No of Pages : 5 **Course Code : 12XW44**

Roll No:
(To be filled in by the candidate)

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

SEMESTER EXAMINATIONS, APRIL / MAY - 2016

MSc - SOFTWARE SYSTEMS Semester : 4

12XW44 OPERATING SYSTEMS

Time : 3 Hours **Maximum Marks : 100**

INSTRUCTIONS:

1. Answer **ALL** questions from GROUP – I.
2. Answer any **4** questions from GROUP – II.
3. Answer any **ONE** question from GROUP – III.
4. Ignore the box titled as **"Answers for Group III"** in the Main Answer Book.

GROUP - I **Marks : 10 x 3 = 30**

1. Consider the dining philosopher problem. Assume that some philosophers always pick up their left forks first (a "lefty") and some philosophers always pick up their right forks first (a "righty"). Also assume that there is at least one lefty and one righty at the table. Can deadlock occur? Is starvation possible? Justify.
2. "Priority inversion is a condition that occurs in real time systems where a low priority process is starved because higher priority processes have gained hold of the CPU" – Comment on this statement.
3. Consider a memory system with a cache access time of 10ns and a memory access time of 110ns – assume the memory access time includes the time to check the cache. If the effective access time is 10% greater than the cache access time, what is the hit ratio H?
4. P is a set of processes. R is a set of resources. E is a set of request or assignment edges. The sets P, R, and E are as follows:

   P = {P1, P2, P3} R = {R1,R2,R3}

   E = {P1 → R2, P2 → R1, P2 → R2, P2 → R3,R1 → P1,R2 → P3,R3 → P3}

   R1 has one instance. R2 has two instances. R3 has one instance.

   - Draw the resource-allocation graph.
   - Is there any deadlock in this situation? Justify.
5. What is the difference between a user-level instruction and a privileged instruction? Which of the following instructions should be privileged and only allowed to execute in kernel mode?

   - Load a value from a memory address to a general-purpose register.
   - Set a new value in the program counter (PC) register.
   - Turn off interrupts.
   - Call a subroutine | pushes the return address onto the stack and jumps to the subroutine.

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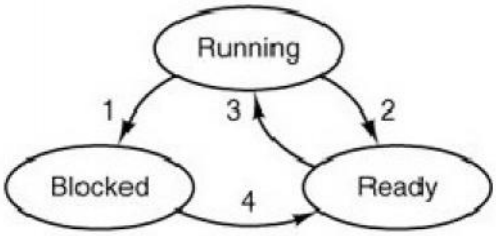
6. In the following graph you can see the three scheduling states a process can be in. Write an example event that triggers each transition.



7. Why is switching threads less costly than switching processes?
8. What is the difference between deadlock prevention and deadlock avoidance? What category does Banker's algorithm falls in and why?
9. When a user uses the mouse to "drag" an object across the screen, what is the sequence of events that the mouse controller will generate to communicate with the CPU? What data is communicated with each event?

   Consider a demand paging system. Assume working set window is 7, and the following reference string is given for process P:

   1, 2, 1, 4, 3, 4, 1, 2, 1, 4, 5, 2, 5, 3, 5, 2, 3

   t

   What is the working set of this process at time t?
10. How efficiently the Contiguous, Linked and Indexed file allocation strategies handles sequential access of large files, and why?

GROUP - II Marks : 5 x 10 = 50

11. a) Consider the following two processes A and B. x and y are common variables for both A and B. What could be the output of the concurrent execution of process A and process B? Write all possible outputs.

int x=0; int y=0;	

Process A
while (x==0) { do nothing };
printf("a");
y=1;
y=0;
printf("d");
y=1;
	Process B
	printf("b");
	x=1;
	while (y==0) { do nothing };
	printf("c");

b) Consider the following flow graph (representing 7 processes) Use the wait() and signal() representation to describe the synchronization. You can denote the code executed by the process using the notation "body". S and F denote the start and end. Write pseudo code for synchronization using semaphore.

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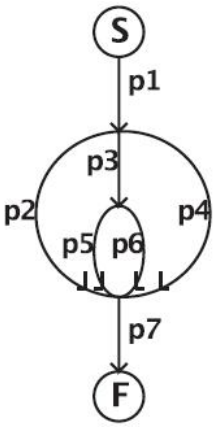

12. When do page faults occur? List the actions taken by the operating system when a page fault occurs. A small computer has 8 page frames, each containing a page. The page frames contain virtual pages A, C, G, H, B, L, N, D, and F in that order. Their respective load times were 18, 23, 5, 7, 32, 19,3, and 8. Their reference bits are 1, 0, 1, 1, 0, 1, 1, and 0 and their modified bits are 1, 1, 1, 0, 0, 0, 1, and 1, respectively. What is the order that second chance considers pages and which one is selected?

13. What is the difference between logical address and physical address? Suppose you have a virtual memory system where addresses are 22 bits and the page size is 4096 (i.e. 2^{12}) bytes.

    i) How many bits of a virtual address are used to determine the virtual page number and how many bits are used to determine the offset?

    ii) How many elements would a page table need to have?

    iii) Suppose, during the execution of a process, the MMU performs the following virtual address to physical address translations:

    0000000101101011010111 → 0000010110101011010111

    0000011110000010110100 → 0010000001000010110100

    0001010001010100010010 → 0000000101010100010010

    0000000101000000010010 → 0000010110000000010010

    How many different elements of the page table are accessed by the MMU to produce the above translations? Which elements of the page table are they and what page frame numbers do these elements contain?

    iv) Briefly describe the sequence of events that occur when a process tries to access a location in its virtual address space that is not currently in RAM. Start with the initial attempt to access the location and end with the location being accessed successfully.

14. Consider the execution of two processes P1 and P2 with the following CPU and I/O burst times.

P1	P2
CPU – 3	CPU – 4
Net – 4	Disk – 3
CPU – 2	CPU – 3
Disk - 3	Net - 3

Each row shows the required resource for the process and the time that the process needs that resource. For example “Net 3” in forth row says that P2 needs network card for 3 time units.

i) If P2 arrives 2 time units after P1 and the scheduling policy is non-preemptive SJF then calculate the finish time for each process and the CPU idle time in that duration.

ii) If P2 arrives 2 time units before P1 and the scheduling policy is preemptive SJF then calculate the finish time for each process and the CPU idle time in that duration.

15. Assume that WindowsXP stores a file on the hard disk using the following runs: (track 12, sectors 1-4), (track 18, sectors 4-8), (track 23, sectors 2-10), (track 35, sectors 3-7). How much seek time is needed to read this file using

    i) the elevator algorithm

    ii) the shortest-seek-first algorithm

    in both cases the initial position of the head is at track 20, the initial direction of the head is down, and the track-to-track seek time is 5ms. Explain whether this computation would change if, instead of using runs, the sectors storing the file were randomly placed in tracks 12-34?

16. Suppose we have files F1, F2, F3 and F4 in sizes 7178, 572, 499 and 1195 bytes. The capacity of the disk is 50 KB with fixed physical block size of 512 bytes for allocation.

    i) How many physical blocks would be needed to store these four files? Assume that in case of linked allocation strategy, 5 bytes are needed to store the next block in the link.

    ii) Using a diagram, show how allocation for these files is done in contiguous, linked and indexed allocation.

    iii) What is the type of fragmentation associated with each of file allocation policies. For each file, find the internal fragmentation measured as percentage of the file size.

    iv) Write the bit vector for the disk and calculate the size of the bit-vector.

    v) Now, the size of the file F3 is increased to 600 bytes. How many more physical blocks are required? How many disk IO is to be performed to add the new block(s) at the end in each allocation policy? Assume that the new block(s) are in memory and other structures are in disk.

GROUP - III **Marks : 1 x 20 = 20**

17. What do you mean by term synchronization? What is Semaphore? Explain how semaphore can used as synchronization tool.

    Consider a coke machine that has 10 slots. The producer is the delivery person and the consumer is the student using the machine. We use the following three semaphores:

    semaphore mutex

    semaphore fullBuffer /* Number of filled slots */

    semaphore emptyBuffer /* Number of empty slots */

    - Write pseudo code for delivery_person() and student()
    - What will be the initial values of the semaphores?
    - Write a solution that guarantees mutual exclusion and no deadlocks.

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18. What is deadlock? What are the necessary conditions for deadlock to occur? Explain the deadlock prevention method of handling deadlock.

    Consider the following information about resources in a system.

    - There are two classes of allocatable resource labeled R1 and R2
    - There are two instances of each resource
    - There are four processes labeled p1 through p4
    - There are some resource instances already allocated to processes as follows:
        - One instance of R1 held by p2, another held by p3
        - One instance of R2 held by p1, another held by p4
    - Some processes have requested additional resources, as follows:
        - p1 wants one instance of R1
        - p3 wants one instance of R2

    i) Draw the resource allocation graph for this system

    ii) What is the state (runnable, waiting) of each process? For each process that is waiting indicate what it is waiting for.

    iii) Is this system deadlocked? If so, state which processes are involved. If not, give an execution sequence that eventually ends, showing resource acquisition and release at each step.

/END/

FD/RL