REVISED (only in solution Q 3 d(v))

SRN | | | | | | | | | | | | |

PES University, Bangalore

(Established under Karnataka Act No. 16 of 2013)

UE17CS302

END SEMESTER ASSESSMENT (ESA) - December 2019

Introduction to Operating Systems

Time: 3 Hrs | Answer All Questions | Max Marks: 100

1.	a)	Explain Process State transition with a **diagram**.	5
	b)	Consider a variant of the Round-Robin scheduling algorithm in which the entries in the ready queue are pointers to the Process Control Blocks. a) What would be the effect of putting two pointers to the same process in the ready queue? b) What would be a major advantage and a disadvantage of this scheme?	4
	c)	Explain with a **diagram** any **three** key features provided by Multi-level feedback queue in process scheduling.	5
	d)	Suppose the following processes arrive for execution as shown below. **Process** **Arrival Time** **Burst Time** P1 0 6 P2 1 2 P3 2 5 Calculate **Average Waiting Time** and **Average Turnaround Time** based on non-preemptive FCFS scheduling Algorithm. You must show the formulas and all steps leading to the result.	6

2.	a)	Consider N threads that want to each execute their first operation before any thread proceeds to the second operation. Below is the code that each thread runs in order to achieve this synchronization.
		
		count is an integer shared variable initialized to zero and **mutex** is a mutex binary semaphore, initialized to one, that protects this shared variable
		step1Done is a semaphore initialized to zero.
		
		You are told that this code is wrong and does not work correctly. Suggest the changes to be made to the code in the snippet below to fix it by using only semaphores and no other synchronization mechanism.
		
		//run first step
		
		down(mutex);
		count++;
		up(mutex);
		if (count == N)
		    up(step1Done);
		down(step1Done);
		
		//run second step
			4

	b)	What is the meaning of the term busy waiting? What other kinds of waiting are there in an operating system? Can busy waiting be avoided altogether? Explain your answer.	3

SRN

c) 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. **5**

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.

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;

d) **8 (6 + 2)**

i. State any three necessary conditions to cause deadlock in a system. Explain each of them in a sentence.
ii. State any two possible remedies to the deadlock problem in the Dining-Philosophers problem.

3. a) Consider the following page reference string: **5**

1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6

How many page faults would occur for **Optimal** replacement algorithm assuming **four** frames? Remember all the frames are initially empty. Your answer must show all steps leading to the result.

b) A paging scheme uses a Translation Look-aside Buffer (TLB). A TLB-access takes 10 ns and a main memory access takes 50 ns. What is the effective access time (in ns) if the TLB hit ratio is 90% and there is no page-fault? **5**

c) **5 (2 + 3)**

i. Consider a logical address space of eight pages of 1024 words each, mapped onto a physical memory of 32 frames.
How many bits are in the logical address?
How many bits are in the physical address?

ii. Consider the following segment table:

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

What are the physical addresses for the following logical addresses given as (segment, offset) tuples?
a) 0, 430
b) 2, 500
c) 7, 112

SRN

	d)	Assume the following: a 32-bit virtual address space, with a 1KB page size and a linear page table with each page table entry size = 4 bytes. i. How many bits are in the offset portion of the virtual address? ii. How many bits are in the Virtual Page Number portion of the virtual address? iii. How many entries are in the table? iv. What is the total size of the table? v. In a live system, if the page table size = 10 MB and there are 100 processes how much memory would be occupied by the page tables?	5
4.	a)	i. 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 8 KB size and each pointer to a disk block requires 4 bytes. 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**: Give the answer as an expression and calculate the final numeric value for both the questions	5 (3 + 2)
	b)	What is the purpose of System Hardening? Explain any 3 best practices for System Hardening.	5
	c)	Consider a system that supports the strategies of contiguous, linked, and indexed allocation. What criteria should be used in deciding which strategy is best suited for a particular file?	5
	d)	i. What is the basic design principle behind FFS? How does FFS determine where to put file data blocks? ii. What is the difference between inode bitmap and inode table?	5 (3 + 2)
5.	a)	Explain with a diagram how Direct Memory Access (DMA) technique improves system performance.	5
	b)	Explain any three techniques used by operating systems to improve disk drive performance.	5
	c)	Explain the three main delays in getting data from disk.	6
	d)	Suppose we have a disk with 200 tracks (numbered from 0 to 199) and the head is initially at track 100. 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 per request.	4