National Institute of Technology Patna
Department of Computer Science and Engineering
End-Semester Examination, Even -2021

Course: Operating Systems | Course Code: CS4404
Full Marks: 40 | Duration: 2 Hours

All questions are compulsory. Assume missing data if any

1) [**5 Marks**]Consider a program which has its **last** instruction an I/O statement, to execute this instruction corresponding process will be in waiting state while this I/O gets completed. Can the corresponding process jump directly to terminated state as it has nothing more to execute? Justify your answer properly in either case with illustrative diagrams.

2) [**10 Marks**]Three processes P1, P2 and P3 need to acess a criticial section of code, consider the followig construct used by the processes:

P1	P2	P3

while(true){
wants1 = true;
while(wants2 == true);
/**Critical Section**/
wants1 = false;
}
*/*Remainder Section*/*
	while(true){
	wants2 = true;
	while(wants3 == true);
	/**Critical Section**/
	wants2 = false;
	}
	*/*Remainder Section*/*
		while(true){
		wants3 = true;
		while(wants1 == true);
		/**Critical Section**/
		wants3 = false;
		}
		*/*Remainder Section*/*

Here, wants1, wants2 and wants3 are shared variables which were initialized to false. Does the above construct satisfy all the three solutions required for a Critical Section problem solution? If Yes, proove it informally, if NO what changes in the above construct will make it satisfy all the conditions.

3) [**10 Marks**]
Consider three process, all arriving at time zero, with total execution time of 10, 20 and 30 units respectively. Each process spends the first 50% of execution time doing computation, the next 10% of time doing I/O, next 20% again computation and the last 20% of time doing I/O again. The operating system uses a *shortest remaining compute time first* scheduling algorithm and schedules a new process either when the running process gets blocked on I/O or when the running process finishes its compute burst. Assume that all I/O operations can be overlapped as much as possible. For what percentage of does the CPU remain idle?

4) [**3 + 2 Marks**]
   i. Discuss the structure of a magnetic disk with suitable diagram. What are the main time components involved in accessing the data from the disk? Which time component is effected by the disk scheduling algorithms?
   ii. Consider a machine with single core CPU. What is the maximum number of process that can run on this machine at any given time? Justify your answer.

5) [**4+4+1+1 Marks**] Consider following memory references (in hex format) made by a process while running on a machine with 16 bit processor, 16 bit Operating System, and 4 KB as page / frame size.
0x3629,0x7535,0x7436,0x6037,0x8364,0x379A,0x52AA,0x36BB,0x336D,0x432C,0x89EE,0x3629,0x0001,0xFD34.
If the initial number of frame allocated to this process was three (3), calculate the number of page faults for following algorithms
   i. LRU Approximation Algorithm – FIFO with Second Chance
   ii. Optimal Algorithm
   iii. What is size of physical address space
   iv. what is size of virtual address space for each process