain point in time: Shiva is using one rolling mat. Feroz is not using anything and John is only using one knife and one chopping board.

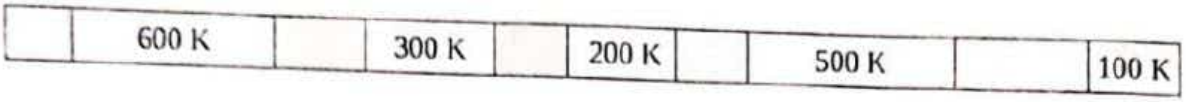
   (a) Draw a resource allocation graph to illustrate the state of the system. (Show future claims as dashed lines.) (4 Marks)

   (b) Draw a table to illustrate the maximum, used, needed, and available resources in the system. (3 marks)

   (c) Use the deadlock avoidance approach for allocating resources to each restaurant workers and find out if this system is in a safe state. (6 marks)

   (d) If it is in a safe state, give a safe sequence; if not, identify the resources involved in the resulting deadlock. (2 marks)

3. Given free memory spaces of 600K, 300K, 200K, 500K and 100 K in order and illustrated below; **[10]**



a) How would each of the given memory placement strategies, "smallest free partition," "rapid search-based," and "first adequate space," place processes of 112K, 426K, 212K, and 417K (in order)?(6Marks)

b) Which of the above three approaches makes the most efficient use of memory with the least amount of time justification? (4 marks)

4. Assume you are interning with a memory management team, and they have assigned you a simple memory management assignment. This work must consider both dynamic partitioning as well as placing and locating the portion memory for faster process hand in. **[10]**

a) Identify a suitable approach and provide a detailed descriptions for managing the memory with solid justification to deliver a solution to the aforementioned requirements. (3 marks)

b) Allocate memory on the 1 MB of memory for the following requests and release memory using your recommended approach. Use a binary tree and a list to illustrate procedure of your method (7 marks)

- Request 100 KB (Named as A)
- Request 240 KB (Named as B)
- Request 64 KB (Named as C)
- Request 256 KB (Named as D)
- Release B
- Release A
- Request 75 KB (Named E)
- Release C
- Release E
- Release D

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Continuous Assessment Test-II – October 2023

Programme	:	B.Tech(CSE)	Semester	:	Fall 23-24
Course	:	Operating Systems	Code	:	BCSE303L
			ClassNbr	:	CH2023240100890, CH2023240101112
Faculty	:	Dr. L. Shyamala, Dr. Braveen	Slot	:	C1+TC1
Time	:	90 Minutes	Max. Marks	:	50

Answer all Questions **Mark**

1. Consider an University with the following five departments: CSE, ECE, EEE, Civil & Mech. There are a total of 10 projectors, 12 printers, and 8 scanners available in the University. Each department has its own requirement on the above mentioned resources which is dynamic over time based on the demand. But, the maximum number of resources that each department can utilize at any point in time is restricted by the overall administrator and it is given below. **15**

Dept.	Projectors	Printers	Scanners
CSE	5	6	6
ECE	4	2	5
EEE	2	2	1
Civil	1	4	1
Mech.	3	3	2

At present, the CSE department is allocated with 3 projectors, 4 printer and 3 scanners. ECE department is allocated with 2 projectors. EEE department is allocated with 2 projectors and 1 printer. Civil department is allocated with 1 projector, 3 printers and 1 scanner, and the Mechanical department is allocated with 1 projector, 1 printers and 2 scanners.

i. Define the necessary matrix.(2 marks)

ii. At time T0, Ilustrate that the current allocation is safe or not by demonstrating an order in which the departments may be served. (5 marks)

ii. At time T1, If the CSE department requests for 2 printers and 1 scanners can the request be granted immediately? Justify your answer.(4 marks)

iii. At Time T2, If the Mech department requests for 1 printer and 1 scanner, will it be possible for the administrator to grant immediately? (4 marks)

2. Consider two processes P1 & P2 on a system. P2 has high priority over P1. Both P1 & P2 share a single memory address space. Assume Peterson's solution is used for providing mutual exclusive access to the shared memory space. The request for the shared resource by P1 and P2 should follow an order as P2 then P1. Modify the pseudo code of Peterson's solution to ensure process synchronization for the above-mentioned process execution order. **10**

3.		do { while (test_and_set(&lock)); /* do nothing */ /* critical section */ lock = false; /* remainder section */ } while (true); (i) Discuss whether the above code satisfies all the conditions required by synchronisation. Justify your answer.(2 mark) (ii) Do modification on the code if it is not satisfying the necessary conditions.(3 mark)	5
4.	(i)	Consider a main memory in the system with 8 partitions, where 4 partitions are already loaded with user processes and remaining four partitions are free. The memory map of the system is given below: 300 MB | 750 MB | 2000 MB | 1500 MB | 1000 MB | 2500 MB | 2800MB | 3500 MB The processes with different sizes have to be loaded into the main memory at Time T0 are given as (in order): 1550MB, 600MB, 2000MB, and 2750MB. Implement the partition allocation strategies for the given input and determine which strategy can optimally satisfy this requirements. Justify your answer with a proper explanation. At Time T1 ,new process make request of 2250 MB, 800 MB. Will it be allocated, if all the previous processes are utilising memory for the above mentioned memory map. Justify your answer for request at T1. For the above mentioned scenario in (a), will it cause fragmentation? Discuss a solution if fragmentation occurs. (7 marks) **Note:** the free partitions are 750MB, 1500MB, 2500MB and 3500MB and remaining partitions are in use by other processes.	10
	ii)	Consider a paging hardware with a TLB. Assume that the entire page table and all the pages are in the physical memory. It takes 20 milliseconds to search the TLB and 80 milliseconds to access the physical memory. If the TLB hit ratio is 80%, Calculate the effective memory access time (in milliseconds) (3 marks)	
5.	i)	If a process makes a memory request of 1560 MB, and main memory also contains free blocks sum to 1600 MB but not in contiguous way. Will this request by process accepted by the MMU of OS for execution? Justify your answer. (4 marks)	10
	ii)	Explain in detail with illustrative diagram, how the two memory access in look up mechanism of page table in paging address translation is effectively reduced by MMU of OS? (6 marks)	

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