Sardar Patel Institute of Technology
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(Autonomous College Affiliated to University of Mumbai)

End Semester Examination
May 2022

Max. Marks: 60 Duration: 2 Hrs.

Class: S.Y. Semester: IV
Course Code: CS206/IT206 Branch: I.T./Comp
Name of the Course: Operating Systems

Instruction:
(1) All questions are compulsory
(2) Draw neat diagrams
(3) Assume suitable data if necessary

Q. No.		Max. Marks	CO-BL-PI
1 a)	What is the role of linker and loader? Draw the loader diagram and state its three functions.	6	1-2.2.1.1
b)	Hari wants to translate program from high level language with following requirements 1. One statement at a time 2. It should take less amount of time to analyze the source code and no intermediate object code should be generated . 3. It should be easy to debug as well. So Hari should use which type of software or hardware ? and why?	5	1.2.2.1.3
c)	What is meant by dual mode of operation in the context of execution of a process?	4	1-2-2.1.1

2 a)	What is meant by microkernel architecture? What are the two benefits of this architecture? It is suitable for which environment?	4	1-2-2.1.1
b)	Listed below are some operating system abstractions (in the left column) and the hardware components or mechanism (in the right column) that they are abstractions of. Match the following. A – Thread – 1 – Interrupt B – Virtual address space – 2 – Memory C – File system – 3 – CPU D – Signal – 4 – Disk	2	1-2-1.3.1
c)	State following statement is true or false with justification. When a user-level process wishes to call a function inside the kernel, it directly jumps to the desired function.	1	2-3-2.1.3
d)	Consider four processes P, Q, R and S scheduled on a CPU as per round robin algorithm with a time quantum of 4 units. The processes arrive in the order P, Q, R, S, all at time t = 0. There is exactly one context switch from S to Q, exactly one context switch from R to Q, and exactly two context switches from Q to R. There is no context switch from S to P. Switching to a ready process after the termination of another process is also considered a context switch. Which one of the following is NOT possible as CPU burst time (in time units) of these processes? A. $P = 4, Q = 10, R = 6, S = 2$ B. $P = 2, Q = 9, R = 5, S = 1$ C. $P = 4, Q = 12, R = 5, S = 4$ D. $P = 3, Q = 7, R = 7, S = 3$	4	2-3-2.1.3

e)	The following C program is executed on a Unix/Linux system:
	`#include < unistd.h >`
	`int main ()`
	`{`
	`int i ;`
	`for (i=0; i<10; i++)`
	`if (i%2 == 0) fork ( ) ;`
	`return 0 ;`
	`}`
	The total number of child processes created is _____. Justify
		4	2-3-2.1.3

3a)	Consider the following threads, T1,T2 and T3 executing on a single processor, synchronized using three binary semaphore variables, S1,S2 and S3, operated upon using standard wait()and signal(). The threads can be context switched in any order and at any time.	5	3-3-2.1.3

T_1	T_2	T_3
while(true){	while(true){	while(true){
wait(S_3);	wait(S_1);	wait(S_2);
print("C");	print("B");	print("A");
signal(S_2);}	signal(S_3);}	signal(S_1);}

Which initialization of the semaphores would print the sequence BCABCABCA…?

OR

Synchronization in the classical readers and writers problem can be achieved through use of semaphores. In the following incomplete code for readers-writers problem, two binary semaphores mutex and wrt are used to obtain synchronization.

wait (wrt)
writing is performed
signal (wrt)
wait (mutex)
readcount = readcount + 1
if readcount = 1 then S1
S2
reading is performed
S3
readcount = readcount - 1
if readcount = 0 then S4
signal (mutex)
The values of S1, S2, S3, S4, (in that order) are
(A) signal (mutex), wait (wrt), signal (wrt), wait (mutex)
(B) signal (wrt), signal (mutex), wait (mutex), wait (wrt)
(C) wait (wrt), signal (mutex), wait (mutex), signal (wrt)
(D) signal (mutex), wait (mutex), signal (mutex), wait (mutex)

Q.3 b)	Given a 'claim matrix' or max matrix , an 'allocation matrix' and a 'resource vector ' for a set of processes: (a) Is there a safe state? If yes, give the order in which the processes should run to completion. (b) If Process P3 requests 1 unit of R3, should we grant this request? If yes, give a in which all processes can run to completion. Allocation Matrix R1 R2 R3 P1 1 0 0 P2 5 1 1 P3 2 1 1 P4 0 0 2 Claim Matrix R1 R2 R3 P1 3 2 2 P2 6 1 3 P3 3 1 4 P4 4 2 2 Resource Vector R1 R2 R3 9 3 6	6	3-3-2.1.3
3 c)	Define a critical section problem. Specify the requirements to be satisfied by the solution to the critical section problem.	4	3-3-2.1.2

Q.4 a)	State whether the following statement is true or false. 1.Two processes reading from the same virtual address will access the same contents. 2. Paging approaches suffer from internal fragmentation, which grows as the size of a page grows.	2	4-3-2.1.2
4 b)	i)If a virtual address is 16 bits and each page is 128B, then each address space can contain how many pages? ii) If 8 bits are used in a virtual address to designate an offset within a page, then what is the page size? iii) If a physical address is 24 bits and each page is 4KB then how many bits represent the frame number.?	3	4-3-2.1.3
4 c)	The collection of tracks under the head at any time is known as ----------. Suppose that the head of a moving head disk with 192 tracks(0-191), is currently serving a request at track 80 and has just finished at track 62. The queue of the request is kept in FIFO order: 119, 58, 114, 28, 111, 55, 103, 30, 75. What is the total number of tracks traversed by head movements needed to satisfy these requests for the Look and C-Look algorithm? **OR** What is Inode? List 3 points about the information it contains. Consider a UNIX file system with 10 direct pointers, 1 indirect pointer, 1 double-indirect pointer, and 1 triple-indirect pointer in the i-node. Assume that disk blocks are 4K bytes and that each pointer to a disk block requires 4 bytes. What is the largest possible file that can be supported with this design?	5	5-3-2.1.3
4 d)	Draw and compare contiguous file allocation and linked file allocation method wrt fragmentation, reliability and speed of operation.	5	5-2-1.4.1