KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2025

Marks Scored:

Level : B.Sc.
Year : III

Course : COMP 307
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 03 MAR 2025

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and Mark [X] in the most appropriate option from each set of choices

1. What is the role of middleware in a distributed operating system?
   [ ] To execute application programs
   [ ] To manage hardware resources
   [ ] To manage file systems
   [ ] To provide a layer of software that enables communication and resource sharing between distributed systems

2. In a microkernel-based operating system, most system-level services are implemented
   [ ] within the kernel
   [ ] as separate user-level processes
   [ ] using device drivers
   [ ] as static libraries

3. What is a zombie process?
   [ ] A process that has completed execution but still has an entry in the process table
   [ ] A process that is waiting for input from the user
   [ ] A process that is running in the background
   [ ] A process that has been terminated abruptly

4. What is the main disadvantage of message passing over shared memory in IPC?
   [ ] It does not provide synchronization mechanisms
   [ ] It does not allow communication between unrelated processes
   [ ] It is slower due to kernel involvement
   [ ] It is not supported in modern operating systems

5. The progress condition ensures that:
   [ ] Only one process can access the critical section
   [ ] Processes waiting to enter the critical section eventually get a chance
   [ ] A process not in the critical section cannot block others from entering
   [ ] There is no indefinite postponement

6. In Round robin scheduling algorithm with 2 ms time quantum, for the given scenario, what is the waiting time for P3?

Process	Burst Time
P1	5
P2	3
P3	6

   [ ] 10 ms [ ] 8 ms [ ] 12 ms [ ] 9 ms

7. An edge, $R_j \rightarrow P_i$, in Resource-Allocation-Graph Algorithm indicates that:
   a) P_i requests resource R_j
   b) Assignment of resource R_j to P_i
   c) P_i may requests resource R_j at some time in future
   [ ] a only [ ] b only [ ] c only [ ] a & c

8. A system has 3 processes and 12 instances of a resource. Each process requires 4 instances. Is the system deadlock-free?
   [ ] Yes [ ] No
   [ ] Depends on Scheduling [ ] Insufficient information

9. Consider six memory partitions of sizes 200 KB, 400 KB, 600 KB, 500 KB, 300 KB and 250 KB, where KB refers to kilobyte. These partitions need to be allotted to four processes of sizes 357 KB, 210 KB, 468 KB and 491 KB in that order. If the worst fit algorithm is used, which partitions are NOT allotted to any process?
   [ ] 250 KB and 300 KB [ ] 200 KB, 250 KB, 400KB and 300 KB
   [ ] 200 KB. 300 KB and 250 KB [ ] 250KB, 300 KB and 400 KB

10. A system uses a page size of 4 KB. If a process requires 18 KB, how many pages will it occupy?
    [ ] 4 [ ] 5 [ ] 6 [ ] 7

11. Which of the following is a "dirty page"?
    [ ] A page with invalid data
    [ ] A page in the TLB
    [ ] A page modified in memory but not yet written to disk
    [ ] A page causing a page fault

12. A system has 500 KB of memory to be allocated to three processes:
    - Process 1 requires 300 KB
    - Process 2 requires 600 KB
    - Process 3 requires 900 KB

    Using Proportional Allocation, how much memory will be allocated to Process 1?
    [ ] 100 KB [ ] 150 KB [ ] 200 KB [ ] 250 KB

13. If a system has 4 frames and a process requires 7 pages, how many frames are allocated to the process in a system that uses paging with demand paging?
    [ ] 1 [ ] 3 [ ] 4 [ ] 7

14. What is the purpose of mounting a file system?
    [ ] removing portion of the file system into a directory structure [ ] deleting a file system
    [ ] attaching portion of the file system into a directory structure [ ] creating of a file system

15. Which directory structure allows directories to contain subdirectories and files?
    a. Two-level directory
    b. Hierarchical directory
    c. Acyclic graph structure
    [ ] a only [ ] c only [ ] a & c [ ] b & c

16. Which interface is commonly used for internal HDDs in modern desktop computers?
    [ ] SCSI [ ] SATA [ ] NVMe [ ] USB

17. In the context of the Application I/O Interface, what does a device driver do?
[ ] Manages the execution of application programs
[ ] Provides an interface between the application and the hardware
[ ] Handles the processing of user commands
[ ] Optimizes the storage management

18. In the kernel I/O subsystem, which of the following is responsible for managing data transfer between devices and system memory during an I/O operation?
[ ] I/O Scheduler [ ] Device Driver [ ] DMA Controller [ ] Block layer

19. Which RAID level provides mirroring?
[ ] RAID 0 [ ] RAID 1 [ ] RAID 5 [ ] RAID 6

20. Which of the following operations are used to manipulate semaphores?
[ ] acquire() and release() [ ] lock() and unlock()
[ ] signal() and wait() [ ] increment() and decrement()

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SECTION "B"
[6 Q. × 4 = 24 marks]

Attempt ANY SIX questions.

1. Imagine a scenario where a system runs multiple processes concurrently. How does the operating system ensure that these processes do not interfere with each other's execution? Describe briefly three kinds of services that Mainframe Operating System provides? [3+1]

2. State four advantages of cooperating processes. You have a system where two processes are involved in the producer-consumer problem. **Process A** (Producer) generates data and places it in a **buffer**, and **Process B** (Consumer) consumes data from the same buffer. The buffer has a fixed size, and both processes must coordinate to avoid situations like **buffer overflow** or **underflow**. Explain how the Operating System ensures that **mutual exclusion** is maintained and how it prevents race conditions? [1+3]

3. Describe Segmentation with suitable block diagram and write its advantage over Contiguous memory allocation technique? Consider a logical address space of 64 pages of 1,024 words each, mapped onto a physical memory of 32 frames. [3+1]
   a. How many bits are there in the logical address?
   b. How many bits are there in the physical address?

4. In demand paging, the page table plays an important role. How is the page table used to support demand paging? What information does it contain, and how does the operating system use the page table during a page fault? [1+3]

5. Consider a system that supports the strategies of contiguous, linked, and indexed allocation. What criteria should be used in deciding which strategy is best utilized for a particular file? Describe an acyclic graph structure with suitable block diagram? [2+2]

6. Disk Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is
   86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130
   Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests, for each of the following disk- scheduling algorithms? [1+1.5+1.5]
   a. SSTF b. SCAN c. C-LOOK

7. Write Short notes on:(***ANY TWO***) [2+2]
   a. Rate-Monotonic real time Scheduling
   b. Monitors for IPC
   c. Priority based real time Scheduling
   d. Multiple Processor Scheduling
   e. Kernel I/O Subsystem
   f. Distributed Operating System

P.T.O.

SECTION "C"

[2 Q. × 8 = 16 marks]

Attempt ANY TWO questions.

8. What is Multilevel Feedback Queue Scheduling? How does it improve upon simpler scheduling algorithms like Round Robin and Priority Scheduling? Consider a set of five processes for which arrival time, CPU time needed, and priority are given below: [2+2+2+2]

Process	Arrival Time (ms)	CPU Time (ms)	Priority
P0	0	10	5th
P1	0	5	2nd
P2	2	3	1st
P3	5	20	4th
P4	10	2	3rd

a. What will be the average waiting time if the CPU scheduling policy is in SJF?
b. What is the average turnaround time if the CPU scheduling policy is Priority (with Preemption)?
c. What will be the average response time if the CPU scheduling policy is Round robin with time quantum of 2 ms?

9. What is thrashing? A process contains eight virtual pages on disk and is assigned a fixed allocation of four page frames in main memory. The following page trace occurs Given reference to the following pages by a program: [1+2+2+3]

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

How many page faults will occur for Optimal, Second Chance Page Replacement algorithm and show how the belady's anamoly occurs in FIFO for the given example.

10. Describe the methods for recovery from Deadlock? A system has four processes and five allocatable resources. The current allocation and maximum needs are as follows:

Allocation

	A	B	C	D	E
P1	1	0	2	1	1
P2	2	0	1	1	0
P3	1	1	0	1	0
P4	1	1	1	1	0

Max

	A	B	C	D	E
P1	1	1	2	1	3
P2	2	2	2	1	0
P3	2	1	3	1	0
P4	1	1	2	2	1

Available

A	B	C	D	E
0	0	**X**	1	1

What is the smallest value of **X** for which this is a safe state using Banker's Algorithm? [3+5]