SRM Institute of Science and Technology
College of Engineering and Technology
School of Computing

SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu **SET-1 ANSWER KEY**

Test: CLA-T1 Date: 28-Mar-2023 Course Code & Title: 18CSC205J & Operating Systems Duration: 2 Hours **Year & Sem: II Year / V Sem Max. Marks:** 50

Course Articulation Matrix: ***(to be placed)***

S.No.	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	CO1	3		3									
2	CO2	2	1	3									
3	CO3	3	2	2									
4	CO4	3	2	2									
5	CO5	3		2	2								

Qno	**Question**	**Marks**
1	a. Elaborate the concept of Semaphores. A counting semaphore S is initialized to 9. Then, 22 wait() operations and 17 signal() operations are performed on S. What is the final value of S? **<u>Solution:</u>** P operation also called as wait operation decrements the value of semaphore variable by 1. V operation also called as signal operation increments the value of semaphore variable by 1. Thus, Final value of semaphore variable S = 9 – (22 x 1) + (17 x 1) = 9 – 22 + 17 = **4** b. Explain why spinlocks are not appropriate for single-processor systems yet are often used in multiprocessor systems. **<u>Solution:</u>** 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 therefore can modify the program state in order to release the first process from the spinlock.	**5** **5**

2	Five batch jobs, A through E, arrive at a computer center at essentially the same time. They have an estimated running time of 15, 9, 3, 6, and 12 minutes, respectively. Their (externally defined) priorities are 6, 3, 7, 9, and 4, respectively, with a lower value corresponding to a higher priority. For each of the following scheduling algorithms, determine the turnaround time for each process and the average turnaround for all jobs. Ignore process switching overhead. Explain how you arrived at your answers. a. Round Robin with a time quantum of 1 minute b. Priority Scheduling **Solution:** **a. round robin with a time quantum of 1 minute** Sequence with which processes will get **1 minute** of processor time: 1 2 3 4 5 Elapsed Time A B C D E 5 A B C D E 10 A B C D E 15 A B D E 19 A B D E 23 A B D E 27 A B E 30 A B E 33	**10**

A B E 36
A E 38
A E 40
A E 42
A 43
A 44
A 45

Turnaround Time:

Turnaround Time for each Process:
A = 45 min; B = 35 min; C = 13 min; D = 26 min; E = 42 min
Average turnaround time is = (45 + 35 + 13 + 26 + 42) / 5 = **32.2 min**

b. priority scheduling

Priority Job Turnaround Time
3 B 9
4 E 9 + 12 = 21
6 A 21 + 15 = 36
7 C 36 + 3 = 39
9 D 39 + 6 = 45

Average Turnaround Time: (9 + 21 + 36 + 39 + 45) / 5 = **30 min**

c. FCFS (run in order 15, 9, 3, 6, and 12)

Job Turnaround Time
B 15
E 15 + 9 = 24
A 24 + 3 = 27
C 27 + 6 = 33
D 33 + 12 = 45

Average Turnaround Time: (15 + 24 + 27 + 33 + 45) / 5 = **28.8 min**

d. shortest job first

Running
Job Turnaround Time
Time
3 C 3
6 D 3 + 6 = 9
9 B 9 + 9 = 18
12 E 18 + 12 = 30
15 A 30 + 15 = 45

Average Turnaround Time: (3 + 9 + 18 + 30 + 45) / 5 = **21 min**

3

a. The system has 6 processes entering in a ready queue with the time interval of 2ms starts with 2ms respectively. The running time of the process and the priority is given in the table below. Draw the gantt chart and find average waiting time and average turn-around time for the Priority Scheduling.

5

Process ID Arrival

Burst

Priority

Time

Time

P1 2 4 1(low)
P2 4 2 2
P3 6 5 5
P4 8 1 3
P5 10 4 6(high)
P6 12 6 4

Solution:

Gantt Chart:

P1 P2 P3 P5 P3 P6 P4 P1 **2 4 6 10 14 15 21 22 24**

5

Process Arrival

Burst Time Waiting

Completed

TAT

Time

Time

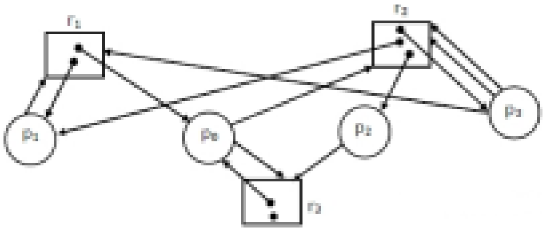
Time

P1 2 4 18 24 22 P2 4 2 0 6 2 P3 6 5 4 15 9 P4 8 1 13 22 14 P5 10 4 0 14 4 P6

12 6 3 21 9 **38 60**

Average Waiting Time: 38/6 =6.33ms
Average TAT: 60/6 = 10ms

b. Consider the resource allocation graph given in the figure.



Check whether the system is in safe state and also find the sequence if the system is safe.

Solution:

Yes, The system is in safe state.
Safe sequence -> P2 - P0 - P1 - P3

4

An operating system uses the banker's algorithm for deadlock avoidance when managing the allocation of three resource types X, Y and Z to three processes P0, P1 and P2. The table given below presents the current system state.

Allocation Maximum

X Y Z X Y Z

P0 0 0 1 8 4 3

P1 3 2 0 6 2 0

P2 2 1 1 3 3 3

The available resources of (X,Y.Z) are (3,2,2). The system is currently in safe state. Check the following independent requests for additional resources in the current state can be granted or not? Also give the modified data structures if the request can be granted.

(i) P0 requests (0,0,2) for the resources of (X,Y,Z)

(ii) P1 requests (2,0,0) for the resources of (X,Y,Z)

Solution:

Only (ii) can be permitted.

If the request REQ1 is permitted, the state would become :

10

	AVAILABLE	X=3, Y=2, Z=0	
	MAX	ALLOCATION	NEED
	X Y Z	X Y Z	X Y Z
P0	8 4 3	0 0 3	8 4 0
P1	6 2 0	3 2 0	3 0 0
P2	3 3 3	2 1 1	1 2 2

Now, with the current availability, we can service the need of P1. The state would become :

	AVAILABLE	X=6, Y=4, Z=0	
	MAX	ALLOCATION	NEED
	X Y Z	X Y Z	X Y Z
P0	8 4 3	0 0 3	8 4 0
P1	6 2 0	3 2 0	0 0 0
P2	3 3 3	2 1 1	1 2 2

With the resulting availability, it would not be possible to service the need of either P0 or P2, owing to lack of Z resource.
Therefore, the system would be in a deadlock.
⇒ We cannot permit REQ1.

Now, at the given safe state, if we accept REQ2 :

	AVAILABLE	X=1, Y=2, Z=2	
	MAX	ALLOCATION	NEED
	X Y Z	X Y Z	X Y Z
P0	8 4 3	0 0 1	8 4 2
P1	6 2 0	5 2 0	1 0 0
P2	3 3 3	2 1 1	1 2 2

With this availability, we service P1 (P2 can also be serviced). So, the state is :

AVAILABLE X=6, Y=4, Z=2

MAX ALLOCATION NEED

X Y Z X Y Z X Y Z

P0 8 4 3 0 0 1 8 4 2

P1 6 2 0 5 2 0 0 0 0

P2 3 3 3 2 1 1 1 2 2

With the current availability, we service P2. The state becomes :

AVAILABLE X=8, Y=5, Z=3

MAX ALLOCATION NEED

X Y Z X Y Z X Y Z

P0 8 4 3 0 0 1 8 4 2

P1 6 2 0 5 2 0 0 0 0

P2 3 3 3 2 1 1 0 0 0

Finally, we service P0. The state now becomes :

AVAILABLE X=8, Y=5, Z=4

MAX ALLOCATION NEED

X Y Z X Y Z X Y Z

P0 8 4 3 0 0 1 0 0 0

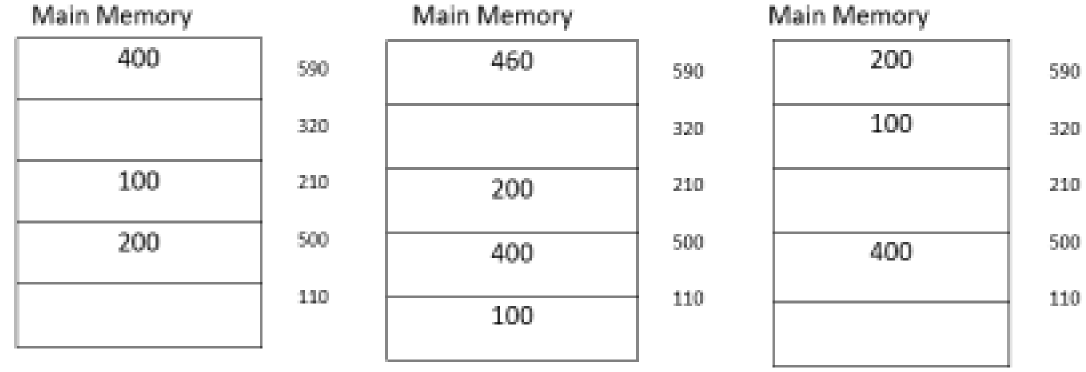
P1 6 2 0 5 2 0 0 0 0

P2 3 3 3 2 1 1 0 0 0

The state so obtained is a safe state. ⇒ REQ2 can be permitted.
So, only REQ2 can be permitted.

5	a. Given 5 Partitioning of 110KB, 500KB, 210KB, 320KB, 590KB, find the first fit; best fit and worst fit for the following processors as, 200KB, 400KB, 100KB, 460KB and also give proper explanation on first fit, best fit and worst fit how the memory allocation is performed on 5 partitioning in the main memory? Main Memory	**5**

Solution: (5M)



First Fit (460 will be waiting)

Best Fit

Worst Fit (460 will be waiting)

b. Explanation on how first fit, best fit and worst fit perform memory allocation in the main memory?

- Explanation of how memory given in the question is allocated to first fit; best fit and worst fit algorithm in the main memory.
- Explanation of how starvation occurs.

5

6 a. Consider the following page table entries. 5

Page No	Frame No
0	412
1	454
2	530
3	574

Calculate the physical addresses for the following logical addresses.

(i) 1,256
(ii) 4,112
(iii) 3,101
(iv) 0,774
(v) 2,220

Solution: 5

The logical address has page number and offset. Frame number can be identified from page table using page number. Then Frame number and page offset will be concatenated to find the physical address. (i) 1,256 Frame no. for page 1 is 454, The page offset is 256. So the physical address is 454256 (ii) 4,112 Page number 4 has no entry in page table. So the logical address is invalid (iii) 3,101 Physical Address is 574101

(iv) 0,774 Physical Address is 412774

(v) 2,220 Physical Address is 530220

b. In a paging scheme, virtual address space is 256 GB and page table entry size is 32 bytes. What should be the optimal page size?

Solution

Given-

- Virtual address space = Process size = 256 GB
- Page table entry size = 32 bytes

We know

Optimal page size

$= (2 \text{ x Process size x Page table entry size})^{1/2}$

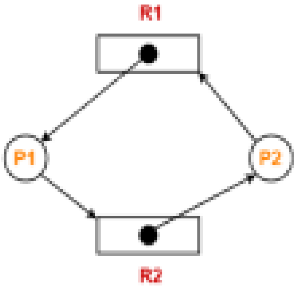
$= (2 \text{ x } 256 \text{ GB x } 32 \text{ bytes})^{1/2}$

$= (2^{44} \text{ bytes x bytes})^{1/2}$

$= 2^{22}$ bytes

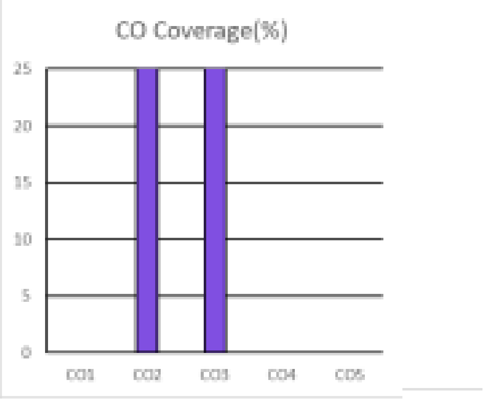
= 4 MB

Thus, Optimal page size = 4 MB.

7	a) Explain the process of translating the logical address to physical address in Paging. **Solution:** Logical addresses refer to the addresses seen by the user whereas physical addresses are the addresses seen by the main memory. Logical addresses are generated in the CPU while physical addresses are seen by the main memory. Virtual memory is used to translate logical addresses to physical addresses. This is what paging is all about. Paging allows us to divide the physical memory into pages and then divide the logical memory into page frames of equal size. This way, a portion of physical memory or page is mapped to each page frame. This mapping is done with the help of page tables. b) Consider the resource allocation graph in the figure. Find if the system is in a deadlock state otherwise find a safe sequence.  **<u>Solution</u>** The given resource allocation graph is single instance with a cycle contained in it. Thus, the system is definitely in a deadlock state.	**5** **5**

***Program Indicators are available separately for Computer Science and Engineering in AICTE examination reforms policy.**

Course Outcome (CO) and Bloom’s level (BL) Coverage in Questions



Approved by the Audit Professor/Course Coordinator