SPRING END SEMESTER EXAMINATION-2015

4th Semester B.Tech & B.Tech Dual Degree

OPERATING SYSTEM (CS-2002 / CS-401)

(Regular-2013 & Back of Previous Admitted Batches)

Full Marks: 60 **Time: 3 Hours**

Answer any SIX questions including Question No.1 which is compulsory.

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

1. Answer all questions. [2 × 10

(a) Whether a Time Sharing Operating system is always a Multi Programmed Operating System or not? Justify.

(b) Name three preemptive CPU scheduling algorithms.

(c) What information are stored in Process Control Block to support context switching between two processes?

(d) A system has 6 identical resources and N processes competing for them. Each process can request atmost 2 resources. Explain for which maximum value of N system may lead to dead lock.

(e) Differentiate between logical address and physical address.

(f) How many child processes would be created for the following C-code

```
for( i=0; i<2;i++)
fork( );
fork( );
```


(g) Calculate the number of page faults for the following page reference string using FIFO algorithm with 4 numbers of frame.

5,0,2,1,0,3,0,2,4,3,0,3,2,1

(h) A program has been divided into five segments. The SMT is given below.

Seg No	Segment limit	Segment Base
0	200	4100
1	700	1000
2	400	3700
3	900	1800
4	1000	2700

Calculate the physical address for the following logical addresses in segmentation scheme.(The most significant digit represents the segment number)

(a) 1665

(b) 3906

(i) SSTF disk scheduling algorithm may suffer from starvation. Jusify.

(j) Write any two advantages of indexed file allocation.

2. Consider five Processes arrived in a system with the following information. [8

Process	CPU Burst Time	Arrival Time	Priority
A	10	0	4
B	7	2	2
C	2	6	1
D	6	7	5
E	8	9	3

Find the turnaround time for every processes and the sequence of completion of processes for the following CPU scheduling policies

(a) Round Robin with time quantum of 2 units.

(b) Preemptive Priority where lower digit indicates higher priority.

3. (a) What are the components of an operating system? Explain with their functionalities. [4

(b) What conditions a solution to the critical section problem must satisfy? How does Peterson's solution satisfy the conditions? Explain. [4

4. (a) Consider a system with five processes P_0 to P_4 competing for 4 resource types that are A, B, C and D. Resources type A has 6 instances, B has 4 instances, C has 4 instances and D has 2 instances. The initial resource allocation table of the processes is as follows. [6

Process	Allocated				Max. Req.			
	A	B	C	D	A	B	C	D
P_0	2	0	1	1	3	2	1	1
P_1	1	1	0	0	1	2	0	2
P_2	1	1	0	0	1	1	2	0
P_3	1	1	1	0	3	2	1	0
P_4	0	0	0	1	2	1	0	1

(i) Show the safe sequence if it is in safe state.
(ii) Will the process P_3 be granted with another resource of type A to avoid deadlock?

(b) Write down deadlock recovery processes. [2

5. (a) What is paging? Explain the hardware required to implement paging. [4

(b) Consider a system with byte–addressable memory, 32-bit logical addresses, 4KB page size and page table entries of 4 bytes each. What would be the size of the page map table in the system? [4

6. (a) Suppose the following disk request sequence (track numbers) for a disk with 100 tracks is given: 45, 20, 90, 10, 50, 60, 80, 25, 70. Assume that the initial position of the R/W head is on track 50. What additional distance (track) that will be traversed by the R/W head when the Shortest Seek Time First (SSTF) algorithm is used compared to the SCAN (Elevator) algorithm? [4

(assume that SCAN algorithm moves towards 100 when it starts execution)

(b) Explain about the various directory structures with their relative advantages and disadvantages. [4

7. (a) What is meant by domain of protection? How is it implemented by the operating system? [4

(b) Explain in detail how o/s will carry out input and output operation. [4

8. Write short notes on the followings.(Any two) [4 × 2

(a) High level Synchronization tools.

(b) Indexed linked allocation

(c) Deadlock Prevention

SPRING END SEMESTER EXAMINATION - 2017

4th Semester BCA

OPERATING SYSTEM

(BCA - 406)

(Regular 2015 Admitted batch & back)

Time: 3 Hours **Full Marks: 60**

*Answer **any six** questions including question No.1 which is compulsory.*
The Figures in the right hand margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

1. Briefly answer the following questions: [2×10]

   a) In a paging systems with TLB, it takes 60 ns to search the TLB and 100 ns to access memory. If the TLB hit ratio is 90%, find the effective memory access time.

   b) Explain about the advantage there in having different time-quantum sizes at different levels of a multilevel queuing system?

   c) Write the major activities of an operating system with regard to information protection and security?

   d) Why it is difficult to implement SJF scheduling algorithm? Define the formula to predict the next CPU burst in SJF algorithm.

   e) What do you mean by context switching? Is context switching an overhead? Why?

   f) Is thrashing a desirable solution? How to overcome it?

g) With suitable diagram explain what do you mean by swapping?

h) What do you mean by dynamic partition memory management scheme? What are the main advantage and disadvantage of it?

i) What are the various operations that can be performed on a file?

j) In a system the following state of process and resources is given

P1→R2, R2→P1,P2→R3, R1→P2, R3→P3, P3→R4, P4→R3, R4→P4, P4→R1, R1→P5

Draw a wait-for-graph for the system, and check the deadlock condition.

2. a) What is a system call? By giving an example, illustrate how system calls are used? Discuss the major categories of system calls. [3+5]

b) Explain the evolution of an operating systems by defining the essential properties of Multiprogramming systems, Time sharing systems, Distributed systems, Real time systems, and Handheld systems.

3. a) Write the optimization criteria for CPU scheduling. [2+6]

b) Consider the following set of processes, with the length of the CPU burst time given in milliseconds.

Process	Arrival time	Burst time
P1	0	8
P2	1	14
P3	1	5
P4	2	10

Draw Gantt Charts to illustrate the execution of above process by using the scheduling algorithm FCFS, SJF preemptive, SJF non-preemptive and Round Robin with quantum 4. Also find the average turnaround time and average waiting time for each algorithm of scheduling.

4. a) State and briefly explain the necessary and sufficient conditions for a deadlock. [2+6]

b) Consider the following snapshot of a system with 3 processes p1 through p3 and 3 resources R_1, R_2,and R_3. Resource type R_1 has 7 instances, resource type R_2 has 7 instances, and resource type R_3 has 10 instances.

Processes	Allocation			MAX		
	R_1	R_2	R_3	R_1	R_2	R_3
P1	3	6	8	2	2	3
P2	4	3	3	2	0	3
P3	3	4	4	1	2	4

Answer the following questions using Banker's algorithm.

ii) What is the content of the matrix need?

iii) Is the system in a safe state? If yes, find the sequence that satisfies the safety requirement.

iv) If a request from process P1 arrives for (1, 1, 0) can the request be granted?

v) If a request from process P2 arrives for (0, 1, 0) can the request be granted?

5. a) Explain different directory structure in the file system. [3+5]

b) Consider a disk drive that has 250 cylinders, numbered 0 to 249. The last request serviced was at track 44 and the head is moving towards track 0. The queue of pending request in the following order is:-

10, 56, 92, 75, 108, 89, 149, 176, 189, 211

Compute the number of tracks the disk arm must move to satisfy all the requests in the queue for the following algorithms:- FCFS, SSTF, SCAN, C-SCAN, LOOK

6. a) Explain the address translation mechanism of the paging method of memory management. [4+4]

   b) With a neat sketch explain about the segmentation architecture.

7. a) Discuss the memory sharing model of inter process communication by giving example of producer-consumer problem. [4+4]

   b) Explain FIFO, LRU and optimal page replacement algorithm using the reference string: 1,5,2,3,4,1,2,3,2,1,5,1,2,3,2,3,4,5

8. a) What are the requirements of a solution to the Critical Section problem? Explain Peterson's Algorithm to show that, it fulfill all the requirement of Critical Section? [4+4]

   b) Explain the working of semaphore operations with no busy waiting. Using semaphores, write a solution to readers and writers problem of process synchronization.

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AUTUMN END SEMESTER EXAMINATION-2018

5th Semester B.Tech & B.Tech Dual Degree

OPERATING SYSTEM

CS 3009

[For 2017(L.E.), 2016 & 2015 Admitted Batches]

Time: 3 Hours Full Marks: 60

Answer any Six questions including question No.1 which is compulsory.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

1. Answer all the questions:- [2×10]

(a) What is distributed operating system?

(b) Consider following three processes arrived in a system.

Process	Next CPU Burst Time(in sec)	Arrival Time (in sec)
A	3	1
B	2	2
C	1	3
D	1	4

What is the waiting time for process D if SRTN Scheduling algorithm is used for scheduling the processes? (scheduler starts at time 0)

(c) Give syntax of fetch-and-set instruction and it's use in mutual exclusion.

(d) Mention the reasons of preempting the process from execution state.

(e) If it takes on the average 10 milliseconds to service a page fault, and a memory access takes 1 microsecond, then what is average memory access time with 99.99% hit ratio?

(f) "In paging, amount of internal fragmentation is on an average 1/2 of page size". Justify.

(g) Consider a process that has been allocated 3 page frames. During the execution, the process makes the following sequence of page references.

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

How many page faults will occur with optimal page replacement algorithm?

(h) Arrange the best fit, worst fit, and first fit algorithms in increasing order of their running time.

(i) Name two preemptive CPU scheduling algorithms.

(j) Which of the following does not interrupt a running process?

(A) A Device (B) Timer
(C) Scheduler process (D) Power failure

2. (a) Consider following three processes arrived in a system. [4]

Process	Execution Time	Arrival time
A	12	1
B	3	2
C	4	3

What will be the order of execution, response time and waiting time for the processes, if the scheduling algorithm is

(i) Round Robin with time slice as 4 time units
(ii) SJF

(b) What are scheduling queues? Explain how operating system updates them with state transitions of processes? [4]

3. (a) What are semaphore variables? How can semaphore be implemented to ensure no busy waiting? [4]

(b) Two processes, P1 and P2, need to access a critical section of code. Consider the following synchronization construct used by the processes: [4]

P1	P2
while (true) {	while (true) {
p1_flag = true;	p2_flag = true;
while(P2_flag==true);	while(P1_flag==true);
Critical Section	Critical Section
p1_flag=false;	P2_flag=false;
Remainder section	Remainder section
}	}

Whether the above code satisfy all requirements for a solution to critical section problem? Justify your answer.

4. An operating system uses the Banker's algorithm for deadlock avoidance when managing the allocation of three resource types X, Y, and Z to three processes A,B, and C. The allocation of the resources and Maximum requirements.

Process	Allocation			Max		
	X	Y	Z	X	Y	Z
A	0	0	1	8	4	3
B	3	2	0	6	2	0
C	2	1	1	3	3	3

The contents of Available vector is 3,2,2 for X, Y and Z respectively.

(a) Whether the current state is safe? If so find a Safe Sequence. [4]

(b) A request 2,0,0 by Process B is generated. Whether the request will be granted? [4]

5. (a) Discuss various memory allocation techniques in a real memory system and make an analysis of memory wastage. [4]

(b) Consider a logical address space of 32 pages of 1024 words mapped into memory of 32 frames. [4]

(i) How many bits are there in the logical address?
(ii) How many bits are there in physical address?

6. (a) Discuss the hardware support required to implement demand paging. [4]

(b) Explain the CREATE( ) and DELETE( ) operations on a file. [4]

7. (a) Discuss various file allocation methods used by the operating system with relative merits and demerits. [4]

(b) What is domain of protection? How it is implemented using Access Matrix? [4]

8. Write short notes on the followings. [4×2]

(a) Resource Allocation Graph

(b) I/O Management

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AUTUMN END SEMESTER EXAMINATION-2019

5th Semester B.Tech & B.Tech Dual Degree

OPERATING SYSTEM

CS3009

(For 2018(L.E) & 2017 Admitted Batches)

Time: 3 Hours | Full Marks: 50

Answer any SIX questions.
Question paper consists of four sections-A, B, C, D.
Section A is compulsory.
Attempt minimum one question each from Sections B, C, D.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

SECTION-A

1. Answer the following questions. [1 × 10]

   (a) Write the actions taken by a kernel to context-switch between processes.

   (b) What is the number of child processes created by the following code:

```
int i;
for(i=0; i<3; i++)
    fork( );
  fork( );
```

   (c) A counting semaphore S is initialized to 10. Then 6 WAIT operations and 4 SIGNAL operations were completed on this semaphore. What would be the resulting value of S?

   (d) Name two CPU scheduling policy where context-switching does not occur.

   (e) A system is having 3 user processes P1, P2 and P3 where P1 requires 2 units of resource R, P2 requires 3 units of resource R, P3 requires 4 units of resource R.

What is the minimum number of units of R that ensures no deadlock in the system?

   (f) Define Highest Response ratio Next scheduling policy with it's advantage.

   (g) Write the difference between thread and process.

   (h) What is a safe state in deadlock detection?

   (i) Define latency and seek time with respect to disk I/O.

   (j) Describe the purpose of device driver.

SECTION-B

2. (a) What is meant by domain of protection? How is it implemented by the operating system? [4]

   (b) Consider the following page reference string: 7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1. How many page faults would occur for the Optimal replacement algorithm and LRU with three frames assuming that all frames are initially empty? [4]

3. (a) Consider the following set of processes, with the length of the CPU-burst time given in milliseconds: [4]

Process	Burst time	Arrival time
P0	3	0
P1	6	2
P2	4	4
P3	5	6
P4	2	8

The processes are assumed to have arrived in the order P1, P2, P3, P4, P5, all at time 0.

i. Draw Gantt charts illustrating the execution of these processes using shortest remaining time first and Round Robin (quantum = 2ms) scheduling.

ii. What is the turnaround time and the waiting time of each process for each of the scheduling algorithms in part a?

   (b) What information is stored in Process Control Block to support context switching between two processes? What are the different criteria based on which a scheduling algorithm can be evaluated? [4]

SECTION-C

4. (a) Explain 1st readers-writers problem and write its solution using semaphore. [4]

   (b) If the virtual address space is represented by 32 bits, the page size is 4Kbyte, the size of the physical memory is 64Mbyte and only 2 bits are used as control bits, calculate the size of the page table. [4]

5. (a) Consider the following snapshot of a system. [4]

Process	Allocation				Max			
	A	B	C	D	A	B	C	D
P0	0	0	1	2	0	0	1	2
P1	1	0	0	0	1	7	5	0
P2	1	3	5	4	2	3	5	6
P3	0	6	3	2	0	6	5	2
P4	0	0	1	4	0	6	5	6

Resource type A has 3 instances, B has 14 instances, C has 12 instances and D has 12 instances.

Answer the following questions using banker's algorithm

   i) What is the content of the Need matrix?
   ii) Illustrate that the system is in a safe state by demonstrating an order in which the processes may complete.
   iii) If a request from process P4 arrives for (0,4,2,0) can the request be granted immediately?

   (b) Demonstrate the deadlock recovery mechanism in details. [4]

6. Write short notes on the following
   (a) Thrashing. [4]
   (b) I-node. [4]

SECTION-D

7. (a) Explain various File allocation methods and compare them with respect to space and time. [4]

   (b) Consider a disk system with 3000 cylinders, numbered 0 to 2999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The requests to access the cylinders occur in the following sequence: [4]

   86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130.

   Starting from the current head position, evaluate the time taken to satisfy all the requests using shortest seek time first policy if it takes 1ms to move from one cylinder to adjacent one? Also show the total head movement (in cylinders) for servicing the request for C-SCAN and C-LOOK policy?

8. (a) In the memory four partitions are there of size 4KB, 8KB, 20KB and 2KB (in order) respectively. Total 8 processes arrive at time 0 with memory request size(in Bytes) and usage time (in ms) as given in the following table: Calculate the time at which process P7 will be completed if the Best fit method is used for fixed sized partitioned memory. [4]

Req. No	P1	P2	P3	P4	P5	P6	P7
Req. Size	2K	14K	3K	6K	6K	10K	7K
Usage time	4	10	2	8	4	1	8

   (b) Illustrate the concept of segmentation memory management scheme in detail with diagram. [4]

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1. (a) What will be the prediction of the next CPU burst time, if five runs from oldest to most recent values of execution time are 30, 10, 20, 30, 10 using the weighting factor 0.5? [2×10]

(b) Consider a logical-address space of 32 pages of 128 words each, mapped onto a physical memory of 64 frames. Find out how many bits are there in the logical-address space and that in the physical-address space.

(c) If there are 7 processes in a system and 5 is the time quantum, what is the maximum and minimum time a process needs to wait for its execution?

(d) What are the scheduling algorithms which may cause starvation? How do you reduce it, if there is?

(e) Explain the characteristics of multiprocessor operating system.

(f) List and discuss various file operations.

(g) Does paging support sharing? Illustrate it with an example.

(h) Which algorithm suffers from Belady's anomaly and why?

(i) In a paging systems with TLB, it takes 60ns to search the TLB and 80 ns to access memory. If the TLB hit ratio is 90%, find the effective memory access time.

(j) What are the advantages and disadvantages of layered architecture of Operating Systems structure?

2. (a) What is a semaphore? What operations can be performed on a semaphore? What are the differences between binary semaphore and counting semaphore? [4]

(b) What is a critical-section problem and what are the requirements which satisfy the solutions to the critical-section problem? Define how Peterson's solution solves the critical-section problem? [4]

3. (a) What is the purpose of system calls? By giving an example, illustrate how system calls are used? Briefly explain the types of system calls provided by a typical operating system. [4]

(b) Draw a queuing diagram representation of process scheduling. Define how process move from one queue to other by illustrating Job-queue, Ready-queue and Blocked-queue. What is the need of multiple blocked-queue? [4]

4. (a) What are the advantages of the variant of linked allocation of directory implementation that uses a file-allocation table to chain together the blocks of a file? [3]

(b) Consider the following set of processes, with the arrival time and length of the CPU burst time/ Service time given in milliseconds. [5]

Process	Service time	Arrival time
P1	10	0
P2	9	0
P3	6	2
P4	4	3
P5	8	4

Draw Gantt Charts, illustrating the execution of the processes using SJF non-preemptive, SJF preemptive algorithms (SRTF) and Round Robin (Time slice=3). Also find the average turnaround time and average waiting time with each algorithm of scheduling.

5. (a) Given memory partitions of 100K, 500K, 200K, 300K, and 600K (in order), how would each of the First-fit, Best-fit, and Worst-fit algorithms place processes of 212K, 417K, 112K, and 426K (in order)? Which algorithm makes the most efficient use of memory? [3]

(b) Consider the following snapshot of a system with 5 processes P0 through P4 and 4 resources A, B, C, and D. Resource type A has 10 instances, resource type B has 5 instances, resource type C has 7 instances, resource type D has 8 instances. [5]

Processes	Allocation A B C D	MAX A B C D
P0	4 2 0 2	4 2 0 2
P1	1 0 0 0	1 0 0 0
P2	0 1 3 1	3 1 2 1
P3	0 0 0 0	1 0 2 0
P4	1 0 1 2	0 1 1 3

i) Is the system in a safe state?

ii) If a request from process P1 arrives for two instances of B and one of D, can the request be granted immediately?

iii) If a request from process P3 arrives for one instance of each resource type, can the request be granted immediately?

6. (a) Assume that the memory size is of 3 frames (3 pages can be in memory at a time per process). Given, the reference string of referenced page numbers is [3]

6,0,5,2,0,3,0,4,2,3,0,3,0,3,2,5,2,0,1,6,0,1,6

Evaluate by running it on the above string of memory references and compute the number of page faults for each of the following algorithms.

i) FIFO ii) Optimal iii) LRU

(b) A hard disk having 400 cylinders, numbered from 0 to 399. the drive is currently serving the request at cylinder 143,and the previous request was at cylinder 125.The status of the queue is as follows 86, 147, 13, 77, 294, 345, 102, 175, 213 [5]

What is the total distance (in cylinders) that the disk arm moves to satisfy the entire pending request for each of the following disk-scheduling algorithms?

(i) SSTF (ii) FCFS (iii) SCAN (iv) C-SCAN (v) C-LOOK

7. (a) Consider the following segment table: [3]

Segment	Base	Limit
0	215	500
1	2300	14
2	90	350
3	1327	580
4	1952	120

What are the physical addresses for the following logical addresses reference string?
i) Segment 0, 430 ii) Segment 1, 10 iii) Segment 2, 500
iv) Segment 3, 400 v) Segment 4, 112

(b) Give the basic concepts about paging and its address translation scheme. [5]

8. Write short notes on **(any four):** [4×2]

(a) Process Control Block
(b) Distributed Operating Systems
(c) Inverted page table
(d) Copy-on-Write
(e) Timesharing Operating Systems
(f) Acyclic-graph Directories

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Question No	Question Type(MCQ/SAT)	Question	CO Mapping	Answer Key (For MCQ Questions only)
Q.No:1	MCQ	Consider the following statements: S1: Cache memory is faster than Registers. S2: Main memory is cheaper than both cache and registers. Which of the following is true? a) S1 is true, S2 is false b) S1 is false, S2 is true c) Both are false d) Both are true	CO1	b
	MCQ	Consider the following statements: S1: Swap space is used when RAM is full S2: Swap space is used when Cache is full Which of the following is true?	CO1	a

		a) S1 is true, S2 is false b) S1 is false, S2 is true c) Both are false d) Both are true		
	MCQ	BIOS is used: a) By operating system b) By compiler c) By interpreter d) By application software	CO1	a
	MCQ	What do you mean by the Booting in the operating system? a) Restarting computer b) Install the program c) To scan d) To turn off	CO1	a
Q.No:2	MCQ	If the fork() is called 'n' times by the parent process, then the total number of processes are: a) 2n b) n^2 c) 2^n d) 2^n-1	CO2	c

	MCQ	Statement- I: OS act as resource allocator Statement II: OS act as resource manager Which of the following is correct? a) Statement-I b) Statement-II c) Both d) None	CO2	c
	MCQ	Which one of the following are not an attribute of a process? a) Process ID b) Program Counter c) Process state d) Process Name	CO2	d

	MCQ	In which state process is not in main memory? a) New b) Ready c) Run d) Wait/Block	CO2	a

Q.No:3	MCQ	Consider the following statements: S1: Deadlock avoidance is rarely used as a practical solution to the deadlock problem. S2: Banker's algorithm is sufficient for a practical system. Which of the following options is correct about the above statements? a) S1 is False, S2 Is True b) S1 is True, S2 is False c) Both S1 and S2 are False d) None of the above	CO4	b
	MCQ	A system is having '3' user processes P1, P2, and P3. P1, P2, and P3 requires 3, 4, and 5 unit of resource 'R' respectively. What is the minimum number of units of 'R' such that no deadlock occurs? a)10 b)12 c)9 d)15	CO4	a
	MCQ	A system is having '6' user processes. Each require 3 unit of resource 'R'. What is the minimum number of units of 'R' such that no deadlock occurs? a)18 b) 11 c)7 d)13	CO4	d
	MCQ	A system is having '3' user	CO4	a

<table>
<tr><td></td><td></td><td>processes P1, P2, and P3. P1, P2, and P3 requires 3, 4, and 5 unit of resource ‘R’ respectively. What is the minimum number of units of ‘R’ such that no deadlock occurs?

a)10
b)12
c)9
d)15</td><td></td><td></td></tr>
<tr><td>Q.No:4</td><td>MCQ</td><td><table><tr><th>Process</th><th>CPU Burst Time (ms)</th><th>Arrival Time</th></tr><tr><td>A</td><td>5</td><td>0</td></tr><tr><td>B</td><td>10</td><td>10</td></tr><tr><td>C</td><td>7</td><td>2</td></tr><tr><td>D</td><td>2</td><td>6</td></tr><tr><td>E</td><td>6</td><td>12</td></tr></table>Calculate the average turnaround time if FCFS scheduling algorithm is used for scheduling above processes?

a) 10
b) 11
c) 12
d) 13</td><td>CO2</td><td>b</td></tr>
<tr><td></td><td>MCQ</td><td><table><tr><th>Process</th><th>CPU Burst Time (ms)</th><th>Arrival Time</th></tr><tr><td>A</td><td>5</td><td>0</td></tr><tr><td>B</td><td>10</td><td>10</td></tr><tr><td>C</td><td>7</td><td>2</td></tr><tr><td>D</td><td>2</td><td>6</td></tr><tr><td>E</td><td>6</td><td>12</td></tr></table>Calculate the average waiting time if FCFS scheduling algorithm is used for scheduling above processes?
a) 5
b) 7
c) 10</td><td>CO2</td><td>a</td></tr>
</table>

	MCQ	<table><tr><th>Process</th><th>CPU Burst Time (ms)</th><th>Arrival Time</th></tr><tr><td>A</td><td>5</td><td>0</td></tr><tr><td>B</td><td>10</td><td>10</td></tr><tr><td>C</td><td>7</td><td>2</td></tr><tr><td>D</td><td>2</td><td>6</td></tr><tr><td>E</td><td>6</td><td>12</td></tr></table> Find out the order of completion if FCFS scheduling algorithm is used for scheduling above processes? a) A, B, C, D, E b) A, D, B, C, E c) A, E, D, C, B d) A, C, D, B, E		d
	MCQ	<table><tr><th>Process</th><th>CPU Burst Time (ms)</th><th>Arrival Time</th></tr><tr><td>A</td><td>5</td><td>0</td></tr><tr><td>B</td><td>10</td><td>10</td></tr><tr><td>C</td><td>7</td><td>2</td></tr><tr><td>D</td><td>2</td><td>6</td></tr><tr><td>E</td><td>6</td><td>12</td></tr></table> What is the finish time of the process B, if FCFS scheduling algorithm is used for scheduling above processes? a) 5 b) 12 c) 24 d) 28	CO2	c

Q.No:5	MCQ	Consider the following page reference string: 1, 2, 4, 3, 2, 5, 4, 6, 2, 6, 4, 3, 2, 7, 3, 4, 2, 3, 1, 2 How many page faults occur for the FIFO page replacement algorithms having a frame size of 4?	CO5	b

		a) 10 b) 12 c) 14 d) 16		
	MCQ	Consider the following page reference string: 1, 2, 4, 3, 2, 5, 4, 6, 2, 6, 4, 3, 2, 7, 3, 4, 2, 3, 1, 2 How many page hits occur for the FIFO page replacement algorithms having a frame size of 4? a) 4 b) 6 c) 8 d) 10	CO5	c

	MCQ	Consider the following page reference string: 1, 2, 3, 4, 2, 3, 6, 4, 7, 2, 1, 3, 4, 7, 6, 3, 4, 2, 4, 3, 6 How many page faults occur for the FIFO page replacement algorithms having a frame size of 4? a) 10 b) 12 c) 14 d) 16	CO5	c
	MCQ	Consider the following page reference string: 1, 2, 3, 4, 2, 3, 6, 4, 7, 2, 1, 3, 4, 7, 6, 3, 4, 2, 4, 3, 6 How many page hits occur for the FCFS page replacement algorithms having a frame size of 4? a) 5 b) 7 c) 9 d) 11	CO5	b
Q.No:6	MCQ	Consider a single level paging scheme with a TLB. Assume no page fault occurs. It takes 32 ns to search the TLB and 100 ns to access the physical memory. If TLB miss ratio is 20%, the effective memory	CO5	c

		access time is _____ ns. a) 132 b) 142 c) 152 d) 160		
	MCQ	Consider a single level paging scheme with a TLB. Assume no page fault occurs. It takes 12 ns to search the TLB and 100 ns to access the physical memory. If TLB miss ratio is 20%, the effective memory access time is _____ ns. a) 132 b) 142 c) 152 d) 160	CO5	a
	MCQ	Consider a single level paging scheme with a TLB. Assume no page fault occurs. It takes 12 ns to search the TLB and 90 ns to access the physical memory. If TLB miss ratio is 20%, the effective memory access time is _____ ns. a) 110 b) 118 c) 120 d) 130	CO5	c
	MCQ	Consider a single level paging scheme with a TLB. Assume no page fault occurs. It takes 25 ns to search the TLB and 95 ns to access the physical memory. If TLB miss ratio is 20%, the effective memory access time is _____ ns. a) 96.5 b) 130 c) 139 d) 146	CO5	c

Q.No:7	MCQ	A counting semaphore was initialized to 13. Then 6 P (wait) operations and 4V (signal) operations were completed on this semaphore. The resulting value of the semaphore is a) 0 b) 8 c) 10 d) 11	CO3	d
	MCQ	A counting semaphore was initialized to 25. Then 6 P (wait) operations and 4V (signal) operations were completed on this semaphore. The resulting value of the semaphore is a) 4 b) 12 c) 18 d) 23	CO3	d

	MCQ	A counting semaphore was initialized to 19. Then 8 P (wait) operations and 4V (signal) operations were completed on this semaphore. The resulting value of the semaphore is a) 10 b) 11 c) 15 d) 13	CO3	c
	MCQ	A counting semaphore was initialized to 14. Then 6 V (wait) operations and 4 P (signal) operations were completed on this semaphore. The resulting value of the semaphore is a) 12 b) 14 c) 16 d) 18	CO3	c

<table>
<tr><th>Question No</th><th>Question</th><th>CO Mapping (Each question should be from the same CO(s))</th></tr>
<tr><td>Q.No:8</td><td>Consider process arrival as given below where N = right most significant digit of your Roll No.(ex:- for Roll No. 180854, N=4):

<table>
<tr><th>Process</th><th>CPU Burst Time</th><th>Arrival Time</th><th>Priority</th></tr>
<tr><td>A</td><td>9</td><td>0</td><td>3</td></tr>
<tr><td>B</td><td>13</td><td>5</td><td>2</td></tr>
<tr><td>C</td><td>4</td><td>9</td><td>N</td></tr>
<tr><td>D</td><td>2</td><td>N</td><td>1</td></tr>
<tr><td>E</td><td>7</td><td>7</td><td>6</td></tr>
</table>
Calculate the following for priority (preemptive) and round robin (time quantum = 3 ms) CPU scheduling algorithm:
i. Average waiting time
ii. Turnaround time for each process
iii. Order of completion
(Note:-higher digits indicate higher priority)

(12 marks)</td><td>CO2</td></tr>
<tr><td></td><td>Consider process arrival as given below where N = right most significant digit of your Roll No.(ex:- for Roll No. 180854, N=4):

<table>
<tr><th>Process</th><th>CPU Burst Time</th><th>Arrival Time</th><th>Priority</th></tr>
<tr><td>A</td><td>10</td><td>0</td><td>3</td></tr>
<tr><td>B</td><td>17</td><td>5</td><td>2</td></tr>
<tr><td>C</td><td>5</td><td>9</td><td>N</td></tr>
<tr><td>D</td><td>2</td><td>N</td><td>1</td></tr>
<tr><td>E</td><td>9</td><td>7</td><td>6</td></tr>
</table>
Calculate the following for priority (preemptive) and round robin (time quantum = 3 ms) CPU scheduling algorithm:</td><td></td></tr>
</table>

iv. Average waiting time
v. Turnaround time for each process
vi. Order of completion
(*hints:-lower digits indicate higher priority*)

(12 marks)

Consider process arrival as given below where N = right most significant digit of your Roll No.(ex:- for Roll No. 180854, N=4):

Process	CPU Burst Time	Arrival Time	Priority
A	10	0	4
B	15	5	7
C	2	9	N
D	8	N	1
E	6	7	6

Calculate the following for *priority (preemptive)* and *round robin* (time quantum = 3 ms) CPU scheduling algorithm:
i. Average waiting time
ii. Turnaround time for each process
iii. Order of completion
(*Note:-higher digits indicate higher priority*)

(12 marks)

Q.No:9	a)Each Process Pi, i= 1.....9 is coded as follows *repeat* *P(mutex)* *{ Critical Section }* *V(mutex)* *Forever* The process P10 is coded as per the following: *repeat* *V(mutex)* *{ Critical Section }* *P(mutex)* *Forever* If mutex is a counting semaphore variable initialized to 3, then what is the largest number of processes that can be inside the critical section at any moment? Explain with proper justification. *(6 marks)*	CO3

	b) Consider the following program segments for two different processes executing concurrently:
	
	Procedure P1
	Begin
	Do A = 1, 2
	X = X * 2
	End Do
	End
	
	Procedure P2
	Begin
	Do B = 1, 1
	X = X + 1
	End Do
	End
	
	Variable X starts at zero and is a shared variable. Variables A and B are not shared variables. If Processes Pl and P2 execute only once at any speed, what is the largest possible value of X? Justify. *(6 marks)*	

a) Assume that binary semaphore variables is initialized to 1. Assume that no blocked processes exist in the system. What is the Size of blocked queue L for the following operations : 4P, 3V, 5P, 6V, 10P.

(6 marks)

b) Which of the following statement is true?Justify your answer.

i) Binary semaphore has a drawback called busy wait or spin lock.

ii) Binary semaphore is applicable only for two processes

iii) Busy waiting is desirable in multi processing operating system.

(6 marks)

a) Assume that 'D' is a counting semaphore initialized to value '8'. Consider the following program segment:

V(D); P(D); P(D); P(D); P(D) ;
V(D); P(D); V(D); V(D); P(D);

What is the final value of D?

(6 marks)

b) Consider the methods used by processes P1 and P2 for accessing their critical sections whenever needed, as given below. The initial values of shared Boolean variables S1 and S2 are randomly assigned.

	<table><tr><th>Method used by P_1</th><th>Method used by P_2</th></tr><tr><td>while (S_1 == S_2); Critical Section S_1 = S_2</td><td>while (S_1 != S_2); Critical Section S_2 = !S_1</td></tr></table> Examine and explain the feasibility of the solution with respect to all the conditions required for a solution to the critical section problem. *(6 marks)*	
Q.No:10	a) Write the importance of segmentation in operating system? What is the basic difference between paging and segmentation? Explain with diagram. (4 marks) b)Answer the following questions with respect to paging: (i) A machine has 64-bit virtual addresses and 32-bit physical addresses. The size of a page is 8K. Find the number of entries needed for a conventional page table. (4 marks) (ii)A machine has 72-bit virtual addresses. Page size of 1GB, and page table entry is 8B. Show the virtual address split w.r.t page number and page offset. (4 marks)	CO5
	a) Explain static and dynamic linking with proper example. (4 marks) b)Answer the following questions with respect to paging: (i)A machine has 56-bit virtual addresses and 32-bit physical addresses. The size of a page is 4K. Find the number of entries needed for a conventional page table. (4 marks) (ii)A machine has 64-bit virtual addresses. Page size of 16KB, and page table entry is 4B. Show the virtual address split w.r.t page number and page offset. (4 marks)	

	a) Differentiate internal and external fragmentation. Which memory allocation technique(s) is/are affected from these phenomena? (4 marks)	

[redacted]

	b)Answer the following questions with respect to paging: (i)A machine has 64-bit virtual addresses and 48-bit physical addresses. The size of a page is 10K. Find the number of entries needed for a conventional page table. (4 marks) (ii) A machine has 64-bit virtual addresses. Page size of 16MB, and page table entry is 4B. Show the virtual address split w.r.t page number and page offset. (4 marks)	
Q.No:11	a) A computer has 10 tape drives, with n processes competing for it. Each process needs 2 drives. What is the maximum value of n for which the system deadlock free? Justify your answer. (6 marks) b) Find the total head movement for SSTF scheduling with following disk queue requests on I/O blocks: 98, 189, 33, 127, 18, 124, 65, 67. Head starts at Head starts at N (where N= your Roll No. MODULUS 100). (6 marks)	CO4 + CO6

Q.No:11	a) A computer has 10 tape drives, with n processes competing for it. Each process needs 2 drives. What is the maximum value of n for which the system deadlock free? Justify your answer. (6 marks) b) Find the total head movement for SSTF scheduling with following disk queue requests on I/O blocks: 98, 189, 33, 127, 18, 124, 65, 67. Head starts at Head starts at N (where N= your Roll No. MODULUS 100). (6 marks)	CO4 + CO6
	a) A system is having 'N' user processes. Each require 3 unit of resource 'R'. What is the minimum number of units of 'R' such that no deadlock occurs? N = right most significant digit of your Roll No.(ex:- for Roll No. 180854, N=4) (6 marks) b) Find the total head movement for SCAN and C-SCAN scheduling with following disk queue requests on I/O blocks: 0, 19, 33, 61, 65, 66, 98, 122, 133, 183. Head starts at N (where N= your Roll No. MODULUS 100). Which algorithm is more preferable and why? (6 marks)	
	a)A system is having 'N' user processes. Each require 4 unit of resource 'R'. What is the minimum number of units of 'R' such that no deadlock occur? N = right most significant digit of your Roll No.(ex:- for Roll No. 180854, N=4) (6 marks) b) Find the total head movement for FCFS scheduling with following disk queue requests on I/O blocks: 98, 189, 33, 127, 18, 124, 65, 67. Head starts at N (where N= your Roll No. MODULUS 100). (6 marks)	

SECTION-A(Answer All Questions. Each question carries 2 Marks)

Time:30 Minutes **(7×2=14 Marks)**

Question No	Question Type (MCQ/ SAT)	Question	CO Mapping	Answer Key (For MCQ Questions only)

Q.No: 1	**MCQ**	How many child processes will be created and how many times "Welcome" will be displayed after execution the following program?
		`int main() {`
		`fork();`
		`fork();`
		`printf("Welcome");`
		`fork();`
		`return 0;`
		`}`
		A) 2, 2
		B) 3, 4
		C) 7, 4
		D) 7, 8
			1	C

	MCQ	How many child processes will be created and how many times "Welcome" will be displayed after execution the following program?
		`int main() {`
		`int i, j;`
		`for(i=1, j=7; i<j; i++, j--)`
		`fork();`
		`printf("Welcome");`
		`fork();`
		`fork();`
		`return 0;`
		`}`
		A) 15, 8
		B) 16, 7
			1	C

		C) 31, 8 D) 32, 7		
	MCQ	In which of the following process scheduling policies context switching never take place? I. Round-robin II. Shortest job first(non pre-emptive) III. Pre-emptive IV. First-cum-first-serve A) IV only B) I and III C) II and III D) II and IV	2	D
	MCQ	Which of the following statement(s) is(are) true? I. Shortest remaining time first scheduling may cause starvation. II. Preemptive scheduling never cause starvation. III. Round robin is better than FCFS in terms of response time. A) I only B) I and III C) II and III D) I, II , III	2	B
Q.No: 2	**MCQ**	Consider three processes: P1, P2 & P3 with CPU burst time 5, 4, 3 time units and arrival time 0, 3, 4 time units respectively. Consider the FCFS and RR (with time slice 2 time units) scheduling algorithms. Find the order of completion of execution of processes in both algorithms. A) FCFS: P1, P2, P3 RR: P1, P2, P3 B) FCFS: P1, P3, P2 RR: P2, P1, P3 C) FCFS: P1, P2, P3 RR: P1, P3, P2 D) FCFS: P1, P2, P3 RR: P3, P2, P1	2	A

	MCQ	A scheduling algorithm assigns priority directly proportional to the remaining burst time of a process. Every process starts with priority zero (the lowest priority). The scheduler re-evaluates the process priorities every execution of process and decides the next process to schedule. Which one of the following is TRUE if the processes have no I/O operations and all arrive at time zero? A) This algorithm is equivalent to the first-come-first-serve algorithm B) This algorithm is equivalent to the round-robin algorithm C) This algorithm is equivalent to the largest-remaining-time-first algorithm D) This algorithm is equivalent to the shortest-remaining-time-first algorithm	2	C
	MCQ	Which of the following statements are true? I. FCFS scheduling is better in terms of average waiting time	2	C

		II. Priority scheduling may cause starvation III. Round robin is better than FCFS in terms of response time IV. SJF causes starvation A) II and III only B) III and IV only C) II, III and IV only D) I, II and IV only		
	MCQ	Consider three processes (process id 1, 2, 3 respectively) with arrival time 0, 1, 2 and CPU burst time 6, 3 and 2 time units respectively. Consider the shortest remaining time first (SRTF) scheduling algorithm. In SRTF ties are broken by giving priority to the process with the highest process id. Find the average turn around time. A) 5 units B) 6 units C) 7 units D) 8 units	2	B

Q.No: 3	**MCQ**	The following two concurrent processes P_1 and P_2 that share a variable B with an initial value of 5. What is the sum of all possible values of B?
		P_1 ( ) {
		C = B – 1;
		B = 2 * C;
		}
		P_2 ( ) {
		B = 2 * B;
		}
		A) 24
		B) 26
		C) 42
		D) None of the above
			3	C

	MCQ	The following two concurrent processes P_1 and P_2 that share a variable B with an initial value of 5. What is the GCD of all possible values of B?
		P_1 ( ) {
		C = B – 1;
		B = 2 * C;
		}
		P_2 ( ) {
		B = 2 * B;
		}
		A) 1
		B) 2
		C) 4
		D) None of the above
			3	B

	MCQ	The following two concurrent processes P_1 and P_2 that share a variable B with an initial value of 3. What is the sum of all possible values of B?
		P_1 ( ) {
		C = B – 1;
		B = 2 * C;
		}
		P_2 ( ) {
		B = 2 * B;
		}
		A) 18
		B) 22
		C) 12
			3	B

	MCQ	The following two concurrent processes P_1 and P_2 that share a variable B with an initial value of 3. What is the difference between the smallest and largest values of all possible values of B?
		P_1 ( ) {
		C = B – 1;
		B = 2 * C;
		}
		P_2 ( ) {
		B = 2 * B;
		}
		A) 4
		B) 6
		C) 8
		D) None of the above
			3	B

Q.No: 4	**MCQ**	Consider a non-negative counting semaphore S. The operation P(S) decrements S, and V(S) increments S. During an execution, 22 P(S) operations and 14 V(S) operations are issued in some order. The largest initial value of S for which at least one P(S) operation will remain blocked is A) 7 B) 8 C) 9 D) 10	3	C
	MCQ	Consider a system having '*m*' resources of the same type. These resources are shared among three processes P_1, P_2, P_3, which have peak time demands of 4, 5, 7 respectively. What will be the minimum value of '*m*' such that the deadlock will never occur in the system? A) 11 B) 12 C) 13 D) 14	4	D

	MCQ	Consider three processes P_1, P_2, P_3 and four resource types R_1, R_2, R_3, R_4 are available in a system. There are one instance of resource type R_1 two instances of resource type R_2, one instance of resource type R_3 and three instances of resource type R_4 available in the system. At a particular instance of time, P_1 is holding one instance of R_2 and waiting for an instance R_1, P_2 is holding an instance of R_1 one instance of R_2 and waiting for an instance of R_3 and P_3 is holding an instance of R_3 and waiting for an instance of R_4. Find out which of the following statement is TRUE? A) Deadlock will not occur B) Deadlock will occur C) All the instances of R_4 are held by the processes D) All the instances of R_2 are not allotted	4	A
	MCQ	A computer system has 5 printers, with '*n*' processes competing for them. Each process may need 2 printers.	4	C

		What will be the maximum value of '*n*' for which the system is guaranteed to be deadlock free? A) 2 B) 3 C) 4 D) 1		
Q.No: 5	**MCQ**	Consider a system with byte-addressable memory, 32 bit logical address, 2 KB page size and page table entries of 4 Bytes each. What will be the size of the page table in the system in MB? A) 2 B) 4 C) 8 D) 16	5	C

	MCQ	Consider 8 empty frames (numbered 0-7) are allocated to a process with an assumption initially the requested pages will be loaded into a frame in the sequence 0 to 7. With the reference string: 4, 3, 25, 8, 19, 6, 25, 8, 16, 35, 45, 22, 8, 3, 16, 25, 7, in which frame the page 7 will be loaded using LRU page replacement algorithm? A) 4 B) 5 C) 6 D) 7	5	B
	MCQ	In a virtual memory system, size of virtual address is 32-bit, size of physical address is 28-bit, page size is 4 KB and size of each page table entry is 24-bit. The main memory is byte addressable. What is the maximum number of bits that can be used for storing protection and other information in each page table entry? A) 8 B) 10 C) 16 D) 24	5	A
	MCQ	Consider a computer system with 32-bit virtual addressing and page size of 4 KB. If the computer system has a one-level page table per-process and each page table entry requires 40 bits, then what will be the size of the per-process page table in MB? A) 4 B) 5 C) 6 D) 7	5	B
Q.No: 6	**MCQ**	A new process is loaded into main memory. The size of process cannot be exactly fit into the available memory holes. If the process is allocated to any of the available holes, then a new smaller hole is created. Which of the following option is correct in this context? A) The size of new hole created using best fit is never greater than size of the hole created by first fit B) The size of new hole created using best fit is never greater than size of the hole created by next fit	5	A

		C) The size of new hole created using next fit is never greater than size of the hole created by first fit D) The size of new hole created using worst fit is never greater than size of the hole created by first fit		
	MCQ	A new process is loaded into main memory. The size of process cannot be exactly fit into the available memory holes. If the process is allocated to any of the available holes, then a new smaller hole is created. Which of the following option is correct in this context? A) The size of new hole created using best fit is always less than size of the hole created by first fit B) The size of new hole created using best fit is never greater than size of the hole created by first fit C) The size of new hole created using worst fit is greater than or equal to size of the hole created by first fit D) None of the above	5	C
	MCQ	A new process is loaded into main memory. The size of process cannot be exactly fit into the available memory holes. If the process is allocated to any of the available holes, then a new smaller hole is created. Which of the following option is correct in this context? A) The size of new hole created using best fit is always less than size of the hole created by first fit B) The size of new hole created using best fit is never greater than size of the hole created by first fit C) The size of new hole created using worst fit is greater than or equal to size of the hole created by first fit D) None of the above	5	C
	MCQ	A new process is loaded into main memory. The size of process cannot be exactly fit into the available memory holes. If the process is allocated to any of the available holes, then a new smaller hole is created. Which of the following option is NOT correct in this context? A) The size of new hole created using best fit is greater than size of the hole created by first fit B) The size of new new hole created using worst fit is always greater than size of the hole created by first fit C) The size of new hole created using first fit is always smallest among all placement algorithms D) All of the above	5	D

Q.No: 7	**MCQ**	A file system with 200 GB disk uses a file descriptor with 8 direct block addresses, 1 indirect block address and 1 double indirect block address. The size of each disk block is 512 Bytes and the size of each disk block address is 4 Bytes. What is approximately maximum possible file size in this file system? A) 16 MB B) 20 MB C) 32 MB D) Dependent on the size of the disk	5	C
	MCQ	Disk requests come to a disk driver for cylinders in the order 10, 22, 20, 2, 40, 6 and 38, at a time when the disk drive is reading from cylinder 20. The seek time is 6 ms per cylinder. What will be the total seek time (in ms), if the disk arm scheduling algorithm is	6	C

		first-come-first-serve is used? A) 768 ms B) 854 ms C) 876 ms D) None of these		
	MCQ	The method of accessing the I/O devices by repeatedly checking the status flags is A) Program-controlled I/O B) Memory-mapped I/O C) I/O mapped D) None of the mentioned	6	A
	MCQ	Which of the following statements about synchronous and asynchronous I/O is NOT true? A) An ISR (Interrupt Service Routine) is invoked on completion of I/O in synchronous I/O but not in asynchronous I/O B) In the case of synchronous I/O, the process waiting for the completion of I/O is woken up by the ISR that is invoked after the completion of I/O C) A process making a synchronous I/O call waits until I/O is complete, but a process making an asynchronous I/O call does not wait for completion of the I/O D) In both synchronous and asynchronous I/O, an ISR is invoked after completion of the I/O	6	D

KIIT DEEMED TO BE UNIVERSITY

Spring End Semester Examination-2022

OPERATING SYSTEMS (CS2002)

4th Semester B.Tech

SECTION-B

(Answer Any Three Questions.)

Time: 1 Hour and 30 Minutes **Full Marks = 12 × 3 = 36 Marks**

Q.No:8 Consider the following snapshot of a system with 5 processes (P1 … P5) and 4 resources (R1 … R4). Available resources R1: 2, R2: 1, R3: 1 and R4: 0

	Current allocation				Maximum need			
Process	R1	R2	R3	R4	R1	R2	R3	R4
P1	0	0	1	2	0	0	1	2
P2	2	0	0	0	2	7	5	0
P3	0	0	3	4	6	6	5	X
P4	2	3	5	4	4	3	5	6
P5	0	3	3	2	0	6	5	2

Where, X = Roll no % 6

(a) Check that the aforementioned system can reach in safe state or not? If it is in safe state, then what is the safe sequence?

(b) If P4 requests (0 1 0 1) resources, then it can be granted or not?

Q.No:9 Consider process arrival as given below where N = right most significant digit of your Roll No.(ex:- for Roll No. 180854, N=4):

Process	CPU Burst Time	Arrival Time	Priority
A	10	0	3
B	17	5	2
C	5	9	8
D	2	8	1
E	9	7	6

Calculate the following for *priority (preemptive)* and *round robin* (time quantum = 3 ms) CPU scheduling algorithm:

i. Average waiting time

ii. Turnaround time for each process
iii. Order of completion
(*Note:-lower digits indicate higher priority*)

(12 marks)

D B A E C

Q.No:10 During this lockdown period, you are playing Ludo with your n number of family members where, n < 5. Assume that all the tokens are in the starting square and consider following scenarios: If the outcome of the dice is 6 (six), then you can move your one token and get the chance to play dice again; otherwise, you can move your one token and give the dice to the next player.

Think of the players as processes which should be synchronized. You are required to write a code for it using semaphore. Your answer should first (i) list what synchronization and/or what critical section problems you have to solve, (ii) define what semaphore(s) you have to use (including their initial value(s)), and (iii) then write the pseudo code for it. You can assume that wait and signal are variables as primitive calls on a semaphore with their usual meanings.

Q.No:11 (a) Why SJF and SRTF cannot be applied in real world solution? What is the solution for that? – discuss briefly
(marks 3)

(b) Consider the following page reference strings: 7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1, 2, 0, 1, X, 0, 1. What will be the difference in page faults between optimal page replacement and LRU with three empty frames? Note: X = roll no % 7.
(marks 5)

(c) A machine has 56-bit virtual addresses and 32-bit physical addresses. The size of a page is 4K. Find the number of entries needed for a conventional page table.
(marks 4)

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Qn. Set Code-1

Semester: 4th
Programme: B.Tech
Branch: CSE, IT, CSCE, CSSE

SPRING END SEMESTER EXAMINATION-2023

4th Semester B.Tech

OPERATING SYSTEMS

CS 2002

(For 2022 (L.E), 2021 & Previous Admitted Batches)

Time: 3 Hours | Full Marks: 50

Answer any SIX questions.
Question paper consists of four SECTIONS i.e. A, B, C and D.
Section A is compulsory.
Attempt minimum one question each from Sections B, C, D.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

SECTION-A

1. Answer the following questions. [1 × 10]

(a) *The Shortest Job First (SJF) process scheduling algorithm leads to the problem of starvation.* Discuss some of the ways to resolve this issue.

(b) There are some similarities between Semaphores and condition variables (of Monitor). What are the major differences between semaphores and condition variables?

(c) Explain the difference between the logical/virtual and physical address. What are the benefits of virtual memory?

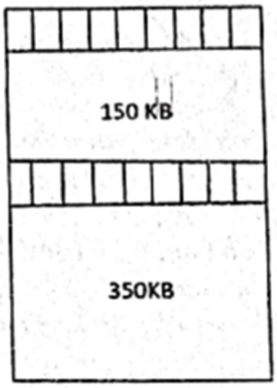
(d) The code for three concurrent processes P0, P1 and P2 is as follows.

Process P0	Process P1	Process P2

while (1)
{
P (S0);
print '0';
P (S1);
P (S2);
}
	V(S0);
	V(S1);
		V(S0);
		V(S2);

The binary semaphores S0, S1, and S2 in the above code are initialized to 1, 0, and 0 respectively. What is the maximum number of *0s* to be printed? Justify.

(e) If the memory requests from processes are in the order: 300K, 25K, 125K and 50K and the current memory availability is as shown below:



Then which approach, between "first fit" and "best fit", can satisfy all the above memory requests in dynamic partition memory allocation?

(f) Consider a process of size 13KB and page of size 4KB. How many pages will this process need? Calculate the % of unused space after allocation of the pages.

(g) A Resource Allocation Graph (RAG) contains a directed cycle. Then, under what circumstances is there a possibility of deadlock?

(h) When a detection algorithm determines a deadlock has occurred? What are some ways to recover the system from this deadlock?

(i) *Rotational latency = 0.5 X time to take one rotation*- true or false? – Justify your answer.

(j) Let a Hard Disk has 6 surfaces, each surface has 8 tracks, and each track has 16 sectors per track.

Find the Cylinder, head, and sector address of the logical block address 610.

SECTION-B

2. (a) Write the pseudo code for Peterson solution to the critical section problem. Explain the correctness of the solution which satisfies the 3 conditions for critical section problem. [4]

(b) [4]

Available			
R1	R2	R3	R4
2	1	0	0

	Current Allocation					Maximum Demand			
Process	R1	R2	R3	R4		R1	R2	R3	R4
P1	0	0	1	2		0	0	1	2
P2	2	0	0	0		2	7	5	0
P3	0	0	3	4		6	6	5	6
P4	2	3	5	4		4	3	5	6
P5	0	3	3	2		0	6	5	2

Consider the above snapshot of a system. There are no current outstanding queued unsatisfied requests.

i. Is this system currently in safe or unsafe state? Justify.

ii. If safe, then write the safe sequence. If unsafe, mention the processes in unsafe state.

iii. If a request from P3 arrives for (0,1,0,0), can the request be safely granted? In what state (deadlock, safe, unsafe) would immediately granting that whole request leave the system? Which processes (if any), are or may become deadlocked if this whole request is granted immediately?

3. (a)

Process	Arrival Time	Execution Time
P1	0	12
P2	5	19
P3	8	21
P4	11	13

[4]

The above Table gives the snapshot of the processes in the system with arrival time and execution time in milliseconds. Draw a Gantt chart showing the scheduling of the processes using Round Robin scheduling algorithm. Find the waiting time of each of

the processes. Calculate the average waiting time for all processes. (Given time quantum = 3 milliseconds)

(b) Explain the various stages of Process State Transition with a neat diagram. [4]

SECTION-C

4. (a) Consider the following page reference string: [4]

2,3,1,2,4,5,1,2,3,4,5,2,6,2,1,2,3,1,4,5,6,

How many page faults would occur for the following page fault algorithms, assuming 3 and 4 available frames? Initially all the frames are empty.

i. Optimal replacement

ii. LRU replacement

(b) Implement Reader-Writer problem with reader dominance using Semaphore and Monitor. (Write the Pseudocode) [4]

5. (a) A system has three processes (P1,P2,P3) and three resource types (R1,R2,R3). There are two instances of R1 and R2 and one instance of R3. P1 holds one instance of R1 and is requesting one instance of R2. P2 holds one instance of R1 and one instance of R2 is requesting for one instance of R3. P3 holds one instance of R2 and one instance of R3 and is requesting one instance of R1. Draw the resource allocation graph for this situation. Does deadlock situation exist? Prove your answer using Banker's Algorithm. [4]

(b) Consider a file system with 5 direct disk blocks, 1 single indirect block and 1 double indirect block. Size of disk block in 512 bytes. 4 bytes are required to store one block number. If a process makes a request to access a byte at offset of 10000, find out which index block contain this byte information. [4]

6. (a) What do you mean by multilevel feedback scheduling? Briefly describe its characteristics, features, pros and cons of the scheduling algorithm. Explain the algorithm by using a neat diagram with a suitable example. [4]

(b) There is a memory with four partitions 4K, 8K, 20K, and 2K (in order). Total *eight* processes come at time *0 ms* with different request size and the execution time (ms) as given in the following table. [4]

Process no.	P1	P2	P3	P4	P5	P6	P7	P8
Req. size	2K	14K	3K	6K	6K	10K	7K	4K
Execution time	4	9	2	8	1	6	5	3

Calculate the time at which process P7 will be completed if *Best-Fit* method is used in fixed partition memory allocation. Explain with proper diagram.

SECTION-D

7. (a) Disk requests come into the disk driver for cylinders: 10,22,55,2,28,12,6,40 and 38 in that order. The disk drive has 60 cylinders numbered 0 to 59 and the current head position is 26. A seek takes 6 millisecond / cylinder moved. How much seek time is needed for: [4]

(A) FCFS (B) SSTF
(C) SCAN (D) LOOK

(b) A manufacturer wishes to design a hard disk with a capacity of 2^{10} GB. If the technology used to manufacture the disks allows 1KB sector size, 4K sectors per track, and having 2^{10}platters, then how many cylinders are required in the hard disk? [4]

(b) There are two kinds of threads, oxygen (O) and potassium (K). Your goal is to group these threads to form Potassium Oxide (K_2O) molecules. There is a barrier where each thread has to wait until a complete molecule can be formed. Potassium and oxygen threads will be given ***releasePotassium*** and ***releaseOxygen*** methods respectively, which will allow them to pass the barrier. These threads should pass the barrier in groups of three, and they must be able to immediately bond with each other to form a Potassium Oxide molecule. You must guarantee that all the threads from one molecule bond before any other threads from the next molecule do. [4]

In other words:

- If an oxygen thread arrives at the barrier when no potassium threads are present, it has to wait for two potassium threads.
- If a potassium thread arrives at the barrier when no other threads are present, it has to wait for an oxygen thread and another potassium thread.

We don't have to worry about matching the threads up explicitly; that is, the threads do not necessarily know which other threads they are paired up with. The key is just that threads pass the barrier in complete sets; thus, if we examine the sequence of threads that bond and divide them into groups of three, each group should contain one oxygen and two potassium threads.

Write the synchronization code for oxygen and potassium molecules that enforces these constraints.