

Roll Number: _____

Thapar Institute of Engineering & Technology
Department of Computer Science and Engineering

AUXILIARY EXAMINATION

B. E. (2nd Yr. COE/CSE)

Course Code: UCS303

10th March, 2022

Course Name: Operating Systems

Thursday, Time – 5:30 to 7:30 pm

Time 2 Hrs, Maximum Marks: 50

Note: Attempt any 05 complete questions (including sub-parts) out of 07 questions. Assume any missing data. Only first 5 questions (including sub-parts) will be considered during marking/evaluation.

- Q1. a) Explain Zombie process and orphan process and find out output for the following code: [5]

```
int main ()
{
    fork ();
    printf("Hello world! \n");
    fork ();
    printf("Hello world! \n");
    return 0;
}
```

- b) Two concurrent process P1 and P2 want to use two resources printer and scanner in mutually exclusive manner, initially printer and scanner are free. The program executed by two processes are given below.

[5]

P1	P2
I1: while (printer==busy) {};	I1: while (printer==busy) {};
I2: printer=busy;	I2: printer=busy;
I3: while (scanner==busy) {};	I3: while (scanner==busy) {};
I4: scanner=busy;	I4: scanner=busy;
I5: use both resources	I5: use both resources
I6: printer = free	I6: scanner = free
I7: scanner = free	I7: printer = free

- Is mutual exclusion guaranteed for printer and scanner? If not show a possible interleaving of the statements of P1 and P2 such mutual exclusion is violated.
- Can deadlock occur in the above program? If yes, show a possible interleaving of the statements of P1 and P2 leading to deadlock.

- iii. If we exchange the statements I1 and I3 and statements I2 and I4 in P2. Is mutual exclusion guaranteed now? Can deadlock occur?

Q2. a) Explain multiprogramming and multitasking with their major objectives. Consider three jobs JOB1, JOB2 and JOB3. JOB1 runs in a loop for 10 iterations that requires 5 seconds of CPU time, followed by 11 seconds of I/O to disk, followed by 7 seconds of CPU time. JOB2 runs in a loop for 10 iterations that requires 7 seconds of CPU time followed by 12 seconds of disk I/O followed by 2 CPU time, JOB3 runs in a loop for 15 iterations that requires 2 seconds of CPU time followed by 9 seconds of disk I/O followed by 5 CPU time. Find out CPU utilization in following cases. [5]

- If jobs run consecutively in batch mode?
 - How would this improve if multiprogramming is allowed?
- b) Consider the following snapshot of a system: Assume we have 5 tape drives, 2 graphic displays, 4 printers, 3 disks. List of allocated resources are as follows. [3]

Process Name	Allocation			
	Tape Drives	Graphics	Printers	Disk Drives
Process A	2	0	1	1
Process B	0	1	0	0
Process C	1	0	1	1
Process D	1	1	0	1

Maximum resource requirement is as follows:

Process Name	Maximum			
	Tape Drives	Graphics	Printers	Disk Drives
Process A	3	1	1	1
Process B	0	2	1	2
Process C	4	1	1	1
Process D	1	1	1	1

Answer the following questions using the banker's algorithm.

- If a request from B arrives for (0,0,1,0) can the request be granted immediately.
 - If a request from C arrives for (2,0,0,0) can the request be granted immediately
- c) In a system following state of system is given: [2]

$P1 \rightarrow R1, R1 \rightarrow P2, P2 \rightarrow R4, P2 \rightarrow R3, P2 \rightarrow R5, R3 \rightarrow P5, R4 \rightarrow P3,$
 $P3 \rightarrow R5, R5 \rightarrow P4, P4 \rightarrow R2, R2 \rightarrow P1$

Draw the resource allocation graph and convert it into wait for graph and justify system will be in deadlock state or not.

Q3. a) Explain thrashing with causes and solutions. [4]

b) The address sequence generated by tracing a particular program executing in a pure demand paging system with 100 bytes per page is 0100, 0200, 0430, 0499, 0510, 0530, 0560, 0120, 0220, 0240, 0260, 0320, 0410. Suppose that the memory can store only one page and if x is the address which causes a page fault then the bytes from addresses x to $x + 99$ are loaded on to the memory.

[6]

- i. How many page faults will occur?
- ii. What is the working set if at the penultimate page reference Δ is 5.

Q4: Consider a hard disk with 8 platters (0, 1, 2...7) having 16384 cylinders (0-16383) and each cylinder contains 64 sectors (0-63). Data storage capacity in each sector is 512 bytes. The following 6 disk requests of the form [sector number, cylinder number, surface number] are received by the disk controller at the same time: [120, 30, 2], [180, 85, 1], [60, 90, 0], [212, 100, 3], [56, 105, 2], [118, 110, 1], [56, 135, 2], [118, 145, 1], currently head is positioned at sector number 80 of cylinder 100, and is moving towards higher cylinder numbers. The average power dissipation in moving the head over 100 cylinders is 20 milliwatts and for reversing the direction of the head movement once is 15 milliwatts. Power dissipation associated with rotational latency and switching of head between different platters is negligible.

[10]

- i. Find out total size of the disk.
- ii. If a file of size 42797 KB is stored in the disk and the starting disk location of the file is <40,1200,9>. What is the cylinder number of the last sector of the file, if it is stored in a contiguous manner?
- iii. Find out the total power consumption in milliwatts to satisfy all of the above disk requests using the Shortest Seek Time First disk scheduling algorithm.

Q5. a) Differentiate fixed size and variable size partitioning. Consider the following heap (figure) in which blank regions are not in use and black regions are in use- [3]



The sequence of requests for blocks of size is P1 - 300 kb, P2 - 25 kb, P3 - 75 kb, P4 - 50 kb, P5 - 100 and P6 - 450. Perform the allocation of processes using variable size partitioning scheme and apply first fit and best fit algorithm and compare them in terms of external fragmentation.

b) Explain need of Interprocess communications. How Message passing model is used for Interprocess communication?

[3]

- c) b) In a virtual memory system, size of virtual address is 32-bit, size of physical address is 30-bit, page size is 4 Kbyte and size of each page table entry is 32-bit. The main memory is byte addressable. Which one of the following is the maximum number of bits that can be used for storing protection and other information in each page table entry?

[4]

Q6. Consider below table of four processes under Multilevel Feedback Queue

[10]

Process	Arrival Time	Burst Time
P1	3	8
P2	4	7
P3	8	7
P4	12	1

scheduling. queue1 uses round robin scheduling algorithm having time quantum of 2 ms, queue2 also uses round robin scheduling algorithm with time quantum of 4ms and queue3 uses non-preemptive shortest job first algorithm for process scheduling. Priority of queue1 is highest and priority of queue 3 is smallest (queue1>queue2>queue3), and there is non preemptive priority scheduling between the queues. If process waiting time ≥ 13 ms at any point it must be upgraded to higher priority queue. Find out Avg. waiting time.

- Q7: a) Consider a main memory with three page frames and the following sequence of page references: 3, 8, 2, 3, 9, 1, 6, 3, 8, 9, 3, 6, 2, 1, 3, apply second chance algorithm and find the hit ratio. [5]

- b) Explain following terms: [5]

- i) Belady's anomaly
- ii) RACE condition
- iii) Internal Fragmentation
- iv) Convoy Effect
- v) Aging

Roll Number: _____

Group: _____

Name of Student: _____

Theory Quiz (10 Marks, 10Mins.)

Computer Science & Engineering Department, T.I.E.T. Patiala

Course Code: UCS-303

B.E. (COE/CSE)

Course: Operating System

10th March 2022

1. If a system is using proportional frame allocation method and it have total 72 frames to allocate between the processes of size 20KB and of 120KB, then the first process will be allocated _____ frames and other process will get _____ frames.
 - a) 61, 10
 - b) 10, 61
 - c) 20, 52
 - d) 52, 20
2. We are using fixed size partitioning scheme for memory allocation, let us assume the jobs and the memory requirements as follows:

Memory Requirement

Job1 - 90k

Job2 - 20k

Job3 - 50k

Job4 - 10k

Free Blocks

Block1 - 50k

Block2 - 100k

Block3 - 90k

Block4 - 200k

Block5 - 50K

If we use best fit partition allocation scheme, then what will be the total internal fragmentation for satisfying the request.

- a) 130
 - b) 30
 - c) 50
 - d) 40
3. _____ is used to locate the appropriate memory-resident library routine for dynamic linking
 - a) Stub
 - b) Paging
 - c) RAID
 - d) Working set model
4. In _____ we can survive 2 concurrent disk failures.
 - a) RAID 4
 - b) RAID 5
 - c) RAID 6
 - d) RAID 10

5. Consider a main memory with 3 page frames and the following sequence of page references:

4, 7, 6, 1, 7, 6, 1, 2, 7, 2

Which one of the following is true with respect to page replacement policy Least Recently Used (LRU)?

- a) On 4th page fault page 6 is replaced by page 2
 - b) On 5th page fault page 7 is replaced by page 2
 - c) On 6th page fault page 6 is replaced by page 2
 - d) On 7th page fault page 7 is replaced by page 6
6. Consider Peterson's algorithm for mutual exclusion between two concurrent processes i and j. The program executed by process i is shown below.

```
repeat
    flag[i]=TRUE;
    turn=j;
    while(p) do no-op;
    critical section
    flag[i] = false;
    non-critical section
until false
```

For the program to guarantee mutual exclusion, the predicate P in the while loop should be.

- a) $\text{flag}[j] = \text{true}$ and $\text{turn} = i$
 - b) $\text{flag}[j] = \text{true}$ and $\text{turn} = j$
7. Consider a hypothetical situation where system wants to allocate file f to a block of memory. Let A be an array (of size 10) of available memory blocks. The system accesses the array A only sequentially (i.e forward (1 to 10) or backward (10 to 1)). The following function is evaluated to allocate the file f to a block:

If(f.size<A[i].size){Allocate file to Block A[i]}

The system sorts the array again (ascending or descending based on the algorithm used) after each allocation (by considering leftover block size). Consider the following algorithms for the above hypothetical system:

Algorithm	Sort order of A (According to block size)	Comparison order of system
p	Ascending	A[1] to A[10] sequentially
q	Descending	A[1] to A[10] sequentially

Algorithm P, Q respectively

- a) Best fit, Worst fit
- b) Worst fit, Best fit
- c) Best fit, Best fit
- d) Worst fit, Worst fit

8. Consider a machine with 64 MB physical memory and a 32 bit virtual address space. If the page size is 4 KB, what is the approximate size of the page table?

- a) 16 MB
- b) 8 MB
- c) 2 MB
- d) 24 MB

9. Assume that the system has 3 page frames. Consider the following page reference stream in the given order.

7, 0, 1, 2, 0, 3, 0, 4, 2, 3

The number of page faults occur using optimal page replacement algorithm are

- a) 10
- b) 6
- c) 9
- d) 8

10. Consider a computer system with 40-bit virtual addressing and page size of sixteen kilobytes. If the computer system has a one-level page table per process and each page table entry requires 48 bits, then the size of the per-process page table is _____ megabytes.

- a) 387 MB
- b) 386 MB
- c) 385 MB
- d) 384 MB