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PES UNIVERSITY

PES University, Bengaluru

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UE17CS302

DECEMBER 2020: END SEMESTER ASSESSMENT (ESA) B TECH 5 SEMESTER

(BACKLOG) UE17CS302 – Introduction to Operating Systems - 4 credits

Time: 3 Hrs	Answer All Questions	Max Marks: 100

1	a)	Explain with a **diagram** 5 different Process States a process could occupy when it executes.	6
	b)	Explain three types of Process Schedulers.	6
	c)	The processes P1, P2, P3, P4 and P5 enter the system as shown below. Calculate **Average Waiting Time** and **Average Turnaround Time** based on Round Robin scheduling Algorithm with time quantum = 2 units.. You must show the formulas and all steps leading to the result.	8

Process	Arrival Time	Burst Time
P1	0	5
P2	1	3
P3	2	1
P4	3	2
P5	4	3

2	a)	What are the three requirements that a solution to the critical-section problem must satisfy? Explain each of them in a sentence.	6
	b)	Consider the following classical synchronization problem called the barbershop problem. A barbershop consists of a barber in a room with N chairs. If a customer enters the barbershop and all chairs are occupied, then the customer leaves the shop. If the barber is busy, but chairs are available, then the customer sits in one of the free chairs and awaits his turn. The barber moves onto the next waiting seated customer after he finishes one haircut. If there are no customers to be served, the barber goes to sleep. If the barber is asleep when a customer arrives, the customer wakes up the barber to give him a haircut. A waiting customer vacates his chair after his haircut completes. The following variables (3 semaphores and a count) are provided to you for your solution. You must use these variables and declare any additional variables if required. **semaphore mutex = 1; customers = 0; barber = 0; int waiting count = 0** Write the **pseudocode** for the customer and barber threads with suitable synchronization. **You must use only semaphores to solve this problem.** Use the standard notation of invoking **up/down** or **wait/signal** functions on a semaphore variable.	6
	c)	Explain with **diagrams** 3 multi-threading models supported by all contemporary operating systems.	8
3	a)	Given five memory partitions of 100 KB, 500 KB, 200 KB, 300 KB, and 600 KB (in order), how would each of the first-fit, best-fit, and worst-fit algorithms place processes of 212 KB, 417 KB, 112 KB, and 426 KB (in order)? Which algorithm makes the most efficient use of memory? Note: You must reuse the holes created after every placement for future placements.	6

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	b)	(i) Consider a system with single level paging and page size equal to frame size. If the page size is 2048 bytes and the process size is 72766 bytes, then what is the number of pages allocated and what type of fragmentation it leads to? Explain your answer. (ii) On a system with 1-KB page size and 32 bits address size, what is the page number and offset (both in decimal) for the address reference 3085 (provided as decimal number)? Explain your answer.	6 (3+3)
	c)	What is a Page Fault? For a given page reference string **7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1** calculate the total number of page faults for LRU page replacement algorithm assuming 3 frames. You must show all the steps leading to the result.	8
4	a)	(i) Specify any 4 methods used in the new file system to overcome the limitations of a traditional file system and hence improve the performance of the file system. (ii) What is an inode and what information does it include?	6 (4+2)

	b)	Assume the required header files are included and also successful execution of every statement in the program. What is the output of the following program if the input file "start.txt" contains these two lines?
		Hello World
		Bye
		Justify your answer with proper explanation of what each system call does.
		`int main ()`
		`{`
		`  char arr[100];`
		`  int x=0;`
		`  int fd = open ("start.txt", O_RDONLY);`
		`  x = lseek (fd, 0, SEEK_END);`
		`  while (x > 0) {`
		`  read (fd, arr, 1);`
		`  write (1, arr, 1);`
		`  lseek (fd, -2, SEEK_CUR);`
		`  x--;`
		`  }`
		`  printf("\n");`
		`  close(fd);`
			6

	c)	Consider a file system with 12 direct pointers, 1 indirect pointer and 1 double-indirect pointer in the i-node. Assume that disk blocks are 4 KB size and each pointer to a disk block requires 4 bytes. (i) What is the largest possible file that can be supported with this design? (ii) If the same file system supports an additional triple-indirect pointer, what is the largest file that can be supported? **Note:** Write the answer as a mathematical expression and calculate the final numeric value for both the questions	8 (4+4)
5	a)	Explain with a **diagram** how Direct Memory Access (DMA) technique improves disk I/O performance.	6
	b)	Suppose we have a disk with 200 tracks (numbered from 0 to 199) and the head is initially at track 100 and is moving towards track 0 (the center of the disk). There is a queue of disk access requests for tracks 27, 129, 110, 186, 147, 41, 10, 64 and 120. If Shortest-Seek Time First (SSTF) is being used for scheduling the disk access, show all the requests serviced and calculate the average number of tracks visited.	6
	c)	Explain any four disk scheduling algorithms by highlighting the fundamental problem existing in each of these algorithms.	8