Ex/CSE/MCA/T/211A/2018

MCA Third Semester Examination, 2018(New)
Operating Systems

Time – 3 Hours **Full Marks – 100**

Answer any five questions
Answer sub parts of a question together

1.

a. What are the different states a process can assume? Describe with a suitable diagram, how and under what conditions a process transitions from one state to another.
b. Differentiate between a long term scheduler and a short term scheduler.
c. What is context switch? Give one example of a hardware support that decreases context switch time.
d. Consider the following five processes, with the arrival time and the length of the CPU burst. Determine the waiting time, turn-around time of these processes for both the scheduling algorithms (i) preemptive shortest remaining-time first and (ii) round robin (time quanta = 4).

Process	Arrival Time	Burst Time
P_1	0	6
P_2	3	2
P_3	5	4
P_4	7	6
P_5	10	3

e. Explain with proper justification, what will happen if the time quantum in round robin scheduling is too short and too long compared to average CPU burst time of processes.

4+2+2+8+4=20

2.

a. What is a counting semaphore?
b. Explain the requirements that any solution to the critical section problem must satisfy.
c. Mention one hardware support in form of a processor instruction that can be used to solve critical section problem. Explain how this is achieved.
d. Processes P_1 and P_2 should synchronize among themselves using semaphores such that the string "ABBA" gets printed infinite times. Determine, minimum number of semaphores required and their initial values. Also identify places where operations on those semaphore should be inserted in the code of P_1 and P_2. Provide justifications for your answer.

```
P1
while(true){
        print("A");
}
```

```
P2
while(true){
        print("B");
}
```

e. For the following code segment determine how many times the message "Hello" and "World" will be printed.

```
int i=0;
do{
        if(fork()!=0){
                i++;
                printf("Hello");
        }
        else{
                i+=2;
                printf("World");
        }
}while(i<=3);
```

2+3+3+5+7=20

3.

a. What is process control block? What information does it contain?
b. Discuss an algorithm for handling two process critical section problem and show that it meets all requirements.
c. What are the synchronization requirements of the producer and consumer processes in both bounded-buffer and unbounded-buffer producer consumer problem?
d. A shared variable x, initialized to zero, is operated on by three concurrent processes X, Y and Z as follows. Each of the processes X and Y reads x from memory, increments by one, stores it to memory, and then terminates. Process Z reads x from memory, decrements by one, stores it to memory, and then terminates. Each process before reading x invokes the P operation (i.e., wait) on a counting semaphore S and invokes the V operation (i.e., signal) on the semaphore S after storing x to memory. Semaphore S is initialized to two. What are the possible values of x after all processes complete execution? Provide suitable justifications for your answer.

3+5+2+10=20

4.

a. What are the necessary conditions of deadlock? Explain each briefly.
b. Describe two strategies for deadlock recovery.
c. Define safe state and safe sequence.
d. A system has four resource types and five running processes. Resource types A, B, C and D have 6, 7, 12 and 12 instances respectively. Consider the following snapshot of a system. Allocation column gives current allocation of each process and Maximum column gives maximum needs of each process.

	Allocation				Max			
	A	B	C	D	A	B	C	D
P_0	0	0	1	2	0	0	1	2
P_1	2	0	0	0	2	7	5	0
P_2	0	0	3	4	6	6	5	6
P_3	2	3	5	4	4	3	5	6
P_4	0	3	3	2	0	6	5	2

Determine if the system is currently deadlocked. If a request from P_2 arrives for (0, 1, 0, 0) can it be granted immediately? If not, which processes may become deadlocked if the whole request is granted?

4+2+2+12=20

5.

a. Describe how logical and physical addresses differ in each of the compile-time, load-time and execution-time address binding.

b. What is internal fragmentation?

c. A computer uses 46-bit virtual address, 32-bit physical address, and a three-level page table organization. The page table base register stores the base address of the outer-level page table (PT1), which occupies exactly one page. Each entry of PT1 stores the base address of a page of the second-level page table (PT2). Each entry of PT2 stores the base address of a page of the third-level page table (PT3). Each entry of PT3 stores a page table entry (PTE). Pages of page table in all levels are full. Each PTE is 32 bits long. Determine the page size and number of frames in physical memory.

d. Consider a paging hardware with a TLB. Assume that the entire page table and all the pages are in the physical memory. It takes 10 milliseconds to search the TLB and 80 milliseconds to access the physical memory. If the TLB hit ratio is 0.6, determine the effective memory access time (in milliseconds).

4+2+8+6=20

6.

a. Under what circumstances do page faults occur? Describe the actions taken by the operating system when a page fault occurs.

b. A system uses 3 page frames for storing process pages in main memory. It uses the Least Recently Used (LRU) page replacement policy. Assume that all the page frames are initially empty. What is the total number of page faults that will occur while processing the page reference string 1, 2, 3, 4, 2, 1, 5, 3, 2, 4, 6, 2. How good is LRU with respect to OPTIMAL page replacement policy over the same page reference string? (in terms of number of page faults)

c. What is thrashing?

d. Describe the working set model that is used to avoid thrashing.

e. Determine the working set at the time of each page reference for the page reference string 4, 7, 6, 1, 7, 6, 1, 2, 7, 2, 4, 5. Consider working set window size as 4.

5+4+2+4+5=20

7.

a. Differentiate between sequential and direct file access.

b. Describe with a suitable example the linked allocation strategy for allocating disk blocks to a file.

c. Suppose a disk has 200 cylinders, numbered from 0 to 199. At some time the disk arm is at cylinder 100, and there is a queue of disk access requests for cylinders 30, 85, 90, 100, 105, 110, 135 and 145. If Shortest-Seek Time First (SSTF) is being used for disk scheduling, determine the number of requests after which the request for cylinder 90 is serviced. Find the same, if the disk scheduling strategy is SCAN.

d. Consider a hard disk with 16 recording surfaces (0-15) having 2048 cylinders (0-2047) and each track contains 64 sectors (0-63). Data storage capacity in each sector is 512 bytes. Data are organized cylinder-wise and the addressing format is <cylinder no., surface no., sector no.>. A file of size 2 MB is stored in the disk and the starting disk location of the file is <12, 0, 0>. What is the address of the last sector of the file, if it is stored in a contiguous manner? Also find the size of the disk.

3+3+6+8=20

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