KIIT Deemed to be University
Online End Semester Examination(Spring Semester-2021)

Subject Name & Code: Operating Systems, CS-2002
Applicable to Courses: CSE, IT, CSSE, CSCE

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

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	MCQ	How many child processes will be created and how many times "Welcome" will be displayed after execution the following program?
		
		int main() {
		    fork();
		    fork();
		    printf("Welcome");
		    fork();
		    return 0;
		}
		A) 2, 2
		B) 3, 4
		C) 7, 4
		D) 7, 8
			1	C

	MCQ	How many child processes will be created and how many times "Welcome" will be displayed after execution the following program?
		
		int main() {
		    int i, j;
		    for(i=1, j=7; i<j; i++, j--)
		        fork();
		    printf("Welcome");
		    fork();
		    fork();
		    return 0;
		}
		A) 15, 8
		B) 16, 7
			1	C

		C) 31, 8 D) 32, 7		
	MCQ	In which of the following process scheduling policies context switching never take place? I. Round-robin II. Shortest job first(non pre-emptive) III. Pre-emptive IV. First-cum-first-serve A) IV only B) I and III C) II and III D) II and IV	2	D
	MCQ	Which of the following statement(s) is(are) true? I. Shortest remaining time first scheduling may cause starvation. II. Preemptive scheduling never cause starvation. III. Round robin is better than FCFS in terms of response time. A) I only B) I and III C) II and III D) I, II , III	2	B
Q.No: 2	**MCQ**	Consider three processes: P1, P2 & P3 with CPU burst time 5, 4, 3 time units and arrival time 0, 3, 4 time units respectively. Consider the FCFS and RR (with time slice 2 time units) scheduling algorithms. Find the order of completion of execution of processes in both algorithms. A) FCFS: P1, P2, P3 RR: P1, P2, P3 B) FCFS: P1, P3, P2 RR: P2, P1, P3 C) FCFS: P1, P2, P3 RR: P1, P3, P2 D) FCFS: P1, P2, P3 RR: P3, P2, P1	2	A
	MCQ	A scheduling algorithm assigns priority directly proportional to the remaining burst time of a process. Every process starts with priority zero (the lowest priority). The scheduler re-evaluates the process priorities every execution of process and decides the next process to schedule. Which one of the following is TRUE if the processes have no I/O operations and all arrive at time zero? A) This algorithm is equivalent to the first-come-first-serve algorithm B) This algorithm is equivalent to the round-robin algorithm C) This algorithm is equivalent to the largest-remaining-time-first algorithm D) This algorithm is equivalent to the shortest-remaining-time-first algorithm	2	C
	MCQ	Which of the following statements are true? I. FCFS scheduling is better in terms of average waiting time	2	C

		II. Priority scheduling may cause starvation III. Round robin is better than FCFS in terms of response time IV. SJF causes starvation A) II and III only B) III and IV only C) II, III and IV only D) I, II and IV only		
	MCQ	Consider three processes (process id 1, 2, 3 respectively) with arrival time 0, 1, 2 and CPU burst time 6, 3 and 2 time units respectively. Consider the shortest remaining time first (SRTF) scheduling algorithm. In SRTF ties are broken by giving priority to the process with the highest process id. Find the average turn around time. A) 5 units B) 6 units C) 7 units D) 8 units	2	B

Q.No: 3	**MCQ**	The following two concurrent processes P_1 and P_2 that share a variable B with an initial value of 5. What is the sum of all possible values of B?
		P_1 ( ) { P_2 ( ) {
		C = B – 1; B = 2 * B;
		B = 2 * C; }
		}
		A) 24
		B) 26
		C) 42
		D) None of the above
			3	C

	MCQ	The following two concurrent processes P_1 and P_2 that share a variable B with an initial value of 5. What is the GCD of all possible values of B?
		P_1 ( ) { P_2 ( ) {
		C = B – 1; B = 2 * B;
		B = 2 * C; }
		}
		A) 1
		B) 2
		C) 4
		D) None of the above
			3	B

	MCQ	The following two concurrent processes P_1 and P_2 that share a variable B with an initial value of 3. What is the sum of all possible values of B?
		P_1 ( ) { P_2 ( ) {
		C = B – 1; B = 2 * B;
		B = 2 * C; }
		}
		A) 18
		B) 22
		C) 12
			3	B

		D) None of the above		

	MCQ	The following two concurrent processes P_1 and P_2 that share a variable B with an initial value of 3. What is the difference between the smallest and largest values of all possible values of B?
		P_1 ( ) {
		C = B – 1;
		B = 2 * C;
		}
		P_2 ( ) {
		B = 2 * B;
		}
		A) 4
		B) 6
		C) 8
		D) None of the above
			3	B

Q.No: 4	**MCQ**	Consider a non-negative counting semaphore S. The operation P(S) decrements S, and V(S) increments S. During an execution, 22 P(S) operations and 14 V(S) operations are issued in some order. The largest initial value of S for which at least one P(S) operation will remain blocked is A) 7 B) 8 C) 9 D) 10	3	C
	MCQ	Consider a system having '*m*' resources of the same type. These resources are shared among three processes P_1, P_2, P_3, which have peak time demands of 4, 5, 7 respectively. What will be the minimum value of '*m*' such that the deadlock will never occur in the system? A) 11 B) 12 C) 13 D) 14	4	D
	MCQ	Consider three processes P_1, P_2, P_3 and four resource types R_1, R_2, R_3, R_4 are available in a system. There are one instance of resource type R_1 two instances of resource type R_2, one instance of resource type R_3 and three instances of resource type R_4 available in the system. At a particular instance of time, P_1 is holding one instance of R_2 and waiting for an instance R_1, P_2 is holding an instance of R_1 one instance of R_2 and waiting for an instance of R_3 and P_3 is holding an instance of R_3 and waiting for an instance of R_4. Find out which of the following statement is TRUE? A) Deadlock will not occur B) Deadlock will occur C) All the instances of R_4 are held by the processes D) All the instances of R_2 are not allotted	4	A
	MCQ	A computer system has 5 printers, with '*n*' processes competing for them. Each process may need 2 printers.	4	C

		What will be the maximum value of '*n*' for which the system is guaranteed to be deadlock free? A) 2 B) 3 C) 4 D) 1		
Q.No: 5	**MCQ**	Consider a system with byte-addressable memory, 32 bit logical address, 2 KB page size and page table entries of 4 Bytes each. What will be the size of the page table in the system in MB? A) 2 B) 4 C) 8 D) 16	5	C
	MCQ	Consider 8 empty frames (numbered 0-7) are allocated to a process with an assumption initially the requested pages will be loaded into a frame in the sequence 0 to 7. With the reference string: 4, 3, 25, 8, 19, 6, 25, 8, 16, 35, 45, 22, 8, 3, 16, 25, 7, in which frame the page 7 will be loaded using LRU page replacement algorithm? A) 4 B) 5 C) 6 D) 7	5	B
	MCQ	In a virtual memory system, size of virtual address is 32-bit, size of physical address is 28-bit, page size is 4 KB and size of each page table entry is 24-bit. The main memory is byte addressable. What is the maximum number of bits that can be used for storing protection and other information in each page table entry? A) 8 B) 10 C) 16 D) 24	5	A
	MCQ	Consider a computer system with 32-bit virtual addressing and page size of 4 KB. If the computer system has a one-level page table per-process and each page table entry requires 40 bits, then what will be the size of the per-process page table in MB? A) 4 B) 5 C) 6 D) 7	5	B
Q.No: 6	**MCQ**	A new process is loaded into main memory. The size of process cannot be exactly fit into the available memory holes. If the process is allocated to any of the available holes, then a new smaller hole is created. Which of the following option is correct in this context? A) The size of new hole created using best fit is never greater than size of the hole created by first fit B) The size of new hole created using best fit is never greater than size of the hole created by next fit	5	A

		C) The size of new hole created using next fit is never greater than size of the hole created by first fit D) The size of new hole created using worst fit is never greater than size of the hole created by first fit		
	MCQ	A new process is loaded into main memory. The size of process cannot be exactly fit into the available memory holes. If the process is allocated to any of the available holes, then a new smaller hole is created. Which of the following option is correct in this context? A) The size of new hole created using best fit is always less than size of the hole created by first fit B) The size of new hole created using best fit is never greater than size of the hole created by first fit C) The size of new hole created using worst fit is greater than or equal to size of the hole created by first fit D) None of the above	5	C
	MCQ	A new process is loaded into main memory. The size of process cannot be exactly fit into the available memory holes. If the process is allocated to any of the available holes, then a new smaller hole is created. Which of the following option is correct in this context? A) The size of new hole created using best fit is always less than size of the hole created by first fit B) The size of new hole created using best fit is never greater than size of the hole created by first fit C) The size of new hole created using worst fit is greater than or equal to size of the hole created by first fit D) None of the above	5	C
	MCQ	A new process is loaded into main memory. The size of process cannot be exactly fit into the available memory holes. If the process is allocated to any of the available holes, then a new smaller hole is created. Which of the following option is NOT correct in this context? A) The size of new hole created using best fit is greater than size of the hole created by first fit B) The size of new new hole created using worst fit is always greater than size of the hole created by first fit C) The size of new hole created using first fit is always smallest among all placement algorithms D) All of the above	5	D
Q.No: 7	**MCQ**	A file system with 200 GB disk uses a file descriptor with 8 direct block addresses, 1 indirect block address and 1 double indirect block address. The size of each disk block is 512 Bytes and the size of each disk block address is 4 Bytes. What is approximately maximum possible file size in this file system? A) 16 MB B) 20 MB C) 32 MB D) Dependent on the size of the disk	5	C
	MCQ	Disk requests come to a disk driver for cylinders in the order 10, 22, 20, 2, 40, 6 and 38, at a time when the disk drive is reading from cylinder 20. The seek time is 6 ms per cylinder. What will be the total seek time (in ms), if the disk arm scheduling algorithm is	6	C

		first-come-first-serve is used? A) 768 ms B) 854 ms C) 876 ms D) None of these		
	MCQ	The method of accessing the I/O devices by repeatedly checking the status flags is A) Program-controlled I/O B) Memory-mapped I/O C) I/O mapped D) None of the mentioned	6	A
	MCQ	Which of the following statements about synchronous and asynchronous I/O is NOT true? A) An ISR (Interrupt Service Routine) is invoked on completion of I/O in synchronous I/O but not in asynchronous I/O B) In the case of synchronous I/O, the process waiting for the completion of I/O is woken up by the ISR that is invoked after the completion of I/O C) A process making a synchronous I/O call waits until I/O is complete, but a process making an asynchronous I/O call does not wait for completion of the I/O D) In both synchronous and asynchronous I/O, an ISR is invoked after completion of the I/O	6	D

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

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

Question No	Question	CO Mapping (Each question should be from the same CO(s))
Q.No :8	a) Differentiate between Threads & Processes. Explain the relationship between them. [4] b) Consider the set of processes with their arrival time and the CPU-burst time given in the following Table. N=(Last digit of your roll no % 5) + 2. [8] Processes / Arrival Time / Burst Time P_1 / 0 / 3 P_2 / 1 / N P_3 / 4 / 4	2 2

	P_4 N 2 Find out the average turnaround time, average waiting time, sequence of execution and draw the Gantt chart using Shortest Remaining Time First and Round Robin (with time quantum 2) scheduling algorithms.	
	a) What is the difference between preemptive scheduling and non-preemptive scheduling? What is the issue with the latter? [4] b) For the following set of processes, find the average waiting time using Gantt chart for i) SJF (non-primitive) ii) Priority scheduling [8] Processes / Priority / Burst Time P_1 5 5 P_2 4 3 P_3 3 N P_4 1 2 P_5 2 1 where N=(Last digit of your roll no % 5) + 3. The process has arrived at the same time in the order P_2, P_1, P_4, P_3 and P_5.	2 2
	a) What is context switching? Explain the overheads involved in context switching using a neat sequence diagram. [4] b) Five processes P_1, P_2, P_3, P_4 and P_5 arrive almost at the same time in the order. They have estimated running times of 10, 6, 2, 4 and 8 time units respectively. Their priorities are 3, 5, 2, 1 and 4 respectively, with 5 being the highest priority. Determine the turn around time and waiting time of each process using Gantt chart by ignoring process switching overhead for each of the scheduling algorithms i) Round Robin (with time quantum 2) and ii) Priority scheduling. Mention which algorithm results in minimal average waiting time. [8]	2 2
Q.No :9	a) What is a race condition? Explain with a suitable example. [4] b) A doctor's clinic consists of two partitions: a waiting room with n chairs and a doctor chamber where one patient at a time can be checked. If there is no patient to be checked, the doctor goes to sleep. If a patient arrives at the clinic and found all chairs are occupied, then the patient leaves the clinic. If the doctor is busy but chairs are available, then the patient sits in one of the free chairs. If the doctor is asleep, the patient wakes up the doctor. Write the procedures (namely doctor() and patient()) to coordinate the doctor and the patients using semaphore. [8]	3 3
	a) A semaphore is a blocking synchronization primitive. Describe how they work with the aid of pseudo-code. Assume the existence of a block() and a wakeup() function. [4] b) A university computer science department has a teaching assistant (TA) who helps undergraduate students with their programming assignments during regular office hours. The TA's chamber is small and can hold 2 persons: 1 TA and 1 student. There are five chairs in the outside the chamber where students can sit and wait if the TA is currently helping another student. When there are no students who need help during office hours, the TA sits at the desk and takes a nap. If a student arrives during office hours and finds the TA sleeping,	3 3

the student loudly clears his throat and the TA invites the student. If a student arrives and finds the TA currently helping another student, the student sits on one of the chairs and waits. If no chairs are available, the student will come back at a later time. Write the procedures (namely TA() and Student()) to coordinate the TA and the students using semaphore. [8]

a) Describe briefly the four general strategies for dealing with deadlocks. [4] — 4

b) Consider the following snapshot of a system with five processes P_1, P_2, P_3, P_4, P_5 and four resource types R_1, R_2, R_3, R_4. The maximum number of instances of resources of each type are 10, 8, 9 and 8 respectively. What will be the order of execution of processes with the available resources using Banker's Algorithm? Also check whether the system is in safe state or not. [8] — 4

	Allocation				Maximum			
	R_1	R_2	R_3	R_4	R_1	R_2	R_3	R_4
P_1	1	0	2	2	3	2	5	2
P_2	0	2	1	2	3	N	1	2
P_3	2	4	5	0	2	7	7	N-1
P_4	3	0	0	0	5	5	0	7
P_5	4	2	1	3	6	2	1	4

where N=(Last digit of your roll no % 2) + 4.

Q.No :10

a) Describe briefly the difference between external and internal fragmentation. Indicate which of the two are most likely to be an issues on i) a simple memory memory management machine using base & limit registers and static partitioning, and ii) a similar machine using dynamic partitioning. [4] — 5

b) A virtual memory system has the following specifications: [8] — 5

Size of the virtual address space = 64 KB
Size of the physical address space = 4 KB
Page size = 512 Bytes
The page table is as follows:

Virtual page#	Physical frame#
0	0
3	1
7	2
4	3
10	4
12	5
30	6
31	7

The virtual addresses referenced are as follows: 24, 3784, 10250, 30780.

i. Find the virtual addresses that will generate a page fault.
ii. Compute the main memory addresses for the virtual addresses which are available in the main memory.

a) What is a translation look-aside buffer (TLB)? What is contained in each entry of TLB, explain with a neat diagram? [4] — 5

b) Consider the virtual page reference string: 1, 2, 3, 2, 4, 1, 3, 2, 4, 1.

		On a demand paged virtual memory system running on a computer system with main memory size of 3 page frames which are initially empty. Let LRU, FIFO and OPTIMAL denote the number of page faults under the corresponding page replacement policy. Show the order of these policies on the basis of increasing order of page faults. [8]	5
	a)	What is thrashing? How is it detected? How to recover from it once it is detected? [4]	5
	b)	The available space list of a computer memory is specified as follows: Start address – Block size in words 100 – 50 200 – 150 450 – 600 1200 – 400 Determine the available space list after allocating the space for the stream of requests consisting of the block sizes in sequence: 25, 100, 250, 200, 100, 150 using i) First Fit ii) Best Fit and iii) Worst Fit algorithms. Also mention the external fragmentation for each of the algorithms, if occurred. [8]	5
Q.No :11	a)	Suppose the read/write head of a disk with 200 tracks numbered 0 to 199 is currently serving the request at track 143. If the queue of request is kept in FIFO order: 86, 147, 91, 177, 94, 150, 102, 175, 130. What is the total read/write head movement to satisfy these requests for i) FCFS II) SSTF disk scheduling algorithm. Also mention the pros and cons of these two disk scheduling algorithms. [6]	6
	b)	What is Access Matrix? Describe the access matrix model used for protection purpose. [6]	6
	a)	Given that the maximum file size is combination of direct, single indirect, double indirect, and triple indirect in an inode based file system is approximately the same as a file system solely using triple indirect. Explain with a neat diagram, why not simply use only triple indirect to locate all file blocks. [6]	5
	b)	Describe buffering in the I/O subsystem of an operating system. Give reasons why it is required, and illustrate a case where it is an advantage, and a case where it is a disadvantage. [6]	6
	a)	Compare polling based I/O with interrupt-driven I/O. In what situation would you favour one technique over the other? [6]	6
	b)	What is free space management? Explain two free space management policies with their pros and cons. [6]	5