

Final Assessment Test (FAT) – November/December 2022

Programme	M.Tech. (Integrated)	Semester	Fall Semester 2022-23
Course Title	OPERATING SYSTEMS	Course Code	SWE3001
Faculty Name	Prof. Renuka Devi S	Slot	C1+TC1
		Class Nbr	CH2022231000988
Time	3 Hours	Max. Marks	100

Part A (10 X 10 Marks)

Answer All questions

- Consider that you are designing an efficient operating system for a Smart TV. Demonstrate the critical hardware components and their interactions using a block diagram, explaining the functions of the various components and the default functionalities which your operating system should handle. [10]
- a. X is a program that resides in memory. It has to get executed by an operating system Y. Discuss in the point of Y, what are the states and necessary steps X should undergo for executing in main memory. Illustrate with neat diagram.(5 marks)
b. Write a program to create four processes (1 parent and 3 children) where they terminate in a sequence as follows: (5 marks)
 - Parent process terminates at last
 - First child terminates before parent and after second child.
 - Second child terminates after last and before first child.
 - Third child terminates first.
- Assume that there are 4 customers C1, C2, C3, and C4 arrives at 3 ms, 8 ms, 0 ms, 5 ms and are waiting in the queue at the help desk of a bank. Each customer takes 5ms, 3ms, 9ms and 4ms to complete their requests and have token numbers as 3, 1, 2, and 4 respectively.
Compute the average waiting time and average turnaround time using the appropriate algorithm with respect to the following scenario:
 - Allow the customers based on the minimum time taken to complete their requests first. (3 Marks)
 - Allow the customers based on their token numbers. (3 Marks)
 - Allow the customers to access the help desk counters evenly for 2 ms. (4 Marks)
- A reputed restaurant employs three people A, B and C to make the dish, and they share 5 chopping boards(R0), 6 knives(R1) and 5 bowls(R2) for cooking. At Time T1, three chefs are doing some dish and their current state of possessing and maximum requirement of culinary items are shown in the table below. [10]

Persons	Have			Maximum		
	R0	R1	R2	R0	R1	R2
A	2	0	2	5	1	2
B	0	3	1	1	5	1
C	1	1	2	1	3	3

(a) Will this allocation is safe to prepare the dish? Justify your answer. (5 Marks)

(b) Can a request by "A" for one more knife at T2 is possible? Justify your answer. (5 Marks)

5. Consider three concurrently running processes: P1 with a statement S1, P2 with a statement S2 and P3 with a statement S3. Suppose we require that S1 be executed only after S3 has completed and S2 be executed only after S1 has completed. Write pseudocode to implement this using semaphore and justify the execution of the code. [10]
6. Consider an Educational Institution consisting of 6 computer laboratories with the maximum capacity of 320, 610, 370, 200, 730 and 125 computers. Assume that five concurrent workshops are scheduled at the same time. The expected student strength of the five workshops are 115, 500, 358, 200 and 375. As a lab administrator, how will you allocate the laboratory? If suppose random allocation is made, how effective will the lab utilization be? [10]
7. Consider the following segment table: [10]

Segment	Base	Length
0	190	800
1	1750	126
2	60	120
3	2345	220
4	1876	30

Map the given physical addresses to the corresponding logical addresses?

- a. 1877
 - b. 183
 - c. 1910
 - d. 2407
 - e. 130
8. Consider the following page reference string: [10]
 7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1, 0, 5, 4, 6, 2, 3, 0, 1.
- Assuming demand paging with three frames, how many page faults would occur for the following replacement algorithms?
- a. LRU replacement (5 Marks)
 - b. FIFO replacement (5 Marks)
9. Suppose that a disk drive has 1,000 cylinders, numbered 0 to 999. The drive is currently serving a request at cylinder 431, and the previous request was at cylinder 361. The queue of pending requests, in FIFO order, is: [10]

413, 242, 459, 560, 108, 324, 70, 305, 993, 732

Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms?

- a. FCFS (5 Marks)
- b. SCAN (5 marks)

10. Consider the directory structures as given below:

[10]

Structure 1: (3 Marks)

File Name	Start	Length
W	3	1
X	6	5
Y	12	3
Z	19	4

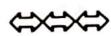
Structure 2: (3 Marks)

File Name	Start	End
W	3	12
X	22	45

Structure 3: (4 Marks)

File Name	Index	Other Blocks
X	9	17,12,43,39,2 3,34

Perform the file allocation methods for the given structures.



Final Assessment Test (FAT) - APRIL/MAY 2023

Programme	B.Tech	Semester	Winter Semester 2022-23
Course Title	OPERATING SYSTEMS	Course Code	BCSE303L
Faculty Name	Prof. Indra Priyadarshini S	Slot	F1+TF1
Time	3 Hours	Class Nbr	CH2022235000819
		Max. Marks	100

Section-A (8 X 10 Marks)
Answer All questions

01. SSS company is manufacturer of Smart medical diagnostic machine products. For this they want to design new customized operating system to incorporate SMART functionality specific to medical device, considering device memory is smaller compared to normal computer system. List the default functions to be supported by OS. Therefore suggest a good architecture which is suitable to build new OS and justify your answer [10]
02. Maths teacher has given you two integers to determine the highest digit in each integer and further she would like to add those two digits. Develop a C program using threads to accomplish the given task concurrently for the two numbers and return the highest digit for the two numbers and display the sum of the returned two highest digits in main(). [10]

Example:

Two numbers are a = 55687 b = 87934.

Highest digit of a = 8 and b = 9.

So the sum will be 8+9 = 17.

03. Redesign the readers-writers problem such that, writer is having higher priority than reader. A reader should start its read after two writers have completed their writing. The third writer has to wait until 5 readers have completed their reading. Use appropriate variables and write the pseudo-code or program for the above scenario using semaphores and justify your algorithm meets the properties of synchronisation. [10]
04. A process contains eight virtual pages on disk and is assigned a fixed allocation of three page frames in main memory. The following page trace occurs: 1, 0, 2, 2, 1, 7, 6, 7, 0, 1, 2, 0, 3, 0, 4 Remember that all frames are initially empty and the frame size is three. Calculate page hit ratio, page miss ratio and page faults for following algorithms. [10]
- i. Optimal page replacement algorithm.(4 marks)
 - ii. Second Chance page replacement algorithms and Comment on the efficiency of algorithms for the given frame size.(4 marks)
 - iii. Identify the algorithm which gives the minimum number of page faults and justify the same. [2 Marks]
05. a) Does Translation Lookaside Buffer (TLB) is used to reduce the time taken for logical to physical address translation?. Justify your answer with proper diagram.(5 Marks) [10]
- b) A process P1 uses TLB for 60% of its execution remaining 40% through page table. Memory access time is 30 nano seconds and TLB access time is 20 nano seconds. Calculate the Effective Access Time of the process P1. (2 Marks)

- c) Consider a logical address space of 128 pages of 1024 bytes mapped onto a physical memory of 256 frames. Calculate the number of bits required to represent logical and physical address. (3 Marks)
06. Assume that there exists 24 numbers of blocks available in the back store each of size 256 bytes. [10]
The list of files, the starting block from where it has to be allocated, with its size details are as follows:
- | File Name | Start | Size in bytes |
|-----------|-------|---------------|
| X | 2 | 856 |
| Y | 7 | 512 |
| C | 11 | 1316 |
| B | 18 | 148 |
| L | 21 | 420 |
- i. Illustrate with diagram the allocation of the files into the blocks specified using contiguous file allocation strategy with file allocation table. [3Marks]
- ii. Illustrate with diagram the allocation of the files into the blocks using indexed file allocation strategy by considering the index block as 9 for file C.[4 Marks].
- iii. Discuss the advantage and disadvantage of above mentioned file allocation strategies.(3 marks)
07. Suppose that a disk drive has 2000 cylinders, numbered 0 to 1999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in order as given below [10]
- 96, 1375, 973, 1797, 848, 1520, 1050, 1650, 230,110
- Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests using the following disk scheduling algorithms (Consider service from left to right)?
- a. SCAN b. LOOK algorithm.
08. a) As a virtualization expert, briefly elaborate different approaches to operating system virtualization. Discuss advantages and limitations. (5 marks)
- b) Online shopping website X would like to host web application on your customized Operating Systems. As an expert, analyse the security threats that are possible with respect to this application and provide the suggestions to enhance the security of the same. (5 marks)

Section-B (1 X 12 Marks) Answer All questions

09. Assume that 6 students S1, S2, ..., S6 are willing to practise basketball and the target is to place a shoot. To complete a shoot, a student will get a maximum of three chance. First chance is based on the arrival of a student, second chance is allowed when no one is waiting for their first chance. Third chance will be given to process based on their longest waiting time for their third chance. First chance allowed for 8 time units for maximum, second chance for 16 time units.Every student enters the stadium on their own time and they take an amount of time to place a shoot. Following table shows the arrival time and required practice time of each student. [12]

Student.No	Arrival Time Clock Time(A.M)	Practice Time Time units in Minutes
1	6.00	3
2	6.10	25
3	6.30	30
4	6.40	10
5	6.45	35
6	6.50	40

Illustrate with required diagram, identify the time at which each student has completed their practice and the time they have taken to wait for their turn to play. (12 Marks)

Section -C (1 X 8 Marks)

Answer All questions

10. Four different groups of family want to go trip on same time. All four groups require different set of vehicles to accomodate all their family members. They approached ABC travel agency for their arrangements. The travel agency has the following number of three different types of luxurious cars. (8 Marks)

[8]

Car Type A=10; Car Type B=8; Car Type C=11;

The maximum requirements of different types of cars and the allotted cars for varius groups are as follows:

	Max Cars Required			Alloted Cars		
	A	B	C	A	B	C
G1	8	6	8	4	2	3
G2	4	3	6	1	1	3
G3	7	7	4	2	3	2
G4	6	4	5	1	1	1

The travel agency wanted to work out the schedule plan to find the possibility of allotting available vehicle based on their trip plan. Initially travel agency allotted some cars to various groups to plan their schedule. Provide a solution to the travel agency to find a sechedule plan. Will that travel agency satisfied all 4 groups requirement? If not, how travel agency can solve this issue, Illustrate your solution in detail for this scenario.



Final Assessment Test - November 2016

Course: CSE2005 - Operating Systems

Class NBR(s): 1406 / 1409 / 1412 / 1415 / 1419 / 1423 / 1428 / 1433

Slot: C1

Time: Three Hours

Max. Marks: 100

PART – A (8 X 5 = 40 Marks)

Answer ALL Questions

1. a) State the main challenges that a programmer must overcome in writing an operating system for a real-time environment? [2]
b) How does the distinction between monitor mode and user mode function as a rudimentary form of protection system? [3]
2. Write a C program to create two POSIX threads. Let the first thread print all prime numbers from 1 to 100 and the second thread count the number of words in the file "one.txt".
3. A multithreaded web server wishes to keep track of the number of requests it services (known as *hits*). Consider the two following strategies to prevent a race condition on the variable *hits*. The first strategy is to use a basic mutex lock when updating *hits*:

```
int hits;  
mutex_lock hit_lock;  
hit_lock.acquire();  
hits++;  
hit_lock.release();
```

A second strategy is to use an atomic integer:

```
atomic_t hits;  
atomic inc(&hits);
```

Explain which of these two strategies is more efficient.

4. a) Given references to the following pages by a program. [2]
0,1,4,2,0, 2,6,5,1,2, 3,2,1,2,6, 2,1,3,6,2, 3, 4
What is the working set $W(t, \delta)$, with t equal to the time between the 13th and 14th references and δ equal to 5 references.
b) Let the page fault service time be 10ms in a computer with average memory access time being 20ns. If one page fault is generated for every 10^6 memory accesses, what is the effective access time for the memory? [3]
5. A system that uses a two-level page table has 2^{12} byte pages and 32 bit virtual addresses. The first 8 bits of the address serve as the index into the first-level page table.
 - a) How many bits specify the second-level index?
 - b) How many entries are in the level-one page table?
 - c) How many entries are in the level-two page table?
 - d) How many pages are in the virtual address space?
6. With reference to an example implementation, explain Para virtualization.
7. Describe Access Matrix with examples.
8. Brief on any two Mobile Operating System which are used extensively these days.

PART – B (6 X 10 = 60 Marks)**Answer any SIX Questions**

9. a) Describe three general methods for passing parameters to the operating system. [5]
 b) The Collatz conjecture concerns what happens when we take any positive integer n and apply the following algorithm: [5]
- $n = n/2$, if n is even (or)
 $3 \times n + 1$, if n is odd

The conjecture states that when this algorithm is continually applied, all positive integers will eventually reach 1. For example, if $n = 35$, the sequence is

35, 106, 53, 160, 80, 40, 20, 10, 5, 16, 8, 4, 2, 1

Write a C program using POSIX threads that generates this sequence in the child thread. The starting number has to be provided from the command line. For example, if 8 is passed as a parameter on the command line, the child thread has to output 8, 4, 2, 1. Let the parent join for the child to complete before exiting the program. Perform necessary error checking to ensure that a positive integer is passed on the command line.

10. a) Differentiate between Many-to-One and Many-to-Many multithreading models. [4]
 b) A system of processes exists as given in Table 1, with the length of the CPU burst time in Milliseconds. [6]

Process	Burst Time	Priority
P_1	10	3
P_2	2	4
P_3	4	3
P_4	2	1
P_5	5	2

Table 1: CPU Scheduling

The processes are assumed to have arrived in the order P_1, P_2, P_3, P_4 , and P_5 all at time 0.

- i. Draw four Gantt charts illustrating the execution of these processes using First-Come, First-Served, Shortest-Job-First, a non-preemptive Priority (a small priority number implies a higher priority) and Round-Robin (Quantum= 3) scheduling.
 - ii. Calculate the average Waiting Time and average Turn-Around Time for the above scheduling algorithms.
11. The operating system contains 4 resources, the No. of instances of each resource type are 4, 12, 10 and 7. The current resource allocation state is as shown below in the table 2.
- a) Is the current allocation in a safe state?
 - b) Can the request made by process P_1 (0, 3, 1, 0) be granted?
 - c) Give the safe process execution sequence and provide each stage "Available & Allocation" strategy.

Process	Allocation				Max			
	R ₁	R ₂	R ₃	R ₄	R ₁	R ₂	R ₃	R ₄
P_0	0	0	1	1	0	0	2	1
P_1	1	0	0	0	1	5	3	0
P_2	1	2	3	1	2	2	4	4
P_3	0	5	3	1	0	6	3	2
P_4	0	0	1	2	0	4	5	4

Table 2 : Resource Allocation

12. The Sleeping Barber problem is a classical inter-process communication and synchronization problem. Consider a hypothetical barber shop with one barber. The barber has one barber chair and a waiting room with a number of chairs in it. When the barber finishes cutting a customer's hair, he dismisses the customer and then goes to the waiting room to see if there are other customers waiting. If there are, he brings one of them back to the chair and cuts his or her hair. If there are no other customers waiting, he returns to his chair and sleeps in it.

Each customer, when he arrives, looks to see what the barber is doing. If the barber is sleeping, then he wakes him up and sits in the chair. If the barber is cutting hair, then he goes to the waiting room. If there is a free chair in the waiting room, he sits in it and waits his turn. If there is no free chair, then the customer leaves. On a naive analysis, the above description should ensure that the shop functions correctly, with the barber cutting hair of anyone who arrives until there are no more customers, and then sleeping until the next customer arrives.

Provide a solution to the Sleeping Barber problem using semaphores.

13. a) Assume a page reference string for a process with m frames (initially all empty). The page reference string has length p with n distinct page numbers occurring in it. For any page-replacement algorithms, what is a lower bound & an upper bound on the number of page faults? [2]
- b) Consider a demand-paging system with the following time-measured utilizations: CPU utilization - >20%, Paging disk->97.7%, Other I/O devices ->5%. Suggest mechanisms to improve CPU utilization [3]
- c) Discuss the parameters involved in estimating the cost of virtualization. [5]
14. Conceptualize the live migration of a running guest from one system to another.
15. Discuss the advantages and disadvantages of associating with remote file systems (stored on file servers) a set of failure semantics different from that associated with local file systems.
16. Suppose that a disk drive has 200 cylinders, numbered 0 to 199. Assume that the disk head starts at cylinder 100. The queue of pending requests, in FIFO order, is

23, 89, 132, 42, 187

Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests, for each of the following disk scheduling algorithms? Also assume the head is moving towards 0 in SCAN and Circular SCAN.

- a) First-Come, First-Served
- b) Shortest-Seek-Time-First
- c) SCAN
- d) Circular-SCAN





Reg. No. :

Final Assessment Test (FAT) - JUNE/JULY 2023

Programme	M.Tech.	Semester	Arrear - July - 2023
Course Title	OPERATING SYSTEMS	Course Code	MCSE504L
Faculty Name	Prof. Valarmathi Sudhakar	Slot	—
Time	3 Hours	Max. Marks	100

Part-A (10 X 10 Marks)

Answer All questions

01. (a) There are two major design types for operating system kernels: monolithic kernels and micro kernels. Which of these types better satisfies the following requirements? Justify your answers. [10]
(5 marks)
i) Conventional access to operating system data structures.
ii) Addition of new operating system components.
iii) Modification of operating system components.
iv) Security and reliability.
(b) Analyse the need of system calls. (3 marks)
(c) CPU needs a way to find out which devices need attention. Justify which of the following methods should be used: polling or interrupts? (2 marks)
02. A number is special if it is divisible (no remainder) by 5 and 7. Write a pseudo code using fork to check the numbers 450 and 675 are special or not. Do the following by creating processes (i) Invoke a child from parent (ii) Execute the above scenario from child (iii) Print the result from child. [10]
03. Consider that there are five clients who want to take up their legal opinion with an advocate. Each client consumes 20m, 10m, 17m, 15m and 25m respectively to consult the advocate. Based on the case filed, the clients are allowed to get legal opinion from the advocate in the following order: client 2, client 3, client 4, client 1, client 5. Draw the Gantt Chart for the above scenario and also calculate the waiting time , average waiting time, turn around time and average turn around time using the following scheduling algorithms. [10]
i) First come First serve
ii) Priority Scheduling
04. Three processes are involved in printing a file. Process A reads the file data from the disk to Buffer 1, Process B copies the data from Buffer 1 to Buffer 2, finally Process C takes the data from Buffer 2 and print it. Assume all three processes operate on one (file) record at a time, both buffers' capacity are one record. Write a program in C to coordinate the three processes using semaphores. [10]

05. Assume that there are 4 resources A, B, C and D. The snapshot of the system is given below.

[10]

	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	0	1	1	0	0	2	1	0	1	3	1	0
P1	1	4	4	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				

i) Is the system in a safe state? If yes find the safety sequence.

ii) If a request from process P0(0,1,0,0) arrives, can it be granted immediately?

06. A computer system employs a cache with the following hit ratio: 80% for write operation and 90% for read operation. Dynamic memory access time is 250ns and the cache memory access time is 28ns. Out of all memory references, 70% are read operations and 30% are write operations. Calculate the average access time for all references(both read and write), for the following two specifications of the system.

[10]

i) Write operation is write back and read is look through.

ii) Write operation is write through and read is look aside.

07. Consider the following reference string:

[10]

1,2,3,2,1,5,2,1,6,2,5,6,3,1,3,6,1,2,4,3

How many Page Miss would occur in the following page replacement algorithms, assuming three page frames which are initially empty.

(i) Least recently used

(ii) First in first out replacement

(iii) Optimal replacement

08. Suppose that a disk drive has 200 cylinders, numbered 0 to 199. Assume that the disk head starts at cylinder 50. The queue of pending requests, in FIFO order is

[10]

95,180,34,119,11,123,62,64

Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests, for each of the following disk scheduling algorithms? Also assume the head is moving towards 0 in SCAN and Circular SCAN.

(i) First come, First serve

(ii) Shortest seek time first

(iii) SCAN

(iv) Circular SCAN

09. In a software company, a team of developers is working on a typical software development process , which needs that each developer to develop the code for medial science applications and also test their code on different platforms. Their real time operating system must ensure that development, testing, security and deployment of the product works correctly and efficiently for all developers. Explain in detail about various issues in security methods provided by real time operating system.

[10]

10. Assume you a specialist at creating useful IT resources. Suggest a method for installing dozen of different machines (such as a server, storage device, network device, etc.) for different purposes on one piece of hardware. Explain about Paravirtualization and also compare it with any one type of hardware virtualization techniques with suitable sketch.

[10]



second review and display the team names in order of highest to lowest score by using a „C“

Patient_id	Arrival Time(Clock time)	Expected ConsultationTime (in minutes)
P1	6.04 pm	3
P2	6.02 pm	7
P3	6.03 pm	5
P4	6.00 pm	10
P5	6.05 pm	3

Give a pictorial representation of the sequence of patients being consulted by the Doctor for both the strategies.:

- a) Arrival time to the clinic.
- b) Expected shortest consultation time (considering with arrival time).

Which of the above mentioned strategies results in the minimum average waiting time and turnaround time ?

Final Assessment Test (FAT) - November/December 2023

Programme	B.Tech.	Semester	FALL SEMESTER 2023 - 24
Course Title	OPERATING SYSTEMS	Course Code	BCSE303L
Faculty Name	Prof. Shyamala L	Slot	C1+TC1
Time	3 Hours	Class Nbr	CH2023240100890
		Max. Marks	100

Part A (10 X 10 Marks)
Answer all questions

01. SSS company is manufacturer of Smart home appliance products. For this they want to design [10] new customized embedding operating system to incorporate SMART functionality specific to the devices. Which structure of OS will be more suitable for embedded systems? Justify your answer by elaborating the architecture of the chosen structure with proper diagram.
02. Maths teacher has given you two integers to determine the highest digit in each integer [10] and further she would like to add those two digits. Develop a C program using threads to accomplish the given task concurrently for the two numbers and return the highest digit for the two numbers and display the sum of the returned two highest digits in main().
- Example:
 Two numbers are a =55687 b = 87934.
 Highest digit of a = 8 and b = 9.
 So the sum will be 8+9 = 17 .
03. Assume that 5 students S1, S2, S3, S4 and S5 are willing to access Internet in a system. All came [10] to a lab at same time where only one system connected with Internet. S1 needs the system for 5ms, S2 for 3ms, S3 for 9ms, S4 for 4ms and S5 for 7ms for accessing the net. Allow them to access the system based on their given CGPA 8.2, 7.3, 8.5, 9.2 and 7.9 in order respectively. Find the average turnaround time and the average waiting time required to allow the students based on the following cases with proper required diagrams.
- CASE 1: Students with Higher CGPA should be allowed first. (5 Marks)
 CASE 2: Every student has to be allowed for a quantum period of 3ms evenly. (5 Marks)
04. A server runs establish function code to M number of connections based on client's request. For [10] example, a server may wish to have only N socket connections at any point in time though the requests is higher than N. As soon as N connections are made, the server will not accept another incoming connection until an existing connection is released. Identify the synchronization problem it depicts and device a mechanism to be used by the server to limit the number of concurrent connections for the clients. Write a pseudocode for the scenario and justify your code with proper explanation that the basic characteristics required for synchronization algorithm are satisfied by the code.
 (pesudo-code -6 Marks, Justification-4 Marks)
05. A system has 4 processes (P1,P2,P3,P4) and 4 allocatable resources(A,B,C,D). Total number of [10] resources it contained is given as A = 9, B = 8 , C = 6, and D= 4 . At Time T0, some resources are allocated to different processes. The maximum needs of processes and current allocation of

resources are as follows:

Maximum Matrix

Process Name	A	B	C	D
P1	3	3	3	2
P2	3	2	1	1
P3	1	3	3	2
P4	4	3	2	1

Allocation Matrix:

Process Name	A	B	C	D
P1	2	3	0	1
P2	2	1	1	0
P3	1	1	1	1
P4	1	2	1	0

- Find the safe sequence for executing the process with the available resource. If not identify a solution. [6 Marks]
- For the above safe sequence, at T1, process P2 requests 1, 1, 0, 0 as additional instance of A, B, C, D. Will the request be granted immediately? Explain it with a proper solution. [4 Marks]

06. a) Consider the following segment table:

[10]

Segment	Base	Length
0	190	500
1	1550	24
2	50	90
3	2327	480

Illustrate with diagram the address translation mechanism used in Operating System. (2 marks)

Also determine whether the below logical address requests are valid requests? If valid logical address requests, find the corresponding physical address of the request from the segment and offset value given in the table. (5 marks)

- (a) 0,730
- (b) 1, 10
- (c) 2,500
- (d) 3,400
- (e) 2,50

- b) In a system, main memory consists of 32 frames of 256KB. At Time T0, 3 processes P1= 10 pages, P2=8 pages, P3= 20 pages are to be executed. If demand paging is used, allocate the available frames to the 3 processes based on proportionality allocation. 2 frames will be considered as buffer. (3 Marks)

07. Assume that there exists 20 numbers of blocks available in the back store each of size 256 bytes. [10]

The list of files, the starting block from where it has to be allocated, with its size details are as follows:

File Name	Size in bytes
A	976
B	510
C	1050

i. Illustrate with clear diagram the allocation of the files into the blocks, where each block will take 15 bytes to store the pointer information and the remaining 241 bytes can be allocated with the file contents. Allocate the files into the blocks specified using linked file allocation strategy. [6 Marks]

iii. List the advantage and disadvantage of Linked list allocation.(4 Marks)

08. Consider a process with logical and physical address space of 1000 and 300 bytes respectively. [10]

Assume the pages are referenced by program in the given order 3,4,2,1,4,7,2,5,3,6,1,3 from left to right. Determine the number of frames required for the below given cases and apply LRU algorithm. Compare the page fault and analyse.

(i)The size of the frame (or page) is 100 bytes.(5 marks)

(ii) The size of the frame (or page) is 75 bytes. (5 Marks)

09. A small scale organisation consists of different physical servers with different working functional group. Each functional group requires different execution environment whereas some are legacy which need dedicated system. If they want that to consolidate the server, discuss the type of virtualization which is more suitable and justify your answer. [10]

10. Suppose that a disk drive has 150 cylinders. The drive is currently serving a request at cylinder 40, and the previous request was at cylinder 23. The queue of pending requests, in FIFO order, is [10]

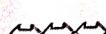
53, 28, 15, 46, 64, 88, 4, 10, 138, 92.

Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests using the following disk scheduling algorithms ?

i. LOOK (5 Marks)

ii. SCAN(5 Marks)

Note: Initially head is moving towards the end of the disk drive.



Final Assessment Test (FAT) - November/December 2023

Programme	B.Tech.	Semester	FALL SEMESTER 2023 - 24
Course Title	OPERATING SYSTEMS	Course Code	BCSE303L
Faculty Name	Prof. Kavitha J C	Slot	C2+TC2
Time	3 Hours	Max. Marks	100

PART-A (7 X 10 Marks)

Answer all questions

- Q1** (i) In the development of autonomous vehicles such as self-driving cars, embedded systems and critical infrastructure applications are the demanding requirements. Identify the most suitable architecture that helps the developers to create a responsive platform that can easily adapt to new hardware and remain secure in an environment where safety is paramount. Justify your answer with an appropriate example. (5 Marks)
- (ii) In the context of a data center or cloud computing environment, multiple applications and services are running on a shared pool of hardware resources. Identify an architecture that is suitable for such an environment that can efficiently manage and scale the resources based on their needs across a distributed infrastructure. Justify your answer with a suitable example. (5 Marks)

[10]

- Q2** (i) You are tasked with creating a program that simulates a scenario involving three processes. The first process, P1, serves as the parent process, and it creates a child process, P2. Subsequently, the second process, P2, also creates another child process, P3. As a result, the first process, P1, becomes the parent of P2, and P2 becomes the parent of P3.
- Write a C program that accomplishes the following tasks:
- Print the Process IDs (PIDs) of the parent and child for each process. (3 Marks)
 - Visualize the process hierarchy in the form of a tree structure. (2 Marks)
 - Justify your answer by explaining the process hierarchy. (1 Marks)

[10]

- (ii) Predict and explain the output of the following code when fork() is executed thrice. (4 Marks)

```
#include <stdio.h>
#include <sys/types.h>
int main()
{
    fork();
    fork();
    fork();
    printf("Child Process creation\n");
    return 0;
}
```

- Q3) The government's Public Distribution System distributes commodities to a special section of people in the society with subsidies. To improve this service, authorities want to update the commodities distribution process by maintaining two separate queues rather than a conventional single queue. The first queue is for the items with a unit price of greater than Rs.10 whereas the second queue is for other items. The unit price of the item is as follows: Rice – Rs.8, Sugar – Rs.14, Wheat – Rs.7.50 and Kerosene – Rs.14.20. Both queues are sorted based on the people's age and distribution service is carried out in a circular manner with 5 minutes and 10 minutes service time for queue1 and queue2 respectively. Consider the following services on some specific day and find the answer to the listed questions; [10]

Person_ID	Item_Name	Age	Arrival Time	Service_Time (in Minutes)
1	Rice	34	8 am	10
2	Sugar	52	8 am	5
3	Wheat	63	8 am	12
4	Rice	40	8.30 am	22
5	Sugar	25	8.30 am	6
6	Kerosene	19	8.30 am	10
7	Sugar	68	9 am	11

- (i) Draw Queue1 and Queue2 with the person ID at the time of commodities distribution (2 Marks)
- (ii) Find the name of the suitable CPU scheduling algorithm to implement this scenario and draw the Gantt chart to solve this problem (5 Marks)
- (iii) Calculate the waiting time and turnaround time for every process and the average waiting time and turnaround time of Queue1 and Queue2 (3 Marks)

- Q4) TechSoft IT Industry runs the project P1, P2, P3, P4 and P5. Total employees of an Industry are as follows under different designations; Analyst (R1)-5, Software Architect (R2) – 3, Tester (R3) – 6, Developer (R4) – 20. Each project has its own maximum manpower requirement under different designations in the following order R1, R2, R3 and R4 (Project P1 requests (2,2,1,8), P2 requests (1,1,1,10), P3 requests (2,1,5,15), P4 requests (1,2,4,12) and P5 requests (1,1,1,3) in each designation as per the above order.) Consider, the following manpower is already allocated to P1 (100%, 50%, 0%, 50%), P2(0%,100%,0%,80%), P3(100%,0%,33%,10%), P4(0%,50%,75%,20%) and P5(0%,0%,0%,67%) at time T1. [10] 25%

Answer the following questions using the banker's algorithm:

- (i) What is the content of the Available vector and Need matrix? (2 Marks)
- (ii) Is the current working condition of an Industry in a safe state to execute different projects without any additional requirements? Then what is the safe project execution order? Explain in detail the proper steps to solve this problem. (6 Marks)
- (iii) If there is an additional manpower request by Project 3 (1, 2, 1, 6) along with the existing setup, can the request be granted immediately by the software project management team? Explain in detail the necessary steps. (2 Marks)

- Q5. (i) Assume yourself to be a database administrator for a retail company managing a large inventory of products and customer data. The company has been facing data access and retrieval challenges and you have been assigned with the task of improving the data access methods. In [10]

the context of your role as database administrator describe the various data access methods and explain the advantages and limitations of each approach. (5 Marks)

(ii) The company's data storage needs have increased significantly and you need to reevaluate and reorganize the structure for managing the project files and customer-related data. Considering the company's specific description of when and why you would choose an appropriate structure for migrating or reorganizing the existing data to the chosen structure. Explain the advantages of each approach with respect to ease of organization, access speed and scalability. (5 Marks)

Q6. Consider the following concurrent program:

[10]

```
int total;
void updateTotal()
{
    for (int i = 1; i <= 30; i++) {
        total = total + 2;
    }
}
int main()
{
    total = 0;
    parbegin //start of a parallel execution block
        updateTotal();
        updateTotal();
    parenend; // end of the parallel execution block
    cout << "The final value of 'total' is: " << total << endl;
}
```

The statements inside the parbegin/parenend block are executed concurrently.

(i) Determine the lower bound and upper bound on the final value of the variable 'total' when this concurrent program is executed with interleaving and without interleaving? (4 Marks)

(ii) Show how you would use semaphores to modify the program above so that the final value in the variable count is always the upper bound determined in part (i). (6 Marks)

Q7. (i) Imagine a computer system controlling a robotic arm in a smart factory. The robotic arm is equipped with a disk drive, and it needs to perform tasks by reading and writing data stored on the disk. The robotic arm must efficiently access data to complete tasks promptly. The factory's disk drive has 4,000 cylinders, numbered from 0 to 3,999 and the robotic arm needs to access data at various cylinder positions. The robot arm has a list of tasks with the following positions for data access:

1045 750 932 878 1365 1787 1245 664 1678 1897

[10]

Suppose the current position of the robotic arm is at cylinder 1167, and the previous task was completed at cylinder 1250. Calculate the total distance (in cylinders) that the robotic arm would move using the algorithm known for its ability to reduce access time and promptly handle the closest requests. (6 Marks)

(ii) Consider a disk with a sector size of 512 bytes, 50 sectors per track, 2000 tracks per surface and five double-sided platters (i.e. 10 surfaces). The disk platters rotate at 5400 rpm. The average seek time is 10 msec. A block size is chosen as 1024 bytes. A file containing 100,000 records of

100 bytes each is to be stored on this disk, and no record is allowed to span two blocks. Calculate the rotational latency of the disk. (4 Marks)

PART -B (2 X 15 Marks)

Answer all questions

08. You are responsible for developing a multi-threaded inventory management system for a large retail store. This system handles the inventory of various products, manages stock levels, and processes both customer orders and restocking requests. The inventory database is shared among multiple threads. [15]

(i) Illustrate how the lock-based mechanism ensures that only one thread can modify the stock level of a specific product at a time. Provide relevant code snippets to support your explanation. (5 Marks)

(ii) Outline the strategies you have implemented to ensure that threads handling customer orders and restocking requests can make progress without leading to conflicts or resource contention. Support your explanation with code examples. (5 Marks)

(iii) Discuss the methodology employed to prevent thread starvation in the inventory management system, ensuring that all products and inventory operations are treated fairly. Provide code snippets to substantiate your approach. (5 Marks)

09. (i) Given six empty car parking areas of 500 ft, 600 ft, 280 ft, 700 ft, 1500 ft and 100 ft in the commercial building. How would the first-fit, best-fit, and worst-fit algorithms place the different model cars with sizes 300 ft, 650 ft, 800 ft, 1000 ft, and 200 ft? Rank the algorithms in terms of how efficiently they use empty car spaces for different-sized cars. Draw the necessary diagrams for each algorithm. Identify the number of cars that can be parked within the given parking space. Identify the number of ft that are wasted under each algorithm after the space allocation to cars under internal and external fragmentation. Find the details of the car that cannot find the parking space under all algorithms. (6 Marks) [15]

Note: ft - Square Feet

(ii) A team plays a game with 3 players. The team can replace any one active player with a substitute player under unavoidable situations in the game.

The substitute players' entry order in the game as per the gaming strategy is as given with their jersey number:

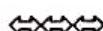
200, 300, 400 / 500, 300, 100 / 200, 300, 600 / 200, 400, 500, 800 / 700, 600, 300, 400, 500, 800, 600

Apply the following page replacement algorithm to find the number of Page Faults. Which page replacement algorithm is best for the given application scenario?

(a) LRU (2 Marks)

(b) Optimal replacement (3 Marks)

? (c) Apply LRU and Optimal with 6 as the maximum number of players in the game. Find an appropriate number of frames as per the generated page fault. (4 Marks)



Final Assessment Test (FAT) - November/December 2023

Programme	B.Tech.	Semester	FALL SEMESTER 2023 - 24
Course Title	OPERATING SYSTEMS	Course Code	BCSE303L
Faculty Name	Prof. Shyamala L	Slot	C1+TC1
Time	3 Hours	Class Nbr	CH2023240100890
		Max. Marks	100

Part A (10 X 10 Marks)

Answer all questions

01. SSS company is manufacturer of Smart home appliance products. For this they want to design new customized embedding operating system to incorporate SMART functionality specific to the devices. Which structure of OS will be more suitable for embedded systems? Justify your answer by elaborating the architecture of the chosen structure with proper diagram. [10]
02. Maths teacher has given you two integers to determine the highest digit in each integer and further she would like to add those two digits. Develop a C program using threads to accomplish the given task concurrently for the two numbers and return the highest digit for the two numbers and display the sum of the returned two highest digits in main(). [10]
- Example:
 Two numbers are a =55687 b = 87934.
 Highest digit of a = 8 and b = 9.
 So the sum will be 8+9 = 17 .
03. Assume that 5 students S1, S2, S3, S4 and S5 are willing to access Internet in a system. All came to a lab at same time where only one system connected with Internet. S1 needs the system for 5ms, S2 for 3ms, S3 for 9ms, S4 for 4ms and S5 for 7ms for accessing the net. Allow them to access the system based on their given CGPA 8.2, 7.3, 8.5, 9.2 and 7.9 in order respectively. Find the average turnaround time and the average waiting time required to allow the students based on the following cases with proper required diagrams. [10]
- CASE 1: Students with Higher CGPA should be allowed first. (5 Marks)
 CASE 2: Every student has to be allowed for a quantum period of 3ms evenly. (5 Marks)
04. A server runs establish function code to M number of connections based on client's request. For example, a server may wish to have only N socket connections at any point in time though the requests is higher than N. As soon as N connections are made, the server will not accept another incoming connection until an existing connection is released. Identify the synchronization problem it depicts and device a mechanism to be used by the server to limit the number of concurrent connections for the clients. Write a pseudocode for the scenario and justify your code with proper explanation that the basic characteristics required for synchronization algorithm are satisfied by the code. [10]
- (pesudo-code -6 Marks, Justification-4 Marks)
05. A system has 4 processes (P1,P2,P3,P4) and 4 allocatable resources(A,B,C,D). Total number of resources it contained is given as A = 9, B = 8 , C = 6, and D= 4 . At Time T0, some resources are allocated to different processes. The maximum needs of processes and current allocation of

resources are as follows:

Maximum Matrix

Process Name	A	B	C	D
P1	3	3	3	2
P2	3	2	1	1
P3	1	3	3	2
P4	4	3	2	1

Allocation Matrix:

Process Name	A	B	C	D
P1	2	3	0	1
P2	2	1	1	0
P3	1	1	1	1
P4	1	2	1	0

i. Find the safe sequence for executing the process with the available resource. If not identify a solution. [6 Marks]

ii. For the above safe sequence, at T1, process P2 requests 1, 1, 0, 0 as additional instance of A, B, C, D. Will the request be granted immediately? Explain it with a proper solution. [4 Marks]

06. a) Consider the following segment table:

[10]

Segment	Base	Length
0	190	500
1	1550	24
2	50	90
3	2327	480

Illustrate with diagram the address translation mechanism used in Operating System.(2 marks)

Also determine whether the below logical address requests are valid request?. If valid logical address requests, find the corresponding physical address of the request from the segment and offset value given in the table.(5 marks)

- (a) 0,730
- (b) 1, 10
- (c) 2,500
- (d) 3,400
- (e) 2,50

b) In a system, main memory consists of 32 frames of 256KB. At Time T0, 3 processes P1= 10 pages, P2=8 pages, P3= 20 pages are to be executed. If demand paging is used, allocate the available frames to the 3 processes based on proportionality allocation. 2 frames will be considered as buffer.(3 Marks)

07. Assume that there exists 20 numbers of blocks available in the back store each of size 256 bytes. [10]
The list of files, the starting block from where it has to be allocated, with its size details are as follows:

File Name	Size in bytes
A	976
B	510
C	1050

i. Illustrate with clear diagram the allocation of the files into the blocks, where each block will take 15 bytes to store the pointer information and the remaining 241 bytes can be allocated with the file contents. Allocate the files into the blocks specified using linked file allocation strategy. [6 Marks]

iii. List the advantage and disadvantage of Linked list allocation.(4 Marks)

08. Consider a process with logical and physical address space of 1000 and 300 bytes respectively. [10]
Assume the pages are referenced by program in the given order 3,4,2,1,4,7,2,5,3,6,1,3 from left to right. Determine the number of frames required for the below given cases and apply LRU algorithm. Compare the page fault and analyse.

(i) The size of the frame (or page) is 100 bytes. (5 marks)
(ii) The size of the frame (or page) is 75 bytes. (5 Marks)

09. A small scale organisation consists of different physical servers with different working functional group. Each functional group requires different execution environment whereas some are legacy which need dedicated system. If they want that to consolidate the server, discuss the type of virtualization which is more suitable and justify your answer. [10]

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Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests using the following disk scheduling algorithms ?

- i. LOOK (5 Marks)
- ii. SCAN(5 Marks)

Note: Initially head is moving towards the end of the disk drive.

