Semester: .7th.....

Programme: B.Tech.....

Branch/Specialization:

AUTUMN END SEMESTER EXAMINATION-2022

7th Semester, B. Tech Course

SUBJECT: OPERATING SYSTEM

CODE:CS2002

(For 2019 Admitted Batches)

Time: 2 Hours **Full Marks: 50**

KIIT Deemed to be University
End Semester Examination(Autumn Semester-2022)

SECTION-A(Answer All Questions. Each question carries 2 Marks)

Time:30 Minutes **(7×2=14 Marks)**

Question No	Question Type(MCQ/SAT)	Question	CO Mapping	Answer Key (For MCQ Questions only)
Q.No:1	Which of the following is a valid process state transitions? a) Ready – Ready b) Ready – Waiting c) Waiting – Ready d) Waiting – Running	Question - 1 on concept D1	CO1	c
	Which of the following is an invalid process state transitions? a) Ready – New b) Ready – Waiting c) Waiting – Running d) All of the above	Question - 2 on concept 1	CO1	d
	CPU scheduler involves the following queue a) Device queue b) Ready queue c) Both of above d) None of above	Question - 3 on concept 1	CO1	b
	Mid-term scheduler involves the following transition a) Ready-Running b) Running-Waiting c) Both of above d) None of above	Question - 4 on concept 1	CO1	d
		Question -		

Q.No:2	Select the incorrect option regarding Process synchronization: (A) Busy waiting cycles reduces the productivity of the processor (B) Binary semaphore behave similar to the mutex lock (C) Semaphores can also be used for resources handling (D) Application of semaphore can never result in timing error	1 on concept 2	CO2	D
	Select the correct option regarding Process synchronization: (A) Busy waiting cycles increases the productivity of the processor (B) Binary semaphore behave similar to the mutex lock (C) Application of semaphore can never result in timing error (D) Semaphores cannot be used for resources handling	Question - 2 on concept 2	CO2	B
	Select the correct option regarding Process synchronization: (A) Monitor construct ensures that only one process at a time is active within the monitor (B) Spinlock has a disadvantages of having too much context switching during a process must wait on a lock (C) Spinlocks are useful when locks are expected to be held for long times (D) The representation of Monitor type can be used directly by various processes	Question - 3 on concept 2	CO2	A
	Select the incorrect option regarding Process synchronization: (A) The representation of Monitor type cannot be used directly by various processes (B) Spinlock has a disadvantages of having too much context switching during a process must wait on a lock (C) Monitor construct ensures that only one process at a time is active within the monitor (D) Spinlocks are useful when locks are expected to be held for short times	Question - 4 on concept 2	CO2	B
Q.No:3	Given a Resource allocation graph (RAG) with multiple instance multiple resources, choose the correct statement: a) A cycle in RAG guarantees deadlock. b) A cycle in RAG means no deadlock. c) A cycle in RAG may or may not guarantee deadlock. d) Absence of cycle may guarantee no deadlock.	Question - 1 on concept 3	CO4	c
		Question - 2 on concept 3	CO4	a

	Given a Resource allocation graph (RAG) with single instance multiple resources, choose the correct statement: a) A cycle in RAG guarantees deadlock. b) A cycle in RAG means no deadlock. c) A cycle in RAG may or may not guarantee deadlock. d) Absence of cycle may guarantee no deadlock.			
	Given a Resource allocation graph (RAG) 'm' resource types and 'n' processes, choose the correct statement: a) RAG algorithm is more efficient than Banker's algorithm by a factor of 'm'. b) RAG algorithm is more efficient than Banker's algorithm by a factor of '1/m' types. c) RAG algorithm is more efficient than Banker's algorithm by a factor of 'm/n^2'. d) RAG algorithm is more efficient than Banker's algorithm by a factor of 'n^2/m'.	Question - 3 on concept 3	CO4	a
	Given a Wait for graph (WFG) 'm' resource types and 'n' processes, choose the correct statement: a) WFG algorithm is more efficient than Deadlock detection algorithm by a factor of '1/m'. b) WFG algorithm is more efficient than Deadlock detection algorithm by a factor of 'm'. c) WFG algorithm is more efficient than Deadlock detection algorithm by a factor of 'n^2/m'. d) WFG algorithm is more efficient than Deadlock detection algorithm by a factor of 'm/n^2'.	Question - 4 on concept 3	CO4	b
Q.No:4	The arrival and burst times of three processes P0, P1, and P2, are given in the following table. Process Arrival time(ms) Burst Time(ms) P0 0 9 P1 1 4 P2 4 7 The algorithm employed is the pre-emptive shortest job first scheduling. Scheduling is performed only at the arrival of the processes. What is the average waiting time for the three processes? A. 5.33 ms B. 4.66 ms C. 4.33 ms	Question - 1 on concept 4	CO3	E

	D. 6.33 ms E. None of the above			
	Consider four processes, which require 10, 5, 8 and 6 time units and arrive at times 0, 4, 6 and 10, respectively. If the operating system uses a shortest remaining time first scheduling technique, how many context changes are required? Do not count the context switches at time zero and at the end. **(A)** 2 **(B)** 3 **(C)** 4 **(D)** 6 **(E)** None of the above	Question - 2 on concept 4	CO3	C
	An operating system uses shortest remaining time first scheduling algorithm for pre-emptive scheduling of processes. Consider the following set of processes with their arrival times and CPU burst times (in milliseconds). The average waiting time (in milliseconds) of the processes is _____. Process Arrival time(ms) Burst Time(ms) P0 0 12 P1 2 4 P2 3 6 A. 5.33 ms B. 4.66 ms C. 4.33ms D. 6.33 ms E. None of the above	Question - 3 on concept 4	CO3	C
	Assume that each process requires 2 seconds of service time in a single-processor system. If new processes are arriving at the rate of 40 processes per two minutes, then calculate the CPU idle rate? **(A)** 50% **(B)** 30% **(C)** 33.33% **(D)** 66.66% **(E)** None of the above	Question - 4 on concept 4	CO3	C
		Question -		

Q.No:5	Which module gives control of the CPU to the process selected by the short-term scheduler? a) dispatcher b) interrupt c) scheduler d) none of the mentioned	1 on concept 5	CO4	a
	The processes that are residing in main memory and are ready and waiting to execute are kept on a list called _____ a) job queue b) ready queue c) execution queue d) process queue	Question - 2 on concept 5	CO4	b
	The interval from the time of submission of a process to the time of completion is termed as _____ a) waiting time b) turnaround time c) response time d) throughput	Question - 3 on concept 5	CO4	b
	Which of the following transition relates to non-preemption a) Running-Ready b) Running-Waiting c) Ready-Running d) Waiting-Ready	Question - 4 on concept 5	CO4	b,c,d
Q.No:6	Which of the following condition is required for a deadlock to be possible? a) mutual exclusion b) a process may hold allocated resources while awaiting assignment of other resources c) no resource can be forcibly removed from a process holding it d) all of the mentioned	Question - 1 on concept 6	CO5	d
	A system is in the safe state if _____ a) the system can allocate resources to each process in some order and still avoid a deadlock b) there exist a safe sequence c) all of the mentioned d) none of the mentioned	Question - 2 on concept 6	CO5	a
	Which one of the following is the deadlock avoidance algorithm? a) banker's algorithm b) round-robin algorithm c) elevator algorithm	Question - 3 on concept 6	CO5	a

	d) karn's algorithm			
	Which one of the following is a visual (mathematical) way to determine the deadlock occurrence? a) resource allocation graph b) starvation graph c) inversion graph d) none of the mentioned	Question - 4 on concept 6	CO5	a
Q.No:7	Given a logical memory of size 16KB and page size of 4B. If the physical memory has a total of 8 bits, (assume byte addressable memory), choose the most appropriate option: a) Data insufficient b) 64 frames, 256B RAM, 12 page table entries c) 64 frames, 256B RAM d) 64 frames, 256B RAM, 256 KB page table size e) Address mapping not possible	Question - 1 on concept 7	CO6/CO7	c
	Perform FIFO with the following page sequence: 7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1, 2, 0, 1, 7, 0, 1 having a frame size of 3. The number of page faults: a) 15 b) 11 c) 13 d) 10	Question - 2 on concept 7	CO6/CO7	a
	Given a logical memory of size x KB and page size of 4B. If the size of physical memory and that of page table is 256B (assume byte addressable memory), choose the most appropriate option: a) No. Of pages is 4K b) Size of logical memory is 16KB c) Data insufficient d) Both (a), (b)	Question - 3 on concept 7	CO6/CO7	a,b,c,d
	Perform FIFO with the following page sequence: 1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5 having a frame size of 4. The number of page faults: a) 9 b) 10 c) 11 d) None of the above	Question - 4 on concept 7	CO6/CO7	b

SECTION-B(Answer Any Three Questions. Each Question carries 12 Marks)

Time: 1 Hour and 30 Minutes **(3×12=36 Marks)**

<table>
<tr><th>Question No</th><th>Question</th><th>CO Mapping (Each question should be from the same CO(s))</th></tr>
<tr><td>Q.No: 8</td><td>
a. Discuss the major problem in priority scheduling algorithm and its solution. [6]
The following table shows the processes along their arrival time, burst time and priorities which are waiting for CPU to get executed.
<table>
<tr><td>Process</td><td>Arrival time</td><td>Burst time</td><td>Priority</td></tr>
<tr><td>P0</td><td>0 ms</td><td>9 ms</td><td>1(low)</td></tr>
<tr><td>P1</td><td>1 ms</td><td>5ms</td><td>4</td></tr>
<tr><td>P2</td><td>2 ms</td><td>6 ms</td><td>3</td></tr>
<tr><td>P3</td><td>3ms</td><td>3 ms</td><td>5(high)</td></tr>
<tr><td>P4</td><td>4ms</td><td>7ms</td><td>2</td></tr>
</table>
Scheduling is carried out only at arrival or completion of processes. What is the average waiting time and turnaround time if the processes are executed as per the pre-emptive priority scheduling algorithm?

b. Differentiate between semaphore and monitor. Write a solution for reader writer problem using semaphore. [6]
</td><td>CO4/CO5</td></tr>
</table>

a. What is process synchronization? Why it is required? [6]
Consider the following processes arrived in a system.

Process	Arrival time	Burst time
P0	5 ms	5 ms
P1	4 ms	6 ms
P2	3 ms	7 ms
P3	1 ms	9 ms

Calculate the average waiting time of the processes if the scheduling algorithm is Round Robin with time slice length as 3 ms.

b. Suggest a semaphore based deadlock free solution to dinning philosopher problem? Whether the solution is free from starvation? Justify. [6]

a) Consider process arrival as given below:

Process	CPU Burst Time(ms)	Arrival Time	Priority
A	4	0	2
B	3	3	3
C	6	4	6
D	5	5	4
E	1	15	4

Calculate the following for *priority (non preemptive)* and *round robin*(time quantum = 2 ms) CPU scheduling algorithm: [6]

i. Average waiting time
ii. Turnaround time for each process
iii. Order of completion

(*hints:-higher digits indicate higher priority*)

b. What is semaphore? Discuss the difference between WAIT and Signal operation used in semaphore. Explain how busy waiting can e solved in semaphore? [6]

Q.No:9	a. There are three resource types X, Y, and Z to three processes P0, P1, and P2. The table given below presents the current system state. Here, the Allocation matrix shows the current number of resources of each type allocated to each process and the Max matrix shows the maximum number of resources of each type required by each process during its execution. [6]	CO5

There are 3 units of type X, 2 units of type Y and 2 units of type Z still available. The system is currently in a safe state. Consider the following independent requests for additional resources in the current state:

	Allocation			Max		
	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

REQ1: P0 requests 0 units of X, 0 units of Y, and 2 units of Z.

REQ2: P1 requests 2 units of X, 0 units of Y and 0 units of Z

Using Banker's algorithm, which request can be granted or permitted for resource allocation? Justify your answer with proper steps.

i. REQ1 is permitted only.
ii. REQ2 is permitted only.
iii. Both REQ1 and REQ2 are permitted.
iv. Neither REQ1 nor REQ2 can be permitted.

b. What is resource allocation graph and how it is useful for detection of Deadlock? [6]

There are four processes {P1, P2, P3, P4} and two resources {A (2 instance), B(2 instance)} and the allocation and request of each process is given as:

P1: Request for resource A, resource B is allocated

P2: Request: nil, resource A is allocated

P3: Request for resource B, resource A is allocated

P4: Request: nil, resource B is allocated.

Draw the resource allocation graph and state whether the deadlock exists or not in the system.

Consider a system with five processes P0 to P4 competing for and 4 resource types that is, A, B, C and D. Resources type A has 6 instances, B has 4 instances, C has 4 instances and D has 2 instances. The initial resource allocation of the processes is as follows.

Process	Allocation				Max			
	A	B	C	D	A	B	C	D
P_0	2	0	1	1	3	2	1	1
P_1	1	1	0	0	1	2	0	2
P_2	1	1	0	0	1	1	2	0
P_3	1	1	1	0	3	2	1	0
P_4	0	0	0	1	2	1	0	1

(a)Does this initial allocation lead to safe state? If yes show a safe sequence. [6]

(b)A request <1,1,0,0> by Process P4 is generated. Whether the request will be granted? [6]

Find a safe sequence(if any) for the following resource allocation table using deadlock detection algorithm. [6+6]

Process	Alloc	Req	Avail
P0	0 1 0	2 2 2	4 3 3
P1	1 1 1	1 2 2	
P2	1 0 1	3 2 2	
P3	2 1 2	4 2 3	
P4	0 0 0	3 2 3	

Does the system has deadlock, if so then which are the deadlocked processes? Also find any unsafe sequence and provide the value of 'Work' vector for it.

Q.No:10

a. Explain the algorithms to select a free hole from a set of available holes in contiguous memory allocation. And write down the demerits of contiguous memory allocation and its solutions? [6]

b. What is a page fault? Describe the steps with diagram how a page fault is handled by OS in demand paging. [6]

CO6

a. What is the segmentation and how it is different from the paging technique? [6]

b. i. If there are 32 segments, each of size 1KB, then the logical address should have how many bits to represent its address?

ii. Calculate the physical addresses for the following logical addresses using given segmentation table: [6]

1. (0, 430) 2. (4, 106) 3. (1, 10)4. (2, 600)

segment	Base	Limit
0	316	500
1	1509	96
2	2300	580
3	1327	140
4	115	100

a. Consider a disk system with 100 cylinders. The requests to access the cylinders occur in following sequence: 4, 34, 10, 7, 19, 73, 2, 15, 6, 20. Assuming that the head is currently at cylinder 50, what is the time taken to satisfy all requests using shortest seek time first policy if it takes 1ms to move from one cylinder to adjacent one? Also show the head movement for servicing the request for C-SCAN and C-LOOK policy? [6]

b. Write the different file allocation methods and also compare their performance. [6]

Q.No:11

Write short notes on the followings: [4 x 3]

a. Inter process communication

b. Thrashing

c. Inverted page table

CO7

Write short notes on the followings: [4 x 3]

a. Deadlock recovery

b. Inverted page table

c. Second chance page replacement algorithm

Write short notes on the followings: [4 x 3]

a. Deadlock recovery

b. Inverted page table

c. Second chance page replacement algorithm