No of Pages : 7 **Course Code : 15XW44 / 15XT44 / 15XD44**

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

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

SEMESTER EXAMINATIONS, APRIL 2017

MSc - TCS / SOFTWARE SYSTEMS / DATA SCIENCE Semester: 4

15XW44 / 15XT44 / 15XD44 OPERATING SYSTEMS

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

INSTRUCTIONS:

1. Answer **ALL** questions from GROUP – I.
2. Answer any **FIVE** 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. A computer has 192 bytes of memory organized into 64 byte blocks. The following addresses are accessed in the order specified:

   50, 306, 96, 194, 141, 298, 90, 275, 133, 265, 9

   How many pages of memory are accessed?

   How many frames of memory are accessed?

2. The following are some characteristics of disk allocation methods. Namethree methods of disk allocation and indicate which characteristics they possess.

   - Space wasted in index block
   - Inefficient for random access
   - Single file typically resides on a single cylinder
   - Suffers external fragmentation
   - Suffers internal fragmentation if initial file size allocation is too big.
   - Unreliable because single error can cause loss of many blocks of data

3. What factors make up the time necessary to read data off a disk drive? Which is the limiting factor? Why?

4. What are the necessary conditions for deadlock?Fix the following code to avoid the possible deadlock. What condition did you remove by making your change?

Process A	Process B
acquire(L1) acquire(L2) release(L2) release(L1)	acquire(L2) acquire(L1) release(L1) release(L2)

5. How does the mixture of I/O bound processes with CPU bound processes maximizes system utilization? Why is this more important in batch systems than it is on most computers sitting around in our department?

6. What's the difference between a process starting another copy of itself and starting another thread? Suppose a program has three threads Thread1, Thread2, and Thread3, and ashared counter variable,count, as shown below:

```
int count = 10;
Semaphore Lock = 1;          // initial value is 1
```

Thread1	Thread2	Thread3

// do something
wait(Lock);
count++;
Signal(Lock);
	// do something
	wait(Lock);
	count−−;
	Signal(Lock);
		// do something
		wait(Lock);
		printf("%d", count);
		Signal(Lock);

What are the possible outputs of this program? If there is more than one answer,provide them all. Does this process suffer from a race condition? Justify your answer.

7. What is a link? In a UNIX file system, list the inode anddata blocks that must be accessed by the file system when a process requests to open /a/b/c
   - If /a/b/c is a hard link to the file /x/y/z.
   - If /a/b/c is a symbolic (soft) link to the file /x/y/z.
8. A professor shares file with the students by placing them in a publically accessible directory onthe department's system. One day, he realizes that a file placed there the previous day is worldwritable. He change the permissions and verifies the file is identical to his master copy. The nextday he finds the file has been changed. How could this have happened and how could it have beenprevented (by the professor, not by the OS)?
9. What do you mean by locality of reference? A student in a compiler course proposes to the professor a project of writing a compiler that willproduce a list of page references that can be used to implement the optimal page replacementalgorithm. Is this possible? Why or why not?
10. Consider a FAT-based (File Allocation Table) file system. Entries in the table are 16 bits wide. A user wants to install a disk with 131072 512-byte sectors. What is a potential problem?

GROUP - II **Marks : 5 x 10 = 50**

11. Suppose the following processes arrive at the times indicated. The total available memory is 35 units. OS occupies 10 units and the remaining 25 units for user process. Assume all processes are CPU bound and the content switch time is 1.

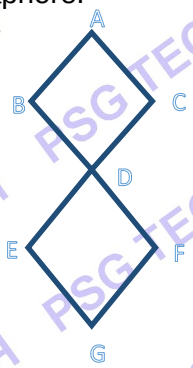
Process	Arrival Time	CPU Burst Time	Memory Required (Units)
P1	0	5	3
P2	3	3	5
P3	7	9	8
P4	12	10	12
P5	18	16	2
P6	25	2	6
P7	29	8	9

- Calculate the turnaround time for each process using FCFS scheduling policy.

- Draw the memory map if First-fit allocation policy is used and processes are scheduled using FCFS.
- Draw the memory map if Best-fit allocation policy is used and processes are scheduled using FCFS.

12. a) What are the primary mechanisms that an applications programmer and systems programmer can use to ensure correct process synchronization when manipulating shared data?

b) Semaphores can be used to express scheduling constraints between activities performed by different threads. Consider the following flow diagram denoting the dependencies between activities A, B, C, D, E, F and G which are executed by 7 different threads. Write a complete C program to implement these 7 threads to ensure these constraints using semaphore.



13. a) A process has the following history of bursts. Given the following α's, what is the estimate for the next burst? (higher α weighs more recent history more heavily.) Answers must be accurate within 0.5 time units

Initial	History	History	History	α
2	3	7	3	0.5000
4	4	4	4	0.6667
10	9	8	5	0.0000
8	5	5	3	1.0000

b) Assume that the execution of each process is divided into a sequence of CPU bursts. Assume that P1, P2 and P3 are three processes in the system and they all arrived before t=0. Their sequences of CPU bursts are specified as the following:

P1: (2,3,2), P2: (3,4,2), and P3(2,1,4).

Assume they have different α value: α(P1) = 0.45, α(P2) = 0.5 and α(P3) = 0.55. Use the following formula to evaluate the (n+1) th CPU burst time.

$$\tau_{n+1} = \alpha\, t_n + (1-\alpha)\tau_n$$

and t_0= 0 and τ_0= 10 for all processes. Draw a Gantt chart to illustrate the scheduling of these processes if a SJF algorithm is used.

14. The output from a particular user's recent session on a local Linux system is given below. Use this output and your knowledge of Linux to answer these questions.

- What inode number does the source code file have in the file system?
- What is the name of the object code file used in this example?

- How large (in bytes) is the object code file used in this example?
- What specific type of executable file is it?
- How many processes are created when the final command is executed?
- What is the output produced when the final command is executed?

```
[vsk@csl]$ ls
a.out
meow
meow.c
[vsk@csl]$ cat meow.c
        /* Test program for final exam */
        #include <stdio.h>
        #include <stdlib.h>
        #include <unistd.h>
        int main()  {
                int pid;
                printf("I like eating!\n");
                pid = fork();
                if( pid == 0 )        {
                        printf("I like napping!\n");
                        sleep(60);
                        execlp("./meow", "meow", NULL);
                        printf("I don't like noodles!\n");
                }
                else if( pid > 0 )    {
                        printf("I like liver!\n");
                        execlp("/bin/date", "date", NULL);
                        printf("I like tuna!\n");
                }
                printf("Please deliver!\n");
        }
[vsk@csl]$ cc -o meow meow.c
[vsk@csl]$ file meow
meow: ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), for GNU/Linux
2.6.9, dynamically
[vsk@csl]$ ls -li
17908146 8 -rwxr-xr-x 1 vskroot 5254 Apr 17 13:38 a.out
17908147 8 -rwxr-xr-x 1 vsk root 5331 Apr 17 13:50 meow
17908148 4 -rw-r--r-- 1 vsk root522 Apr 17 13:47 meow.c
[vsk@csl]$ date
Thu Mar 30 14:40:24 IST 2017
[vsk@csl]$ ./meow
```

15. a) Consider a system where the virtual memory page size is 2K (2048 bytes), and main memory consists of 4 page frames. Now consider a process which requires 8 pages of storage. At some point during its execution, the page table is as shown below:

Virtual page	Valid	Physical page
0	No	
1	No	
2	Yes	1
3	No	
4	Yes	3
5	No	
6	Yes	0
7	Yes	2

- List the virtual address ranges for each virtual page.
- List the virtual address ranges that will result in a page fault.
- Write the main memory (physical) addresses for each of the following virtual addresses (all numbers decimal): (i) 8500, (ii) 14000, (iii) 5000, (iv) 2100.

b) Consider a system with the following specification:

- Total available physical memory frame: 1200KB
- Frame Size is 4 KB
- Total processes : 6
- The frame needed by each process has the following format (Process ID, Total frame). (0, 40), (1, 60), (2, 100), (3, 20), (4, 80), (5, 100)

Unfortunately the total available frames are limited. The system cannot supply all the requested frames to every process.

i) Determine total frames given to each process if the system uses equal allocation mechanism.

ii) Determine total frames given to each process if the system uses proportional allocation algorithm.

16. Disk requests come into the disk driver for cylinders 10, 22, 20, 2, 40, 6, and 38, in that order. Assume that the disk has 100 cylinders.A seek takes 6msec per cylinder moved. Compute the average seek time for the request sequence given above for

- First-come, First-served
- Shortest Seek Time First (SSTF)
- LOOK (with the disk-arm initially moving towards higher number cylinders from lower number cylinders)
- C-SCAN

In all the cases, the arm is initially at cylinder 20.

No of Pages : 7 **Course Code : 15XW44 / 15XT44 / 15XD44**

GROUP - III Marks : 1 x 20 = 20

17. Consider a disk with the following specifications:
    - Using five platters
    - One platter consists of two surfaces (top surface #0 and bottom surface #1).
    - One surface capacity: 5 Gb
    - Total tracks on one surface: 2500 (track#0 - #2499).
    - Speed rotation: 6000 rpm.
    - Total sectors in one track: 500 (sector #0 - #499).
    - Time needed to move from one track to adjacent track: 1 ms
    - Assume, only one head active reading/writing. Time needed to move from surface #0 to surface#1 is 0 ms.
    - Disk scheduling algorithm: First Come First Served.
    - At T=0, the head position is above cylinder #0, sector #0.
    - Measurement: 1 kbyte = 1000 byte; 1 Mbyte = 1000 kbyte; 1 Gbyte = 1000 Mbyte.

    Answer the following Questions:

    i. Determine the capacity of one cylinder and also determine the disk size.

    ii. How long it takes to read/write one sector?

    iii. Determine the time (mS) to move from surface#0, track#0, sector#0 to surface#0, track#4,sector #399 ([0,0,0] →[0,4,399]).

    iv. Determine the time (mS) to move from [0,0,0] → [0,0,499] → [0,3,99] → [0,3,499] →[0,2,249].

    v. Some processes request to read/write some cylinders in surface 0. System pools the entire request on the following queue:

    Queue(Q)= 200, 1500, 900, 2000, 340, 500, 1100, 1800

    Right now the disk is reading cylinder 1000. Determine the cylinder access sequence and its total movement if SSTF and SCAN disk scheduling algorithms are used. Assume the head moves towards the end.

18. **Explain deadlock avoidance Apply** deadlock avoidance to the following problem. A restaurant would like to serve four dinner parties, P1 through P4. The restaurant has a total of 8 plates and 12 bowls. Assume that each group of diners will stop eating and wait for the waiter to bring a requested item (plate or bowl) to the table when it is required. Assume that the diners don't mind waiting. The maximum request and current allocation tables are shown as follows:

Maximum Request	Plates	Bowls
P1	7	7
P2	6	10
P3	1	2
P4	2	4

Current Allocation	Plates	Bowls
P1	2	3
P2	3	5
P3	0	1
P4	1	2

i) Determine the Need Matrix for plates and bowls.

Need	Plates	Bowls
P1		
P2		
P3		
P4		

ii) Will the restaurant be able to feed all four parties successfully? Clearly explain your answer – specifically, why no or why/how there is a safe serving order.

iii) Assume a new dinner party, P5, comes to the restaurant at this time. Their maximum needs are 5 plates and 3 bowls. Initially, the waiter brings 2 plates to them. In order to be able to feed all five parties successfully, the restaurant needs more plates.

- Determine the new Need Matrix for plates and bowls.

Need	Plates	Bowls
P1		
P2		
P3		
P4		
P5		

- At least how many plates would the restaurant need to add?
- Show a safe serving sequence.

FD/RL **/END/**