GEHU/02E/9.1.3

Graphic Era
HILL UNIVERSITY
Established by an Act of the State Legislature of Uttarakhand (Adhiniyam Sankhya 12 of 2011)
University under section 2(f) of UGC Act 1956

End Term (Odd) Semester Examination December 2024

Roll no. 2294038

Name of the Course and semester: B. Tech. CSE 5th Semester
Name of the Paper: Operating System
Paper Code: TCS 502
Time: 3 hour

Maximum Marks: 100

Note:

(i) All the questions are compulsory.
(ii) Answer any two sub questions from a, b and c in each main question.
(iii) Total marks for each question is 20 (twenty).
(iv) Each sub-question carries 10 marks.

Q1. (2X10=20 Marks) (CO1)

a. Discuss the booting process sequence in order to explain how operating system takes control on computer system.

b. What is the purpose of system calls? What system calls have to be executed by a command interpreter or shell in order to start a new process?
A process executes the following code-

```
main()
{
   fork();
   printf("Hello");
   fork();
   printf("Linux");
   fork();
   printf("RedHat");
}
```

How many total number of child processes will be created and what will be the output?

c. Which of the following instructions should be privileged?
   i. Write the program Counter
   ii. Read the clock
   iii. Reboot
   iv. Change processor priority
   v. Set OS mode to kernel mode.
Explain your answer.

Q2. (2X10=20 Marks) (CO2)

a. What do you mean by critical section problem? What necessary conditions should a solution to critical section problem should satisfy? What are the limitations of Peterson's solution?

b. Consider three processes, all arriving at time zero, with total execution time of 10, 20 and 30 units, respectively. Each process spends the first 20% of execution time doing I/O, the next 70% of time doing computation, and the last 10% of time doing I/O again. The operating system uses a shortest remaining compute time first scheduling algorithm and schedules a new process either when the running process gets blocked on I/O or when the running process finishes its compute burst. Assume that all I/O operations can be overlapped as much as possible. For what percentage of time does the CPU remain idle?

c. We wish to schedule three processes P1, P2 and P3 on a uniprocessor system. The priorities, CPU time requirements and arrival times of the processes are as shown below:

Process	Priority	CPU Time Required (sec)	Arrival time (hh:mm:ss)
P1	10 (highest)	20	00:00:05
P2	9	10	00:00:03
P3	8	15	00:00:00

We have a choice of preemptive or non-preemptive scheduling. In preemptive scheduling, a late-arriving higher priority process can preempt a currently running process with lower priority. In non-preemptive scheduling, a late-arriving higher priority process must wait for the currently executing process to complete before it can be scheduled on the processor. What are the turnaround times of P2 using preemptive and non-preemptive scheduling respectively?

Q3. (2X10=20 Marks) (CO 4)

a. Consider the following resource-allocation policy. Requests for and releases of resources are allowed at any time. If a request for resources cannot be satisfied because the resources are not available, then we check any processes that are blocked waiting for resources. If a blocked process has the desired resources, then these resources are taken away from it and are given to the requesting process. The vector of resources for which the blocked process is waiting is increased to include the resources that were taken away.

A system has three resource types, and the vector Available is initialized to (4,2,2). If process P0 asks for (2,2,1), it gets them. If P1 asks for (1,0,1), it gets them. Then, if P0 asks for (0,0,1), it is blocked (resource not available). If P2 now asks for (2,0,0), it gets the available one (1,0,0), as well as one that was allocated to P0 (since P0 is blocked). P0's Allocation vector goes down to (1,2,1), and its Need vector goes up to (1,0,1).

(i) Can deadlock occur? If you answer "yes," give an example. If you answer "no," specify which necessary condition cannot occur.

(ii) Can indefinite blocking occur? Explain your answer.

b. A student Soham of B.Tech 5th sem gave the following solution for producer consumer problem using semaphores:

semaphore mutex=1, empty=n, full=0; (n is the size of buffer)

Producer

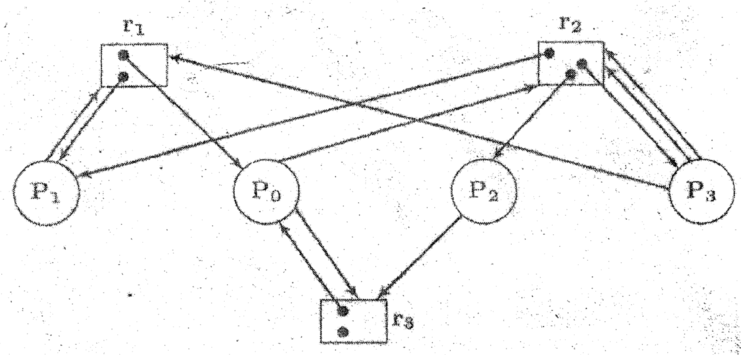
```
while(1)
{
//produce item
 wait (mutex);
//line 1
 wait(empty);
 //line 2
  ..........
  .........
// add item to buffer
  ...........
 signal(mutex);
 signal(full);
 }
```

Consumer

```
do
{
wait (mutex);
 //line 3
wait(full);
 //line 4
 ..........
 ..........
// consume item from buffer
 ..........
signal(mutex);
 signal(empty);
} while(1);
```

His friend Aarav told to him that above solution given by Amit is incorrect. It has a problem. But Amit refuses to accept it. Do you think this code has problem? If yes, identify and explain that problem and give the correct code for producer and consumer. If no, then show that this solution works correctly.

c. Consider the following Resource allocation graph for a system



(i) Find if the system is in a deadlock state
(ii) Otherwise, find a safe sequence

Q4. (2X10=20 Marks) (CO3)

a. Consider the following page reference string -
1, 2, 3, 4, 5, 5, 3, 4, 1, 6, 7, 8, 7, 8, 9, 7, 8, 9, 5, 4, 5, 4, 2
How many page faults would occur for the following replacement algorithm, assuming three frames? (all frames are initially empty)
(i) LRU Replacement
(ii) Optimal Replacement

b. On scanning primary memory (variable size partitioning), we find holes of the following sizes 10K, 15K, 5K, 32K and 2K. In what order would the allocation happen if we need to allocate segments having sizes 2K, 7K, 27K and 1K if we followed
(i) First fit policy
(ii) Best fit policy
Illustrate with the help of diagram.

c. Describe the segmented paging scheme of memory management and the hardware required to support the system. Suppose that a total of 64 MB memory is available in a system. This memory space is partitioned into 8 fixed size slot of 8 MB each. Assume 8 processes are currently requesting memory usage with sizes indicated as below: 2 MB, 4 MB, 3 MB,7 MB, 9 MB, 6MB,1 MB, 8 MB. Calculate the size of memory wasted due to external and internal fragmentation.

Q5. (2X10=20 Marks) (CO5)

a. Consider the disk queue with I/O requests on the following cylinders in their arriving order: 67, 12, 15, 45, 48, 50, 109, 89, 56, 59, 34, 88, 130, 24. The disk head is assumed be at cylinder 80 and moving in the direction of increasing number of cylinders. The disk consists of total 150 cylinders.
Show the disk head movement with diagram using FCFS, SSTF and C-SCAN scheduling algorithms. Calculate the total head movements.

b. Discuss the Contiguous, Linked, Index and Multilevel Indexing file allocation schemes. Which allocation scheme will minimize the amount of space required in directory structure and why?

c. Define external fragmentation? What are the causes of external fragmentation? Differentiate between external and Internal fragmentation.

Note For the question paper setters:

- Question paper should cover all the COs of the course.
- Please specify COs against each question.